MEMORANDUM

Date: **10/5/2010**

To: **Matt Braman, Energy Trust of Oregon (Energy Trust)**

CC: **Rob Russell, Northwest Energy Efficiency Alliance (NEEA)**

From: **Fluid Market Strategies**

Re: **Aggregation of Gas Savings from NEEA and Energy Trust Residential, Commercial and Industrial Programs, 2005-2009**

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1. Summary Findings

1.1. Background

In January of 2010 the Energy Trust contracted Fluid Market Strategies to estimate the total gas savings that have occurred in Energy Trust's territory as a result of NEEA's and Energy Trust's conservation and energy efficiency programs. In addition to gas savings, Energy Trust also requested the verification of the total electrical savings from the mid-2008 ENERGY STAR® Homes Northwest Code Change and a forecast of potential savings across all programs.

The time period of interest for the programmatic savings in this survey is from 2005 and ending in 2009 inclusive. With respect to the program scope, Energy Trust expressed interest in understanding the quantity of natural gas savings that occurred in the following NEEA programs:

- ENERGY STAR® Washers
- ENERGY STAR® Windows (Existing homes only)
- ENERGY STAR® Homes Northwest Code Change (Gas and Electric)
- NEEA's Commercial BetterBricks Program
- NEEA's Industrial Continuous Energy Improvement (CEI) Program

Table 1 lists the verified cumulative natural gas savings by program.

Table 1: Verified Gas Savings in Energy Trust Territory, 2005 -2009[1] (Therms)

Program	Baseline	Local Incentives	Net Market Effects	Regional Total
ENERGY STAR® Washers	525,509	420,835	39,804	986,148
ENERGY STAR® Windows Existing Homes Only	436,515	79,860	284,312	800,687
NEEA's Commercial BetterBricks Program	35,188	0	434,002	469,190
NEEA's Industrial CEI Program	97,608	0	878,472	976,080
ENERGY STAR® Homes Northwest Code Change	12,141	0	516,835	528,976
Total			**2,153,425**	**3,761,081**

The savings presented in Table 1 are natural gas savings occurring in Energy Trust's territory as a result of NEEA and Energy Trust's residential, commercial and industrial programs. Total net market effects occurring in Energy Trust territory across all five programs for the period 2005-2009 is 2,153,425 Therms. The net market effects are the savings above the baseline conservation and beyond what Energy Trust has already claimed; these are the additional savings that Energy Trust will claim given the participants are on the proper rate schedule. Large commercial and industrial customers who are on a 32CSI rate schedule with Northwest Natural Gas do not pay a public purpose charge.

Energy Trust is also interested in understanding the extent of savings that is forecasted to occur in their territory over the next 10 years as a result of the programs addressed in this survey. Table 2 lists the forecasted savings by program and forecasting period.

Table 2: Forecasted Gas Savings in Energy Trust Territory, 2010 – 2020 (Therms)

Program	Forecasting Period	Baseline	Local Incentives	Net Market Effects	Regional Total
ENERGY STAR® Washers	2010 - 2020	2,307,787	516,280	915,920	3,739,987
ENERGY STAR® Windows Existing Homes Only	2010 - 2020	1,580,547	0	400,659	1,981,206
NEEA's Commercial BetterBricks Program	2010 - 2011	2,847	0	35,116	37,963
NEEA's Industrial CEI Program	N/A	N/A	N/A	N/A	N/A
ENERGY STAR® Homes Northwest Code Change	2010 - 2015	1,191,609	0	3,883,189	5,074,798
Total				**5,234,884**	**10,833,954**

Energy Trust is forecasted to see 5,234,884 Therms of savings from the five programs included in this survey over the next 10 years. The forecast for ENERGY STAR® Washers is based on a maximum MEF = 2.2 while the Windows savings estimate is based on a R-value upgrade from .40 to .35.

[1] Although all of these savings occurred in Energy Trust service territory, some savings cannot be claimed by Energy Trust due to the fact that some customers are not on the correct rate schedules. More details are provided in the appropriate sections in the remainder of the document.

In aggregating the gas savings in this survey several sources were used to verify the total number of units implemented, per unit savings values and the site location of the program savings. Table 3 shows the sources of data for each of the programs listed in the scope of this survey.

Table 3: Data Sources

Program	Data on Units Implemented	Data on Per Unit/Site Savings	Data on Site Location
ENERGY STAR® Washers	NEEA's ENERGY STAR® Washers ACE Model	ACE Model	Data Not Available
ENERGY STAR® Windows	NEEA's ENERGY STAR® Washers ACE Model	NEEA 2005 Long Term Measure & Tracking Report	Data Not Available
NEEA's Commercial BetterBricks Program	· Cadmus 2009 BetterBricks Energy Savings Evaluation Report · Research Into Action 2009 Evaluation of Energy Savings for the BetterBricks Initiative	· Cadmus Evaluation · Research Into Action Evaluation	· Cadmus Evaluation · Research Into Action Evaluation
NEEA's Industrial CEI Program	Cadmus 2009 CEI Energy Savings Evaluation Report	Cadmus Evaluation	Cadmus Evaluation
ENERGY STAR® Homes Northwest Code Change	· PECI · Fluid Market Strategy's ENERGY STAR® Homes Northwest Database	Ecotope SEEM Software	PECI

The site locations for the installation of washers and windows are unknown. In each ACE model, data is collected by NEEA on shipments to the Northwest for both washers and windows and the baseline and utility or local incentives are estimated and subtracted from total shipments. This leaves the number of programmatic units that NEEA claims to have influenced in the market place.

Since Energy Trust is interested in only verifying savings in their territory, a population weighted distribution of units shipped both to Oregon and then to the Energy Trust's territory was estimated to measure Energy Trust's share of savings for programs where site location is unknown. The data in Table 4 shows Oregon is 29.5% of the total population of the Northwest. PECI, a contracting agency to Energy Trust with information and data on a variety of Energy Trust programs, allocates 83% of the territory in Oregon to the Energy Trust for both gas and electric savings programs. Using Table 4, it then follows that the Energy Trust's share of Northwest shipments is 29.5% multiplied by 83%, or 24.5%.

Table 4: Energy Trust Population Share of Oregon

*Northwest Population	12,830,540
*Oregon Population	3,790,060
Oregon Share of Total Northwest Shipments	29.5%
Energy Trust Share of Northwest Units	24.5%
Energy Trust Share of Oregon Units	83%

*Source: US Dept. of Labor

In areas where site location is known, careful attention was given to verifying that the gas and electricity savings reported in this survey did not occur outside the Energy Trust territory.

2. ENERGY STAR® Washers

2.1. Gas Savings per Unit

The per unit gas savings for ENERGY STAR® Washers is found in the latest version of NEEA's ACE model. Table 5 lists the weighted gas consumption for ENERGY STAR® Washers in homes with gas water heaters.

Table 5: ENERGY STAR® Washers Natural Gas Consumption (Therms/yr)

Baseline (MEF=1.04)	Tier 1 (MEF=1.26)	Tier 2 (MEF=1.6)	Tier 3 (MEF=1.8)	Tier 4 (MEF=2.2)
12.65	11.0	8.8	7.5	4.5

Source: Energy Trust clothes washer assumptions

Each successive Tier shows a reduction in fuel usage. Tier 1 washers reduce fuel consumption by 1.65 Therms/yr for the gas water heater when compared to the baseline washer, Tier 2 by 2.2 Therms/yr compared to Tier 1, Tier 3 by 1.3 Therms/yr compared to Tier 2, and Tier 4 by 3 Therms/yr compared to Tier 3.

2.2. Units

The total regional ENERGY STAR® Washer shipment data is also found in the latest version of NEEA's ACE model. This data is included in the following tables.

Table 6: Energy Trust Regional Total Shipments

Year	T1	T2	T3	T4
2005	45,275	44,443	22,850	0
2006	49,718	48,719	26,950	0
2007	95,404	94,450	87,772	21,943
2008	96,900	96,667	91,629	48,822
2009	99,954	101,382	98,019	56,323

Table 7: Energy Trust Baseline Shipments

Year	T1	T2	T3	T4
2005	33,285	32,674	16,799	0
2006	42,780	41,994	21,590	0
2007	60,162	43,886	17,173	6,678
2008	73,022	55,754	21,482	8,261
2009	84,623	66,564	25,601	9,862

Table 8: Energy Trust Local Utility Incentive Shipments

Year	T1	T2	T3	T4
2005	3,546	3,546	1,823	0
2006	2,328	2,065	3,086	0
2007	7,607	10,914	15,239	3,295
2008	5,124	8,869	15,867	14,239
2009	3,610	8,129	19,551	17,202

Table 9: Energy Trust Net Market Effects Shipments

Year	T1	T2	T3	T4
2005	8,444	8,224	4,228	0
2006	4,610	4,660	2,274	0
2007	27,635	39,650	55,361	11,970
2008	18,754	32,044	54,280	26,323
2009	11,720	26,689	52,867	29,259

Table 6 - Table 9 breaks the total shipments of ENERGY STAR® Washers from Table 6 into the components of baseline units, windows incentivized by local utilities and the NEEA programmatic effects, or the washers NEEA claims to have influenced in the Northwest market place.

2.3. Savings

Estimated savings for Energy Trust are a function of units shipped to Energy Trust territory, the reduction in energy use by the specific tiered washer shipped and the distribution of homes in Oregon that heat water using natural gas.

The equation to estimate gas savings is as follows:

Figure 1: ENERGY STAR® Washers Savings Equation

$$\sum_{ij=1}^{n} Savings_{ij} = (\alpha_{ij} * \omega) * \beta_j * \lambda$$

Where:

Savings = Total Gas Savings from Efficient Washers (Therms)

i = Year

j = Washer Tier 1 – 4

α = NEEA Regional Programmatic Effects Units

ω = ETO Territory Share of Northwest (24.5%)

β = Incremental Reduction in Consumption

λ = Share of Northwest Homes using gas hot water heaters (43%)

The equation in Figure 1 calculates the total savings in each year by the product of Energy Trust territory units, the reduction in gas consumption reached through implementing one of the specific tiered washers and the market share of natural gas hot water heaters in the Northwest (43%)[2]. The NEEA regional programmatic effects units are cumulative across each tier so the incremental reduction in consumption must be applied to the units in order to calculate total savings across each year and across all tiers. This avoids double-counting savings. Total Energy Trust territory savings by year are shown in Table 10.

Table 10: Energy Trust Territory ENERGY STAR® Washer Savings (Therms)

Year	Energy Trust Net Market Effects	Local Incentives
2005	16,128	106,581
2006	8,947	154,764
2007	103,482	53,799
2008	107,903	52,456
2009	100,851	53,235
Total	**337,311**	**420,835**

From 2005 through 2009 ENERGY STAR® Washers saved an estimated 337,311 Therms beyond savings associated with the baseline. During this same time period, the Energy Trust claimed savings of 420,835 Therms. When these 420,835 Therms along with the estimated baseline savings are removed from the regional estimated savings, the Energy Trust's Total Net Market Effects as displayed in Table 1 are 39,804 Therms.

2.4. Forecast

NEEA's ACE model includes forecasting data on the market for ENERGY STAR® Washer's. Table 11 shows the forecasted NEEA programmatic effects for ENERGY STAR® Washers for years 2010 to 2020.

[2] NEEA Market Research Report (06-158): Assessment of the Residential Water Heater Market in the Northwest, page 3-2.

Table 11: Forecast of NEEA Programmatic Units for ENERGY STAR® Washers

Year	T1	T2	T3	T4
2010	27,762	83,360	208,581	133,146
2011	15,643	58,207	204,091	153,259
2012	0	33,298	190,928	174,426
2013	0	7,738	177,396	199,141
2014	0	0	170,258	232,477
2015	0	0	163,329	272,323
2016	0	0	119,636	215,388
2017	0	0	99,551	205,478
2018	0	0	74,331	197,392
2019	0	0	49,921	183,823
2020	0	0	29,738	128,718

Source: ENERGY STAR® Washers ACE Model

The numbers in Table 11 have forecasted retirements, baseline and local utility incentive amounts subtracted and are representative of the four state area; Oregon, Idaho, Montana and Washington. This forecast is also based on a maximum MEF = 2.2. Applying the same equation in Figure 1, forecasted savings for each year are shown in Table 12.

Table 12: Forecast of Energy Trust Territory Savings from ENERGY STAR® Washers (Therms)

Year	Energy Trust Net Market Effects
2010	94,788
2011	92,596
2012	88,993
2013	89,027
2014	96,792
2015	108,436
2016	84,458
2017	78,575
2018	72,566
2019	64,934
2020	44,754
Total	**915,920**

The savings in Table 12 show a slight rise and then decline over the next 10-years. From 2010 to 2020 the Energy Trust can expect to see 915,920 Therms of savings coming from the ENERGY STAR® Washer's program.

3. ENERGY STAR® Windows

3.1. Gas Savings per Unit

The per unit gas savings for ENERGY STAR® Windows is found in the 2005 version of NEEA's Long Term Monitoring and Tracking Report. These savings are the result of ENERGY STAR® Windows upgrading from an R-value of .40 to .35[3].

Table 13: ENERGY STAR® Windows per Unit Existing Homes Gas Savings (Therms/sqft-yr)

Existing Homes		
Single Family	**Multifamily**	**Manufactured**
0.075	0.070	0.080

Source: 2005 LTM&T

Table 13 shows the gas savings for ENERGY STAR® Windows by housing type for existing homes. These savings are only applicable to 56% of all window replacements. According to NEEA's ENERGY STAR® Windows ACE model, 56% of regional window shipments are installed in existing homes.

Table 14 details the percent of homes that are heated by natural gas for existing homes by class of home; single family, multifamily and manufactured home.

Table 14: Share of Existing Homes with Natural Gas Heating

Existing Homes		
Single Family	**Multifamily**	**Manufactured**
41%	2%	1%

Source: NEEA ENERGY STAR® Windows Ace Model

Table 14 shows that the majority of existing single-family homes in the Northwest have electric heating systems. Almost all multifamily and manufactured existing homes in the Northwest are heated by electricity. Understanding the distribution of heating source for single, multifamily and manufactured homes is essential to calculating the total natural gas savings for existing homes.

3.2. Units

NEEA's ENERGY STAR® Windows ACE model also details the total regional window units shipped to the Northwest. Totals are labeled in Table 15.

[3] 2002 ENERGY STAR® Windows Market Progress Evaluation Report #5, Northwest Energy Efficiency Alliance.

Table 15: Energy Star Window Shipments (ft^2)

Year	Total NW ES Window Shipments	Baseline	Net Utility Incentive	NEEA Programmatic Effects	Energy Trust Existing Homes
2005	45,513,879	21,072,926	711,387	23,729,566	3,282,029
2006	43,992,566	22,209,358	532,640	21,250,568	2,939,160
2007	40,944,538	23,105,954	333,454	17,505,131	2,421,129
2008	25,870,345	16,011,755	753,092	9,105,498	1,259,379
2009	23,283,387	15,516,007	931,502	6,835,878	945,468

Source: NEEA ENERGY STAR® Windows Ace Model

The last two columns separate Energy Trust units from the NEEA programmatic Effects. These amounts are calculated by multiplying the Regional shipments by Energy Trust share of the Northwest (24.5%) and again by the new home units and existing home units split of 44% and 56% respectively.

3.3. Savings

Territory savings for Energy Trust are calculated by the product of new and existing home units, the percent of homes with gas heating systems and finally by the associated per unit gas savings. Figure 2 details the equation for this calculation.

Figure 2: ENERGY STAR® Windows Savings Equation

$$\sum_{i=1}^{n} Savings_i = (\alpha_i * \omega * \sigma) * (\beta_k) * (\lambda_k)$$

Where:

Savings = Total Gas Savings from Existing Home Windows (Therms)

i = Year

k = Housing Type, Single Family, Multi Family or Manufactured Home

α = NEEA Net Market Effects Units

ω = ETO Share of Northwest Units (24.5%)

σ = Northwest Share of Housing by Type

β = Market Share of Heating System in Northwest Homes

λ = Window Gas Savings (Therms)

Quantified existing homes window savings for Energy Trust territory using the equation in Figure 2 are shown in Table 16. Again, the numbers reported have the baseline savings removed.

Table 16: Energy Trust Territory ENERGY STAR® Window Savings, Existing Homes Only (Therms)

Year	Energy Trust Net Market Effects	Local Incentives
2005	105,788	12,704
2006	94,736	11,469
2007	78,039	22,302
2008	40,593	12,563
2009	30,474	20,821
Total	**349,630**	**79,860**

From 2005 through 2009 ENERGY STAR® Windows saved 349,630 Therms beyond savings associated with the baseline. During this same time period, the Energy Trust claimed savings of 79,860 Therms. When these 79,860 Therms along with the estimated baseline savings are removed from the regional estimated savings, the Energy Trust's Total Net Market Effects as displayed in Table 1are 284,312 Therms.

3.4. Forecast

Included in NEEA's ACE model for ENERGY STAR® Windows is data on forecasting. Table 17 shows the forecasted NEEA programmatic effects and Energy Trust estimated units for ENERGY STAR® Windows occurring in years 2010 to 2020.

Table 17: Forecast of Units for ENERGY STAR® Windows

Year	Total ENERGY STAR Window Shipments to NW	Baseline	Net Utility Incentive	NEEA Programmatic Effects	ETO New Homes	ETO Existing Homes
2010	23,981,528	16,925,455	0	7,056,073	754,062	975,923
2011	26,379,758	19,446,146	0	6,933,612	740,975	958,986
2012	29,018,117	22,094,761	0	6,923,357	739,879	957,567
2013	31,919,789	24,887,700	0	7,032,089	751,498	972,606
2014	35,111,768	27,851,545	0	7,260,223	775,878	1,004,159
2015	38,622,945	31,018,182	0	7,604,763	812,698	1,051,813
2016	42,485,239	34,423,271	0	8,061,968	861,559	1,115,048
2017	46,733,763	38,104,949	0	8,628,814	922,136	1,193,449
2018	51,407,140	42,103,365	0	9,303,774	994,267	1,286,802
2019	56,547,853	46,460,696	0	10,087,158	1,077,985	1,395,152
2020	62,202,639	51,221,441	0	10,981,198	1,173,528	1,518,806

Source: ENERGY STAR® Windows ACE Model

The numbers in Table 11 are representative of the four state area; Oregon, Idaho, Montana and Washington. Local utility incentive amounts are forecasted to zero as incentive programs are not planned for future window installations. Applying the same equation in Figure 2, forecasted savings for each year are shown in Table 18.

Table 18: Forecast of Energy Trust Territory Savings from ENERGY STAR® Windows in Existing Homes Only (Therms)

Year	Energy Trust Net Market Effects
2010	31,456
2011	30,910
2012	30,865
2013	31,349
2014	32,366
2015	33,902
2016	35,941
2017	38,468
2018	41,477
2019	44,969
2020	48,955
Total	**400,659**

The savings in Table 18 continues to increase over the next 10 years as the market for ENERGY STAR® Windows continues to grow.

4. NEEA's Commercial BetterBricks Program

4.1. Background & Savings

NEEA contracted the Cadmus Group, Inc. in 2009 to conduct an evaluation verifying the total natural gas savings realized for projects participating in the BetterBricks commercial energy efficiency program from 2005 through 2009. Table 19 is taken from the Cadmus evaluation report published in April of 2009.

Table 19: BetterBricks Realized Gas Savings, 2005-2009 (Therms)

Project ID	Program	Total Gas Savings	Energy Trust Net Market Effects
HMG-OR-02	Design and Construction	6,224	5,757
OR-01	Design and Construction	12,071	11,166
OR-02	Design and Construction	18,031	16,679
OR-03	Design and Construction	1,744	1,613
OR-04	Design and Construction	10,266	9,496
OR-05	Design and Construction	56,953	52,682
OR-06	Design and Construction	4,082	3,776
OR-07	Design and Construction	359,819	332,833
Total		**469,190**	**434,002**

Source: BetterBricks Energy Savings Evaluation Report, April 24, 2009 Appendix D

According to NEEA, a straight baseline of 7.5% is applied across all commercial energy efficiency programs. Careful attention was taken to verify that only projects listed in Table 19 were those taking place in Energy Trust territory. The savings are by site

location and not per unit of installation or by measure. From 2005 through 2009 BetterBricks saved 434,002 Therms beyond savings associated with the baseline.

Little information is known about the current rate structures of the participating facilities in the BetterBrick's evaluation. From a separate evaluation report, Mike Kennedy and Associates noted that 5 of the 8 facilities were in fact non-hospital and office space buildings. This would leave one to believe that regardless of the rate schedule, these facilities will not be on interruptible rates and are paying into the Energy Trust. Facilities with interruptible rate schedules, such as hospitals, do not pay into the Trust and the savings associated with these programs have been removed. These deleted savings are the result of Building Operations-Hospital Program ID OR-09, OR-10 and OR-12. Examples of natural gas rate schedules that do not pay into the Energy Trust are Northwest Natural Gas schedules 32CSI and 31CTF.

4.2. Forecast

Cadmus, Inc. was also contracted by NEEA to analyze and quantify the committed gas savings from projects with an expected implementation date occurring sometime in the next two years. These projects are typically in the construction or final design process and have a defined allocated budget. Committed savings by project are listed in Table 20.

Table 20: Committed Gas Savings (Therms)

Project ID	Program	Total Committed Gas Savings	Energy Trust Net Market Effects
OR-14	Design and Construction	6,116	5,657
OR-15	Design and Construction	2,635	2,437
OR-16	Design and Construction	4,113	3,805
OR-17	Design and Construction	19,278	17,832
OR-18	Design and Construction	5,821	5,384
Total		**37,963**	**35,116**

Source: BetterBricks Energy Savings Evaluation Report, April 24, 2009 Appendix D

Cadmus quantified 35,115 Therms of committed gas savings in Oregon beginning on or before 2011.

5. NEEA's Industrial CEI Program

5.1.Background

NEEA contracted the Cadmus Group, Inc. once again in 2009 to conduct an evaluation for the same purpose of verifying the total natural gas savings realized for projects participating in their industrial energy efficiency program from 2006 through 2009. Table 21 shows the gas savings from NEEA's industrial efficiency program by year.

Table 21: Validated Industrial Gas Savings (Therms)

Site ID	Gas Service Territory	2006	2007	2008	2009	Total Gas Savings	Energy Trust Net Market Effects
O-003	NW Natural	0	57,712	57,712	57,712	173,136	155,822
O-005	NW Natural	73,666	73,666	73,666	73,666	294,664	265,198
O-006	Cascade Natural Gas	0	0	30,165	26,439	56,604	50,944
O-007	NW Natural	0	0	225,838	225,838	451,676	406,508
	Total	**73,666**	**131,378**	**387,381**	**383,655**	**976,080**	**878,472**

Source: Cadmus 2009 CEI Energy Savings Evaluation Report

The gas service territory column is listed to show that the projects in Table 21 took place in Energy Trust territory. The savings listed are by site and not per unit of installation.

According to NEEA, a straight baseline of 10% is applied across all industrial energy efficiency programs. From 2006 through 2009 NEEA's industrial program saved 878,472 Therms beyond savings associated with the baseline.

5.2. Forecast

The four projects evaluated by Cadmus, Inc. in their 2009 CEI Energy Savings Evaluation Report are from four food processing facilities in Oregon. In 2008, these food processors signed a commitment letter to reduce their energy intensity by 25% by the year 2020. It is likely that the upward trend of gas savings from these Oregon facilities will be persistent and will grow over the next 10 years. Although a large amount of work has been done in forecasting the potential demand reduction in industrial electricity use for the Northwest there is not enough data to accurately forecast the potential or determine the planned and committed natural gas curtailment programs in the Energy Trust territory.

6. ENERGY STAR® Homes Northwest Code Change

6.1. Background

In June of 2008 a code change in residential housing was introduced involving a significant increase in the energy efficiency of a new home. The new code mandated that any home built after June 2008 must have some combination of a more efficient heating system, duct work, lighting, windows, envelope and hot water heating. As a result of exerting influence on the various state committees that oversee the building codes and standards, Energy Trust is interested in determining how much gas and electricity was saved as a result of this code change.

6.2. Gas and Electricity Savings per Unit

The unit gas and electricity savings for the code change is estimated through a comparison of energy use of houses built to Oregon's old code to those built to the new code. Space-conditioning energy use was estimated using Ecotope, Inc's SEEM modeling software (version 92). Modeling inputs and methodology mimic those used by

the Regional Technical Forum, including use of their prototype houses[4]. Results from the SEEM modeling analysis were weighted to arrive at an estimate for the average savings for an average house in Energy Trust territory. Table 22 lists the assumptions used to determine the per unit savings value for the average new code home. The details of the SEEM modeling and averaging calculations can be found in "New OR Code_SEEM.xls." Adjustments to inputs can be made using the spreadsheet.

Table 22: Savings Calculation Assumptions

Average House Size	
2035	sqft
Mix	Prototype
19%	1344
81%	2200

Gas/Electric Mix	
Gas	86%
Electric	14%

Climate Mix	
Portland	80%
Medford	10%
Redmond	10%

Code Weightings			
New OR Code Compliance Paths		Assumed Weightings	
Option #	Description	Gas Heated	Electric Heated
1	Heating System	25%	26%
2a	Duct Seal	32%	33%
2b	Interior Ducts	35%	36%
3	Bldg Envelope	1%	1%
5	Window/Lighting	5%	5%
6	Window/H2O	1%	0%
7	H2O/Lighting	1%	0%

Note: Option 4 (DHP) was not modeled.
Note: Electric consists of 100% heat pump (no zonal or FAF was modeled)

The resulting per unit savings for the new code home is listed in Table 23.

Table 23: Average Home Annual Savings from Mid-June 2008 Code Change

End Use	Savings
Natural Gas	70 Therms
Electricity	250 kWh

[4] Only the 1344 and 2200 square foot crawlspace prototypes were used in this analysis. The 2688 square foot basement prototype was omitted from the analysis.

6.3. Units

According to PECI, Energy Trust territory accounted for 94% of the single family permits issued in 2008 and 83% issued in 2009. PECI also confirmed that there is no way of tracking whether a home which is granted a permit completes construction in the same year or in a different year. This is why an estimated number of completed homes are used to calculate total regional savings given an actual issued building permit. Table 24 lists the building permits issued in Oregon by year.

Table 24: Single Family Building Permits Issued in Oregon

Month	2007	2008	2009
Jan	1269	618	286
Feb	1355	732	272
Mar	1611	730	505
Apr	1654	897	519
May	1810	901	564
Jun	1512	862	590
Jul	1685	817	554
Aug	1452	655	567
Sep	1015	631	527
Oct	1128	470	483
Nov	754	301	332
Dec	580	251	410

Source: PECI

Housing permits show a rapid decline beginning in November 2007. Additionally, PECI also reported that separating multifamily from single family permits was not possible at the time of their data collection. Because of this multifamily permits are included in Table 24.

Table 25 show the estimated single family homes completed by year. The number of completed homes for each year is estimated from the number of permits issued in that year and the previous year.

Table 25: Estimated Single Family Homes Completed in Oregon

Month	2007	2008	2009
Jan	1729	1416	639
Feb	1592	990	615
Mar	1460	1100	458
Apr	1178	735	293
May	991	566	245
Jun	1237	603	279
Jul	1321	714	265
Aug	1571	712	492
Sep	1613	875	506
Oct	1765	878	550
Nov	1474	840	575
Dec	1643	797	540

Source: PECI

The two main assumptions in estimating completed homes from issued permits are the lag time in building, or time it takes to build a home and the numbers of homes permitted that are never completed. To estimate lag time, PECI interviewed a subset of builders taking part in the program and found the lag time from permitting to completion takes 5 to 6 months. PECI also analyzed program data for builders and found a lag time of 5 months. To estimate the number of homes that were never completed but received permits, PECI references the U.S. Census Bureau's study on the relationship between building permits, housing starts and housing completions. This study found that single-family starts were 2.5% less than permits[5]. Together, PECI estimates that once a builder receives a permit, the lag time to completion is 5 months and only 97.5% of the permitted homes are completed.

The data in Table 24 and Table 25 include all ENERGY STAR® Homes and code homes. To calculate the energy savings from homes built to code Fluid Market Strategies provided data on the number of ENERGY STAR® Homes built from June 2008 through all of 2009 in Oregon only. This data is shown in Table 26.

Table 26: Northwest ENERGY STAR® Homes Completed in Oregon

Year	End Use	Heating & Cooling System	Homes Completed
On or after June 2008	Gas	Gas no AC	91
On or after June 2008	Gas	Gas w/AC	138
On or after June 2008	Electric	Heat Pump	26
2009	Gas	Gas no AC	407
2009	Gas	Gas w/AC	135
2009	Electric	Ductless Heat Pump	12
2009	Electric	Heat Pump	99
2009	Electric	Zonal Electric	3

Source: Northwest ENERGY STAR® Homes Database

To calculate the number of code homes built in Oregon from June 2008 through 2009 the following equation is used:

[5] http://www.census.gov/const/www/nrcdatarelationships.html

Figure 3: Number of Homes Built to June 2008 Code

$$Q_i = (\alpha_i * \beta_i * \omega_j) - (\delta_{ij})$$

Where:

Q = *Number of homes built to code in ETO territory*

i = *Year*

j = *Home Heating System, Gas or Electric*

α = *Total Estimated Single Family Homes Completed in Oregon*

β = *ETO Territory Share of Oregon Housing (2008 = 94%, 2009 = 83%)*

ω = *Estimated Share of Home Heating System*

δ = *Number of ENERGY STAR Homes Built*

For SEEM simulation purposes, the share of homes with a gas heating system was estimated at 86% gas and 14% electric. NEEA's Northwest ENERGY STAR® Homes ACE model estimates this split as 85.6% natural gas and 14.4% electric.

6.4. Savings and Savings Recommendation

With the per unit energy savings estimated as a result of the SEEM software simulation and the number of units calculated using the equation in Figure 3 the total savings is simply the sum over each year of the product of units multiplied by per unit savings. The resulting savings are listed in Table 27 by year.

Table 27: Total Annual Energy Savings from the June 2008 Code Change in Energy Trust Territory

Year	Total Energy Trust Territory Homes	Baseline	Baseline Homes	Energy Trust Territory Homes	Energy Trust Net Market Effects
On or after June 2008	4,159	1.75%	73	4,086	287,485 Therms
2009	3,360	2.97%	100	3,260	229,349 Therms
On or after June 2008	680	1.75%	12	668	167,217 kWh
2009	514	2.97%	15	498	124,766 kWh

The baseline of 1.75% for 2008 and 2.97% for 2009 is taken from NEEA's Northwest ENERGY STAR® Homes ACE model. From mid-2008 through 2009 the new code saved 516,835 Therms and 291,984 kWh beyond savings associated with the baseline.

Recommendation

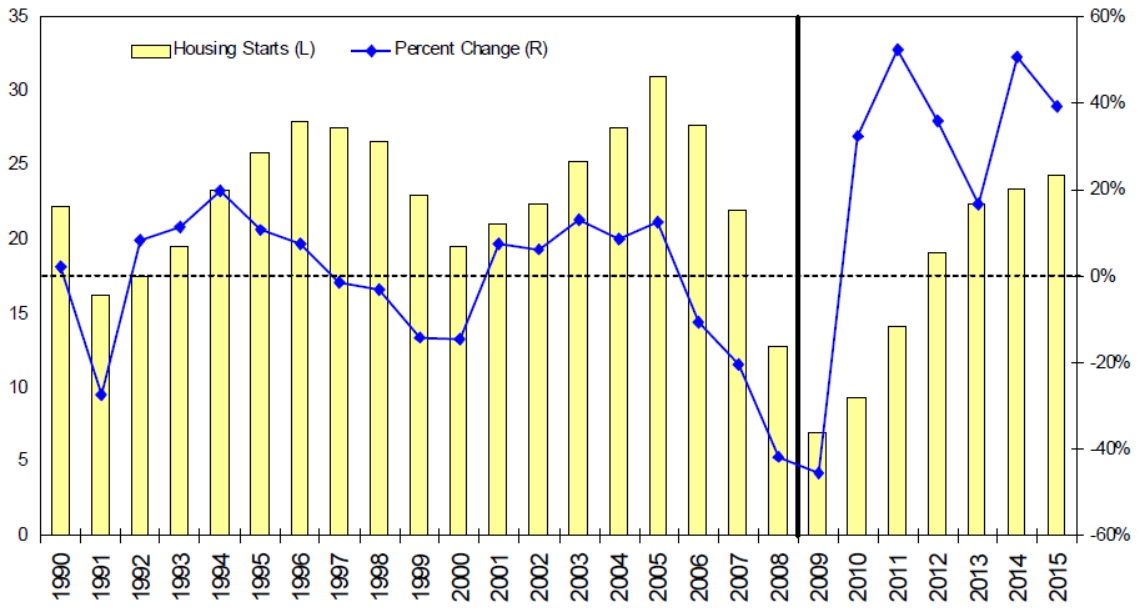
In 2010 NEEA contracted KEMA, Inc. to evaluate the ENERGY STAR® Homes program. This evaluation used a billing analysis approach to estimate the annual electricity and gas savings for an ENERGY STAR® Home. Combined with this new information, a second approach to estimating the per unit savings of each home would be to incorporate the estimation values from KEMA, Inc. with the building simulation values from the ACE model in a Bayesian estimation format. In this format, the building simulation values, or priors, feed the Bayesian estimation model. The advantage gained is that one can fuse information from the simulation into the billing regression model. Through Bayesian estimation, the building simulation data incorporates knowledge into

the regression model about a particular hypothesis or belief about what level of savings should be realized. This type of estimation allows the simulation data to inform the regression model in order to mitigate data uncertainty. The approach is a classic application of Bayesian estimation.

6.5. Forecast

Every year the State of Oregon and the Office of Economic Analysis provides a scientific forecast of housing starts. The 2009 forecast is shown in Figure 4.

Figure 4: Oregon Housing Starts (1990 – 2015)



Source: 2009 Oregon Economic and Revenue Forecast Summary, Oregon Office of Economic Analysis

According to the Oregon Office of Economic Analysis, housing starts will begin to increase in 2010 but will not reach 2007 levels until 2013. Using this forecast in Figure 4 the forecasted gas savings are shown in Table 28.

Table 28: Forecasted Gas Savings from the Mid-2008 Code Change (Therms)

Year	Total Energy Trust Territory Units	Baseline	Baseline Units	Energy Trust Territory Units	Energy Trust Net Market Effects
2010	4,535	4.97%	225	4,310	303,240
2011	6,803	8.13%	553	6,250	439,734
2012	9,320	12.81%	1,194	8,126	571,747
2013	10,905	19.20%	2,094	8,811	619,918
2014	16,902	26.95%	4,555	12,347	868,711
2015	23,663	35.14%	8,315	15,348	1,079,840
Total					**3,883,189**

Forecasted gas savings from the code change increase every year over the next five years but is not forecasted to break one-million Therms per year until 2015. The baseline for 2010 through 2015 is again taken from NEEA's Northwest ENERGY STAR® Homes ACE model. Cumulative forecasted gas savings from 2010 – 2015 is 3,883,189 Therms.

7. ENERGY STAR® Homes Northwest Program

NEEA's ENERGY STAR® Homes Northwest ACE model details the total number of ENERGY STAR® Homes built in the Northwest. According to the ACE model, all the homes built from 2004 to 2009 are either associated with the baseline or with a local utility incentive except for 15 homes built in the region in 2005. Energy Trust gas savings attributable to these 15 regional homes is not large enough to quantify and may be statistically insignificant from zero.

8. Recommendations for Updating Annual Gas Savings

Establishing a sound methodology for updating annual gas savings is a requirement for the Energy Trust. Table 29 details the data location for each program that should be used to update the annual gas savings estimations for the programs listed.

Table 29: Data Sources

Program	Data on Units Implemented	Data on Per Unit/Site Savings	Data on Site Location
ENERGY STAR® Washers	NEEA's ENERGY STAR® Washers ACE Model	ACE Model	Data Not Available
ENERGY STAR® Windows	NEEA's ENERGY STAR® Washers ACE Model	NEEA 2005 Long Term Measure & Tracking Report	Data Not Available
NEEA's Commercial BetterBricks Program	· Cadmus 2009 BetterBricks Energy Savings Evaluation Report · Research Into Action 2009 Evaluation of Energy Savings for the BetterBricks Initiative	· Cadmus Evaluation · Research Into Action Evaluation	· Cadmus Evaluation · Research Into Action Evaluation
NEEA's Industrial CEI Program	Cadmus 2009 CEI Energy Savings Evaluation Report	Cadmus Evaluation	Cadmus Evaluation
ENERGY STAR® Homes Northwest Code Change	· PECI · Fluid Market Strategy's ENERGY STAR® Homes Northwest Database	Ecotope SEEM Software	PECI

The data sources in Table 29 should be queried at the beginning of every year to identify actual units that have occurred in each program over the previous year. These units can then be used in the savings equations located in the respective section to determine program savings. The baseline data and assumptions listed in each section can then be used to calculate savings net of baseline.

In addition to this survey and the data in Table 29 information on gas savings can be obtained from the Northwest Power and Conservation Council (NWPCC) at

http://www.nwcouncil.org/ or from NEEA's updated research and evaluation documents located at http://www.nwalliance.org/research/index.aspx.

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