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# Dry Cleaner Steam Trap Assessment

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June 25, 2009

~~STRATEGIC ENERGY GROUP~~➤

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## Contents

Summary.....	3
Overview.....	3
Key Findings.....	3
Recommendations.....	3
Staff response memo .....	4
Observations.....	5
Business Environment & Relationships .....	5
Survey .....	5
Inspection .....	5
Survey Results.....	7
Contractor Interviews.....	14
Savings Review Summary .....	14
Sample Selection Methodology.....	15
Field Protocol Methodology .....	15
Appendix.....	16
Energy Trust of Oregon Billing Analysis Memo .....	16
Steam Trap Temperature Readings.....	20
Interview Guide & Answers for Alpine Repair Service .....	21
Interview Guide & Answers for Park’s Cleaners Service .....	23

## Summary

Energy Trust of Oregon offers incentives for natural gas efficiency improvements – in particular, for the replacement of steam traps. This report summarizes an assessment of steam trap installations in dry cleaning establishments in the greater Portland area. The goal of this effort was to evaluate the installation of Energy Trust incented steam traps; their operating conditions; customer and contractor satisfaction and awareness; and measure assumptions.

Steam trap installations at ten dry cleaners were assessed. All demonstrated high quality installation and consistent operating practices. Most dry cleaners operate their boilers only when needed, and not continuously during all business hours. Awareness for the Energy Trust among dry cleaners is extremely low. However, awareness could be increased by using the dry cleaning associations as communications channels. Additional natural gas savings opportunities may be available from adding insulation to bare steam pipes.

## Overview

This assessment examined a sample of ten dry cleaners receiving Energy Trust incentives through the Building Efficiency and New Building Efficiency program installed between July 2008 and February 2009. Each were surveyed for installation quality, operating conditions (hours, temperature differential across traps), and program satisfaction. The two installation contractors were also interviewed for their perspectives on working with the program.

## Key Findings

- Boilers operate less than 1/2 of business hours
- All steam traps appeared operational and were well installed
- 100% of steam traps were replaced at each site
- There are additional savings opportunities in steam pipe insulation
- Customers are satisfied with the installation results

## Recommendations

1. This assessment considered expanding the survey sample to twenty dry cleaners. Due to the consistent quality of installations found, an additional study of ten sites is not recommended. The assessment team considers the data collected sufficient for this effort.
2. The endorsement of Energy Trust programs by the Korean American Dry Cleaners Association - Portland Chapter is essential to member participation.
3. Dry cleaner service contractor are not an effective program channel as they rarely provide ongoing services.
4. Approximately half of the inspected dry cleaners do not have *any* insulation covering their steam lines. Insulation would provide additional natural gas savings.
5. Most service contractors consider the metro-Portland the only cost effective area to provide steam trap services. The incentive may need to be reconsidered if a larger area is to be affected.
6. Actual boiler operating hours are 62% of the ICF report *Steam Traps – An Opportunity to Save Natural Gas* assumed time. This needs to be considered when computing natural gas savings estimates.

# MEMO

**Date:** June 25, 2009  
**To:** Board of Directors  
**From:** Greg Stiles,, Senior Business Sector Manager  
Jessica Rose, Business Sector Project Manager  
Brien Sipe, Evaluation Project Manager  
**Subject:** Staff Response to the 2009 Existing Buildings steam trap site verification study

In an effort to verify the quality of steam trap installations given the pace of incentive expenditures, Energy Trust (ETO) contracted with the Strategic Energy Group (SEG) to visit sites which have completed steam trap projects throughout the Portland Metro area. Projects at dry cleaners began in July 2008 and quickly ramped up, with 65 projects totaling over \$100,000 of incentives booked in December 2008 alone.

Ten site visits were conducted during May 2009, which aimed to verify steam trap installation as well as engineering assumptions about boiler operating times and gauge program and agency awareness. Given the quality of installation, SEG decided ten site visits formed a representative sample of steam trap projects and did not pursue additional site visits. In addition, contractors representing the majority of projects were also contacted for interviews by SEG staff.

Key findings from the study included:

- All traps at sites were replaced, regardless of whether they were operating correctly.
- Installations were complete and high quality.
- Boiler operating hours are roughly half those assumed in the measure savings calculation.
- Awareness of participation in an Energy Trust program was low among participants.
- Roughly half of sites do not currently have boiler pipe insulation.

Since the first steam trap replacement, nearly 40% of Existing Buildings (EB) gas savings to date have come from steam trap projects. Lower run times and the replacement of operational steam traps will reduce the engineering estimates associated with the measure. Lower savings have been validated through a billing analysis showing a realization rate of approximately 1/3.

These lower savings and 100% replacement rate indicate the need to redesign this program offering either through lowering the incentive costs or its implementation strategy. One possible change in implementation is for a program representative to identify failed steam traps at qualified customer sites and provide this information to prequalified contractors.

Findings should be used in planning further expansion of this offering to other building sectors and geographic areas (i.e. Clark County) as this measure may quickly absorb a large proportion of gas funding yet provide only marginal savings.

Another avenue could see a requirement of boiler pipe insulation with the installation of any steam traps. The current verification study found fewer than 50% of boiler pipes are insulated. While insulation yields small savings, the combination can reduce lost opportunities.

## Observations

### *Business Environment & Relationships*

The Portland area dry cleaning industry is mostly represented by the Korean American Dry Cleaners Association - Portland Chapter (the Association). Once the implementer (Lockheed Martin Energy Services) gained the approval of the Association, four contractors very quickly replaced most of the steam traps in Portland area dry cleaners. The business relationships within the industry are nuanced and typically run along family lines across several west coast markets.

### *Survey*

The Association is highly influential. Lockheed Martin suggested informing the Association president before going to the field. The Association was given one week notice, while the owners and operators (Operators) were given no direct notice. It is possible the notice given to the Association influenced the survey results, but it also provided the field staff with the necessary credentials for the cooperation of the Operators and access to their facilities.

Most operators report they heard about the Energy Trust steam trap program through the Association. However, given the apparent success of Park's Cleaners Service, an organization unaffiliated with the Association, suggests that direct marketing can also be affective promotions channel.

All operators were aware their steam traps had been replaced. They all knew the size, age, and type of controls on their boilers. All mentioned business is down and they are operating their boilers less than before the recession. The operators reported boilers are used sparingly in efforts to control costs. For this reason, boiler operating hours cannot be assumed to be equivalent to business hours. Only a few operators reported detectable natural gas savings – this they ascribed to their reduced boiler use because of the weak economy.

The Operators perform steam system maintenance themselves. It is performed irregularly and with limited technical proficiency.

### *Inspection*

Visual inspections revealed thorough and high-quality installations. Infrared thermometer readings indicated temperature differentials consistent with functional steam traps (when readings could be taken). Operator satisfaction was high, likely due to the quality of installation and the operators' zero out-of-pocket cost. However, most Operators did not see a reason to continue their business relationship with the contractors. Moreover, the operators were largely unaware of the Energy Trust of Oregon or the incentives, but they remain open to additional low/no cost measures endorsed by the Association. The inspections did not include visual assessments of non-steam systems such as lighting.

Photo 1 – Typical installed steam trap on uninsulated system

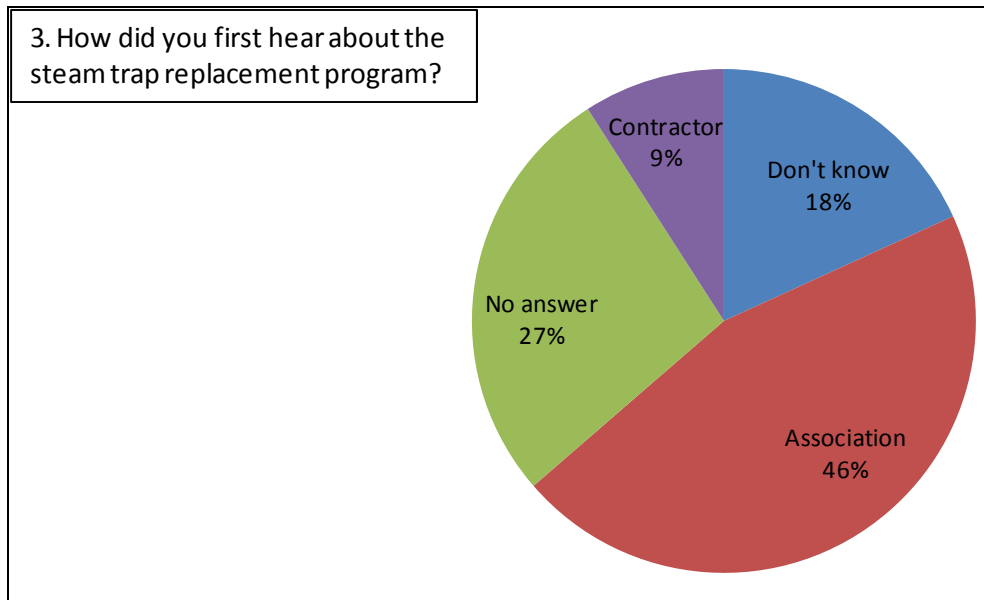


Photo 2 – Typical installed steam trap on an insulated system



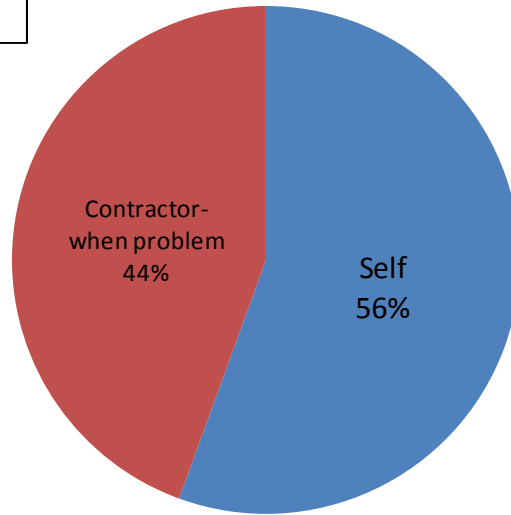
Survey Results

No.	Survey Question	Count	Unit	n
1	Are you aware that [name of contractor] installed steam traps at your dry cleaner(y/n/DN)?	11	Yes	11
2	Are you familiar with steam traps(y/n)?	11	Yes	11

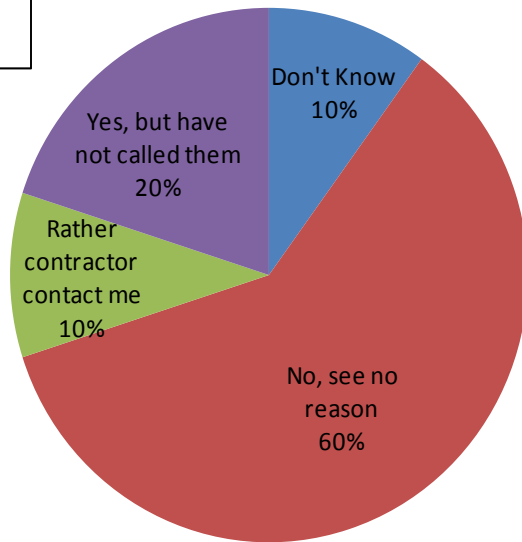


No.	Survey Question	Count	Unit	n	Comments
4	Did you know the steam trap replacement was part of an Energy Trust program (y/n)	4	Yes	10	Apparent confusion over source - ETO or California contractor
5	Have you or your business participated in any Energy Trust programs in the past?	1	Yes	10	

6. How do you maintain your steam system?



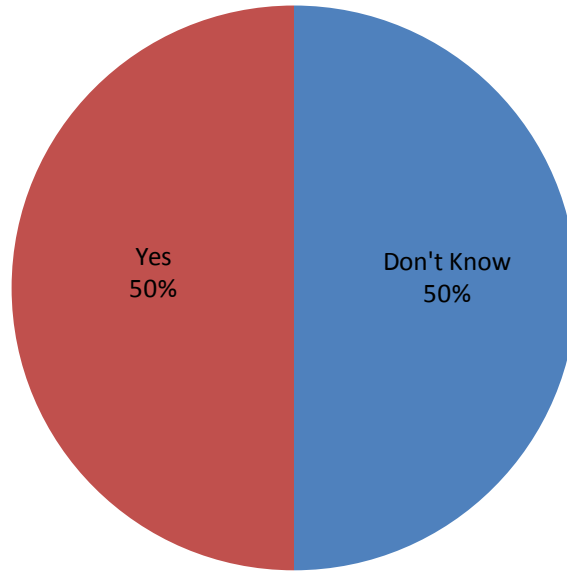
7. Would you use the same contractor for another equipment purchase or change?



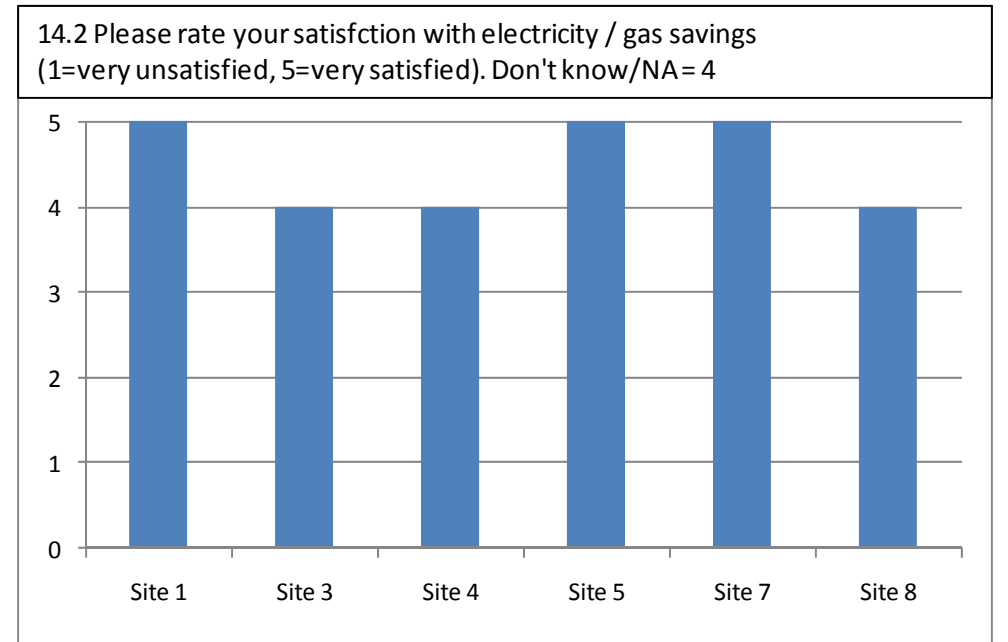
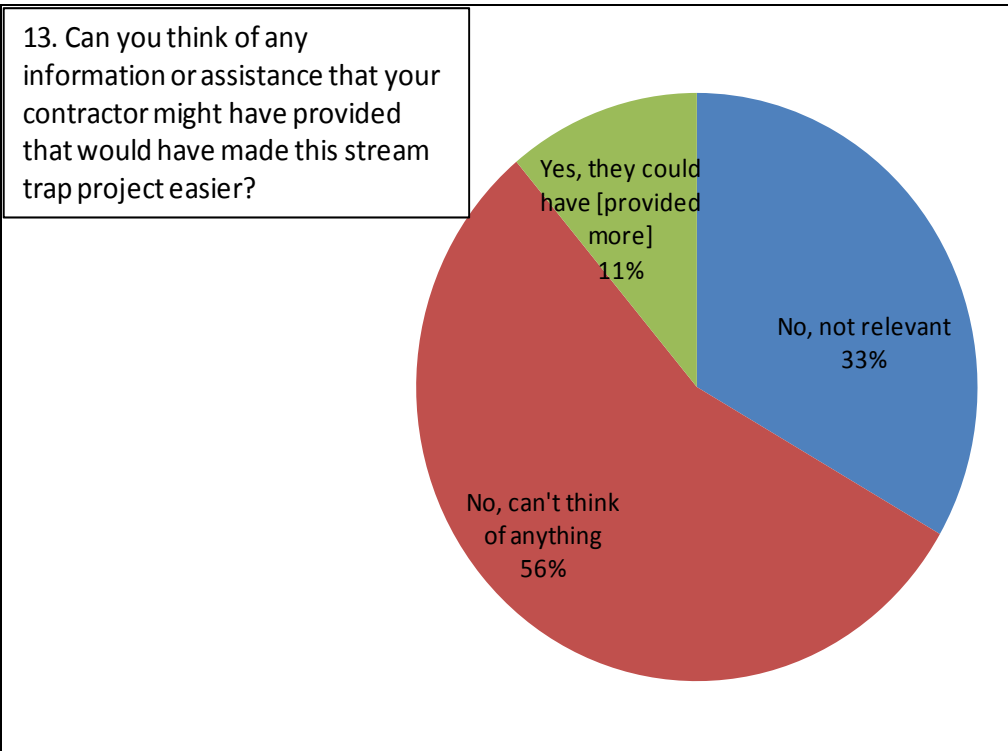
No.	Survey Question	Ave	Min	Max	n
8	Please rate how well you think your contractor understands the challenges you face in operating your business? (1=no understanding, 5= well understood)	2	1	5	9



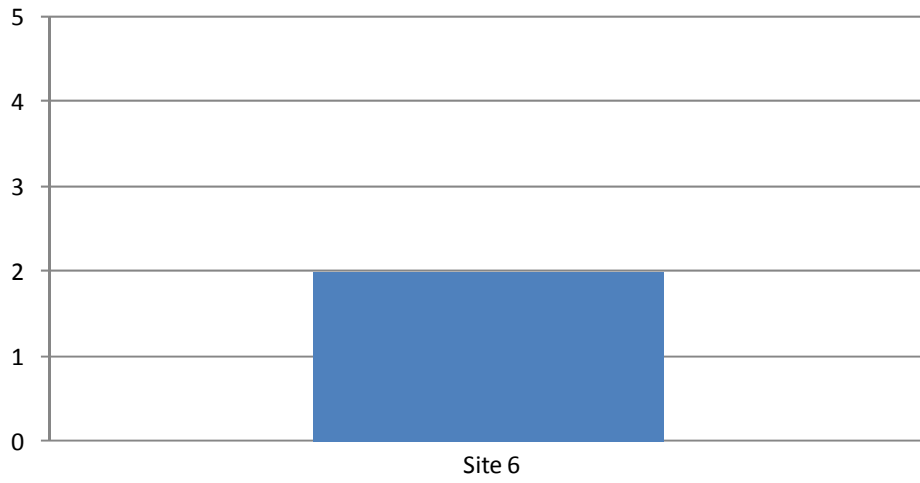
9. Do you feel your contractor served your company's best interests?



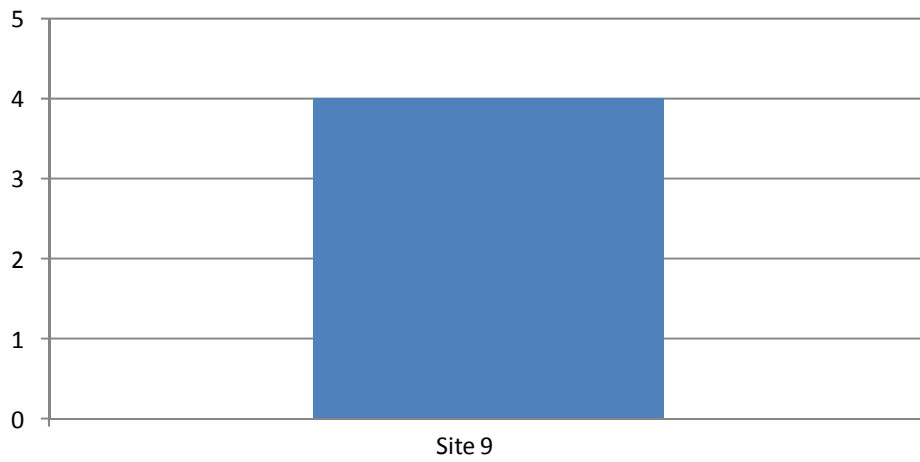
No.	Survey Question	Count	Unit	n
10	Why did you install the steam traps?	10	Energy Savings	10
11	Would you participate in Energy trust programs again?	8	Yes	10
12	What systems would you consider improving in the future?	10	No or No Answer	10



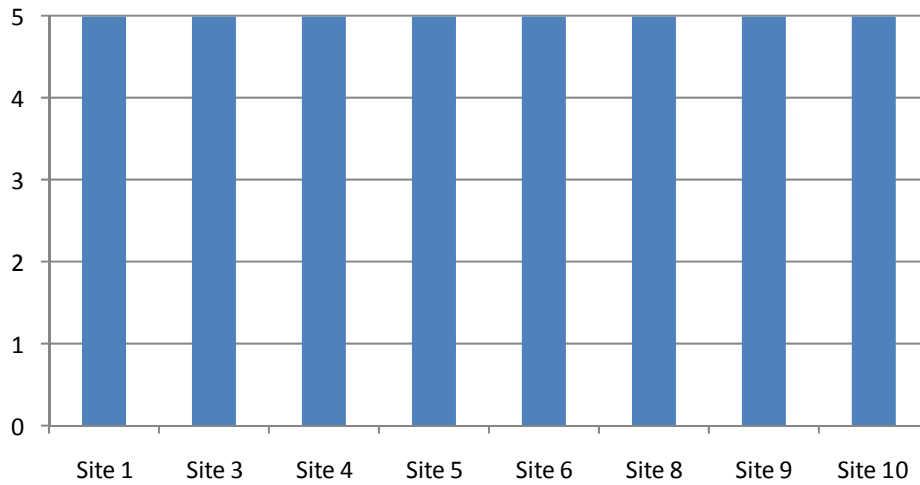
14.3 Please rate your satisfaction with the incentive amount (1=very unsatisfied, 5=very satisfied). Don't know/NA= 9



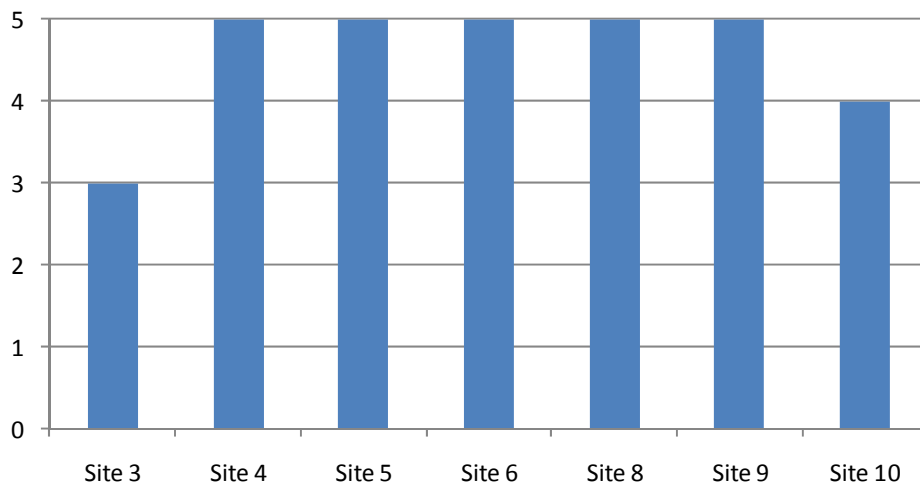
14.4 Please rate your satisfaction with the application process (1=very unsatisfied, 5=very satisfied). Don't know/NA= 9



14.5 Please rate your satisfaction with the quality of work conducted by the contractor (1=very unsatisfied, 5=very satisfied) Don't know/NA = 2

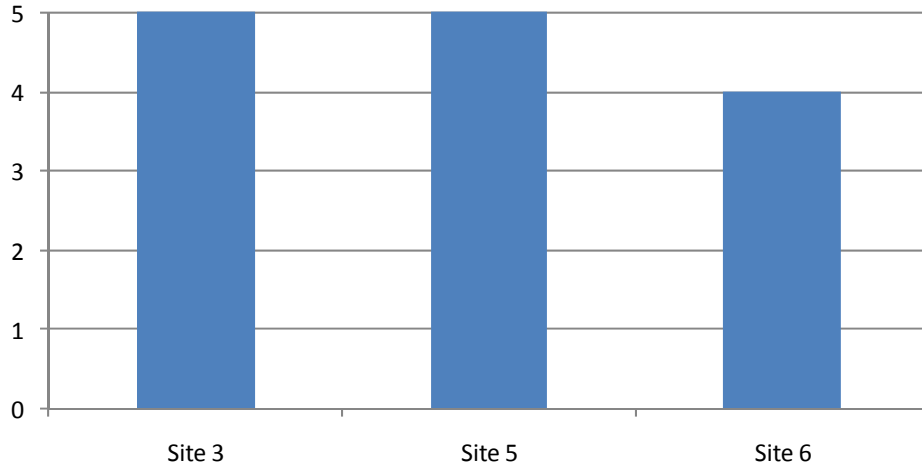


14.6 Please rate your overall program experience (1=very unsatisfied, 5=very satisfied). Don't know/NA = 3



14.7 Please rate your satisfaction of the programs staff knowledge: 10/10 don't know

14.8 Please rate any problem issue that needed resolution (1=very unsatisfied, 5=very satisfied). Don't know/NA = 7



### *Contractor Interviews*

This study contacted two of the ten dry cleaner service contractors responsible for 1,861 or 66% of steam trap replacements.

Contractor 1 expressed frustration that the Energy Trust of Oregon used, in his view, an out of area unlicensed contractor. Lockheed Martin later confirmed that the contractor in question was in fact licensed. Moreover, the perception of Contractor 1 is that this outside contractor only changed easily accessible changed steam traps. The field assessment team observed that all steam traps were replaced at all dry cleaners.

Contractor 2 is based outside of Oregon, and found Portland the only cost effective area to provide its services outside their home territory. He learned of the program online and also saw additional energy savings opportunities in steam pipe insulation.

### *Savings Review Summary*

This study reviewed the assumptions contained within *Steam Traps – An Opportunity to Save Natural Gas* by ICF international as it is the basis for the Energy Trust’s natural gas savings calculations for this measure. The primary assumptions provided in the report are as follows:

1. Inlet steam pressure -Inlet pressures were not recorded in this study.
1. Operating hours – This study found that actual operating hours were only about sixty percent of the assumed value. While Portland area operators use their boilers only 1,505 hours per year, the ICF report assumes 2,425 hours per year. The difference in operating time will have a significant impact on savings calculations.
2. Leak rate – All steam traps were replaced regardless of need. No visual or audible leaks were detected. The leak rate assumed in the ICF report is acceptable.
3. Boiler efficiency – All the boilers observed were less than 15 years old. The 80% operating efficiency assumed in the ICF report is acceptable.

## Field Protocol Methodology

The following information was gathered in the field:

1. Survey data
2. Number of new traps installed
3. Number of old traps left
4. System size (e.g. BTU)
5. System age
6. Number of boilers
7. If the piping was insulated
8. The type of controls
9. Hours of business operation
10. Hours of steam boiler operation
11. Boiler fuel
12. Inlet and outlet temperatures on steam traps:
13. Major steam demands

The field work was performed in May 2009. The dry cleaners were not provided advance notice regarding the assessment; however, the Korean American Dry Cleaners Association - Portland Chapter may have announced the upcoming field assessment to its members. The field staff then administered the survey to the person in charge of the boiler system – usually the owner. Approximately 15 minutes later, the field staff inspected the boiler system and completed the inspection form.

## Appendix

Energy Trust of Oregon Billing Analysis Memo



# MEMO

**Date:** June 15, 2009

**To:** Greg Stiles, Jessica Rose, Nick Parsons, Peter West, Philipp Degens

**From:** Brien Sipe

**Subject:** Realization rates for EB steam traps

To provide early feedback about the state of steam trap projects in the Existing Building (EB) program, the following details results from billing analysis for participant and non-participating sites. This analysis was conducted to supplement the site verification carried out by the Strategic Energy Group (SEG) in late May 2009.

Gas utility bills for 136 project sites were used in the study. These sites represent 65% of total steam trap projects conducted since July 2008. Sites receiving only steam traps were included in the analysis. To arrive at estimates of savings, a variety of modeling approaches were used, all of which yielded stable estimates of steam trap replacement savings.

A recent site verification study performed by SEG found all steam traps, regardless of functionality, were being replaced at participating sites. This finding was consistent with measure savings assumptions. In addition, SEG identified that boiler operating hours were significantly less than the assumptions used to estimate engineering savings. The report suggested that these reduced hours were a result of a downturn in business due to current economics conditions. In an effort to account for these changes in business climate, 58 dry cleaners which have not participated in the program were included to act as a comparison group to enable the capturing of 'net' steam trap savings.

### Key Findings:

- Participant sites used in the analysis averaged 15 trap replacements.
  - Engineering estimates of savings assume that, on average, sites run their boilers 2,425 hours per year, of 7.7 hours per day (assuming the business operates 6 hours per week). SEGs field work indicated boilers are typically operating 4.8 hours per day, or 62% of expected hours.
- Regression estimates of savings per installed steam trap ranged from 44-55 therms depending on modeling approach. This yields a realization rate of 32%-39%.
- Despite the low realization rate, this measure still passes the Energy Trust cost effectiveness tests when using the lower end of the savings estimate range.



## The Data

**Table 1: Average pre and post billing period lengths and energy consumption**

Descriptive statistics	Participants	Comparison Group
Sites used in analysis	136	58
Avg. pre-billing days used	322	299
Avg. post-billing days used	152	160
Avg. daily pre-period therm consumption	21.2	18.1
Avg. daily post-period therm consumption	19.8	19.0

Table 1 describes the length of pre and post period utility billing data that was used to generate the estimates of savings. A larger comparison group than the participant group is typically desirable, but in this case most dry cleaner sites identified had already participated in the program.

**Table 2: Average monthly therm use by year**

Year	Participant
2007	682
2008	663
2009	645

Average monthly therm consumption by participant group is shown in table 3. Despite the lower average run-times discovered during the SEG site verification study, these monthly figures are consistent with the ICF estimate of commercial dry cleaners averaging 650 therms per month.

## Methods

Non-participants were given a random ‘treatment’ month proportional to those of the participant group to help reflect economic and seasonal trends in business to minimize any potential bias. In addition, non-participants have been weighted to more closely match the participant pre-period average consumption (min, max, quartile and mean consumption as well as region were used to generate strata). This aligned the two groups’ pre-period consumption more closely, although overall precision was limited by the small non-participant sample.

Regarding geographic distribution, the majority of participating sites and all but a handful of non-participant sites were located in the PDX area.

## Regression model specifications used:

$$(1) \text{AVGUSE}_{it} = \alpha + \beta_1 \text{POST}_i + \beta_2 \text{HDD65}_{it} + \beta_3 \text{CDD75}_{it} + \beta_4 \text{PARTICIPANT}_i + \beta_5 \text{POSTQTY}_{it} + \gamma_i + \epsilon_{it}$$

$$(2) \text{AVGUSE}_{it} = \alpha + \beta_1 \text{POST}_i + \beta_2 \text{PARTHDD65}_{it} + \beta_3 \text{HDD65}_{it} + \beta_4 \text{PARTCDD75}_{it} + \beta_5 \text{CDD75}_{it} + \beta_6 \text{PARTICIPANT}_i + \beta_7 \text{POSTQTY}_{it} + \gamma_i + \epsilon_{it}$$

## Where:

AVGUSE<sub>it</sub> = average daily therm usage in period ‘t’

POST<sub>it</sub> = dummy variable equal to 1 in the post-installation period for both participants and comparison group

HDD65<sub>it</sub> = average daily heating degree days in period ‘t’ calculated at reference temperature 65

$PARTHDD65_{it}$  = post period participant weather interaction term ( $HDD65 * PARTICIPANT$ )  
 $CDD75_{it}$  = average daily cooling degree days in period 't' calculated at reference temperature 75  
 $PARTCDD75_{it}$  = post period participant weather interaction term ( $CDD75 * PARTICIPANT$ )  
 $PARTICIPANT_i$  = dummy variable indicating program participant  
 $POSTQTY_{it}$  = Scale variable identifying number of steam traps installed in the post period  
 $\gamma_i$  = individual site fixed effect  
 $\epsilon_{it}$  = unexplained variation in AVGUSE

**Table 3: Model estimates<sup>1</sup>**

Variable	Model (1)	Model (2)
AVGHDD65	0.106***	0.198***
	0.009	0.018
PARTHDD65		-0.126***
		0.021
AVGCDD75	-1.634***	-0.376
	0.409	0.791
PARTCDD75		-1.729*
		0.922
POSTQTY	-0.150***	-0.121***
	0.018	0.018
PARTICIPANT	-4.961**	-3.065
	2.113	2.125
POST	-0.042	-0.373
	0.25	0.254
Constant	20.063***	18.584***
	1.955	1.958
Observations	2849	2849
R-squared	0.939	0.94
Standard errors below the coefficient		
*** p<0.01, ** p<0.05, * p<0.1		

Regression estimates of therm savings from steam trap installations are detailed in table 3. Site specific intercepts are not reported. The primary difference in the model specifications was to account for differing levels of seasonal energy use in the two groups. Ideally, the two groups should not differ in energy use in the pre-period, but the limited size of the non-participant group prevented exact matching of average use in the pre-period (these differences are captured by PARTICIPANT in model 1 and AVGHDD65 in model 2). POSTQTY, our variable of interest, reflects the daily therm savings stemming from each steam trap installation at a participating site. These estimates yield an annual savings per trap ranging from 44-55 therms, depending on specification.

<sup>1</sup> Non-constant variance is present in all model specifications and unfortunately, the weighting scheme employed to stratify the non-participants does not allow for the calculation of robust standard errors. Un-weighted models were estimated using robust standard errors, which did not affect the statistical significance of the variables of interest. Given this finding, the above model estimates, which account for secular changes in consumption, were judged to be consistent estimates of steam trap savings.

Several alternate specifications were examined (e.g., controlling for year and month effects, removing weather related variables) but no appreciable difference in impact estimates were observed.

### **Conclusions**

This memo examined the utility billing data for the majority of dry cleaners which had steam traps replaced through Energy Trust's EB program. On average, around five months of post-installation data was available to estimate energy savings stemming from steam trap installations. Based on this data, we estimate that the average steam trap installation saves between 44-55 therms annually. Reduced boiler run-times due to current economic conditions may be behind the realization rates, although average pre-period consumption closely mirrored the assumptions made in the original engineering estimates of savings.

*Steam Trap Temperature Readings*

<b>Steam Trap</b>	<b>Site 1* (F)</b>	<b>Site 2* (F)</b>	<b>Site 3 (F)</b>	<b>Site 4* (F)</b>	<b>Site 5 (F)</b>	<b>Site 6 (F)</b>	<b>Site 7 (F)</b>	<b>Site 8 (F)</b>	<b>Site 9 (F)</b>	<b>Site 10 (F)</b>
Inlet/outlet 1	67/67	70/70	93/87	80/79	122/90	109/106	273/205	195/119	236/189	255/184
Inlet/outlet 2	67/63	69/69	104/96	81/80	132/108	125/98	262/175	264/159	216/169	284/154
Inlet/outlet 3	67/66	70/69	140/84	78/76	67/67	147/118	-	263/144	229/153	-

\*Boilers not operating during inspection

Date 5/21/09

Business Contractor 1 Phone \_\_\_\_\_

Contact Contractor 1 Contact Address \_\_\_\_\_

**Introduction**

Your business installed steam traps in dry cleaning establishments with incentives from Energy Trust of Oregon. I am working with Energy Trust to understand how this program worked for you.

This interview will not change the incentives you or your customers received, and it does not reflect on your business in any way. This is only to improve the programs Energy Trust offers to business.

I have about 8 questions to ask you. It's always OK to answer "don't know" or to tell me something doesn't apply to you.

**Awareness**

How did you *first* hear about the steam trap replacement program?

program representative

vendor/contractor

utility (PGE, Pacific Corp)

other (describe) **He heard from a friend that an unlicensed contractor from California was up here installing steam traps at dry cleaners. He contacted David Jackson and asked what was going on. David told him about the program so he started making calls.**

don't know

**Comments: He was quite upset that ETO would use unlicensed contractors**

1. Do you have particular background in maintenance of steam systems for dry cleaners, or is it just one of the many services you provide for your customers?

yes  no

**Comments: He is a licensed boiler installation and repair contractor.**

2. Did you replace just failed steam traps or all the steam traps at a facility?

only failed traps  all the traps

**He commented that the contractor from California only replaced the steam traps that were easy to get to.**

3. Do you see other energy efficiency opportunities for your dry cleaners customers?

yes  no

**Comments: \_\_\_\_\_**

4. Have dry cleaners commented on or asked about other programs?

**Comments: Some have asked about lighting upgrades but he told them that if they don't own the building it would not be cost effective for them.**

5. Are you aware of the benefits of the Oregon Business Energy Tax Credit (BETC—"betsy") for the steam traps you installed?

yes → go to 5.

no → skip to 7.

6. IF YES, did you pass on BETC information to the dry cleaners?

yes → skip to 7.

no → go to 6.

7. IF NO, why didn't you pass on BETC information to the dry cleaners?

didn't know enough about BETC

didn't think of it

didn't know equipment would qualify

BETC application seemed too difficult or time consuming

other: **He told the owners that they would see the savings each month on their gas bill.**

(don't know)

Comments: \_\_\_\_\_

**Past and Ongoing Program Interactions**

8. Has your business participated in Energy Trust programs in the past?

yes

Comments:

no

don't know

Residential

**Program Experiences**

Are you still replacing steam traps at dry cleaners and laundries?

yes  no

If no why not? **He only has one dry cleaner left to do.**

9. Would you install equipment for Energy Trust programs again?

Y → What, if anything, would you want to have happen differently? **He thinks they should only use licensed and bonded**

**contractors** \_\_\_\_\_

N → Why not?

\_\_\_\_\_

10. Have you done any other work for any of the dry cleaners where you replaced steam traps either before or after the installation?

yes  no

11. If you have any sources of dissatisfaction we haven't asked about or suggestions for how Energy Trust Programs might be improved, please let me know.  Only the use of unlicensed contractors

issue. \_\_\_\_\_

**Conclusion**

Comments: **They were all regular customers. He said he didn't make any cold calls.**

Date 5/26/09  
Business Contractor 2 Phone \_\_\_\_\_  
Contact Contractor 2 Contact Address \_\_\_\_\_

**Introduction**

Your business installed steam traps in dry cleaning establishments with incentives from Energy Trust of Oregon. I am working with Energy Trust to understand how this program worked for you.

This interview will not change the incentives you or your customers received, and it does not reflect on your business in any way. This is only to improve the programs Energy Trust offers to business.

I have about 8 questions to ask you. It's always OK to answer "don't know" or to tell me something doesn't apply to you.

**Awareness**

How did you *first* hear about the steam trap replacement program?

- program representative
- vendor/contractor
- utility (PGE, Pacific Corp)
- other (describe) read about the program on-line
- don't know

**Comments:** \_\_\_\_\_

1. Do you have particular background in maintenance of steam systems for dry cleaners, or is it just one of the many services you provide for your customers?  
 yes  no

**Comments:** They do equipment repairs for dry cleaners as well as steam system maintenance

2. Did you replace just failed steam traps or all the steam traps at a facility?  
 only failed traps  all the traps

3. Do you see other energy efficiency opportunities for your dry cleaners customers?  
 yes  no

**Comments:** They see a need for steam pipe insulation in most dry cleaners.

4. Have dry cleaners commented on or asked about other programs?  
**Comments:** NO

5. Are you aware of the benefits of the Oregon Business Energy Tax Credit (BETC—"betsy") for the steam traps you installed?  
 yes → go to 7.  
 no → skip to 9.

6. IF YES, did you pass on BETC information to the dry cleaners?  
 yes → skip to 7.  
 no → go to 6.

7. IF NO, why didn't you pass on BETC information to the dry cleaners?

didn't know enough about BETC

didn't think of it

didn't know equipment would qualify

BETC application seemed too difficult or time consuming

other: \_\_\_\_\_

(don't know)

Comments: \_\_\_\_\_

**Past and Ongoing Program Interactions**

8. Has your business participated in Energy Trust programs in the past?

yes

Comments:

no

don't know

Residential

**Program Experiences**

9. Are you still replacing steam traps at dry cleaners and laundries?

yes  no

If no why not? **Not that many dry cleaners to do.**

10. Would you install equipment for Energy Trust programs again?

Y→What, if anything, would you want to have happen differently? **Couldn't think of anything.**

\_\_\_\_\_

\_\_\_\_\_

N→Why not?

\_\_\_\_\_

11. Have you done any other work for any of the dry cleaners where you replaced steam traps either before or after the installation?

yes  no

If you have any sources of dissatisfaction we haven't asked about or suggestions for how Energy Trust Programs might be improved, please let me know. **They felt there were other steam traps that would save more energy and customers asked for them but the \$ 100/trap rebate didn't cover the cost and the dry cleaner owners weren't willing to pay anything for trap replacement.**

**Conclusion**

Comments: **They commented that outside of the Portland area there weren't that many dry cleaners in each town and it wasn't cost effective for them to put workers up in a motel to do 1 or 2 cleaners.**