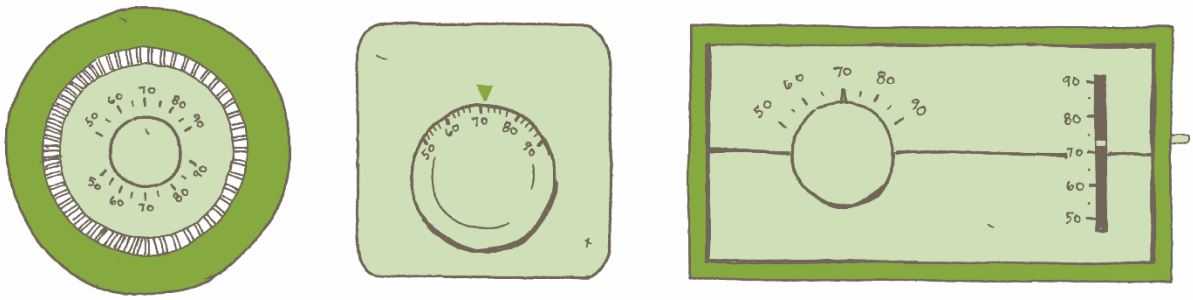
2017 Pennsylvania Annual Report

CELEBRATING 20 YEARS OF PROTECTING THE ENVIRONMENT

(1998 – 2018)



Thermostat Recycling™ CORPORATION

Recycle every mercury thermostat, every time.

Thermostat Recycling Corporation Board Members, Paying Dues Members and Employees (at close of 2017)

THERMOSTAT RECYCLING CORPORATION BOARD MEMBERS

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Honeywell International

John Sartain (Vice-Chairman)
Emerson Technologies (White Rodgers)

Rob Munin (Treasurer)
Lux Products Corporation

THERMOSTAT RECYCLING CORPORATION DUES PAYING MEMBERS

Bard Manufacturing	Burnham Holdings	Carrier Corporation
ecobee Inc.	Empire Comfort Systems	General Electric
ITT	Lear Siegler	Lennox International Inc.
Nest Labs	Nortek Global HVAC, LLC	Rheem Manufacturing
Johnson Controls Inc.	TPI Corporation	Trane Residential Systems
White-Rodgers (Emerson)	Valliant	W.W. Grainger
Chromalox	Climate Master, Inc.	Crane Company
Goodman Global	Honeywell International	Hunter Fan Company
Lux Products Corporation	Marley-Wylain Company	McQuay
Schneider Electric	Sears Holding Corporation	Taco Comfort Solutions
Uponor		

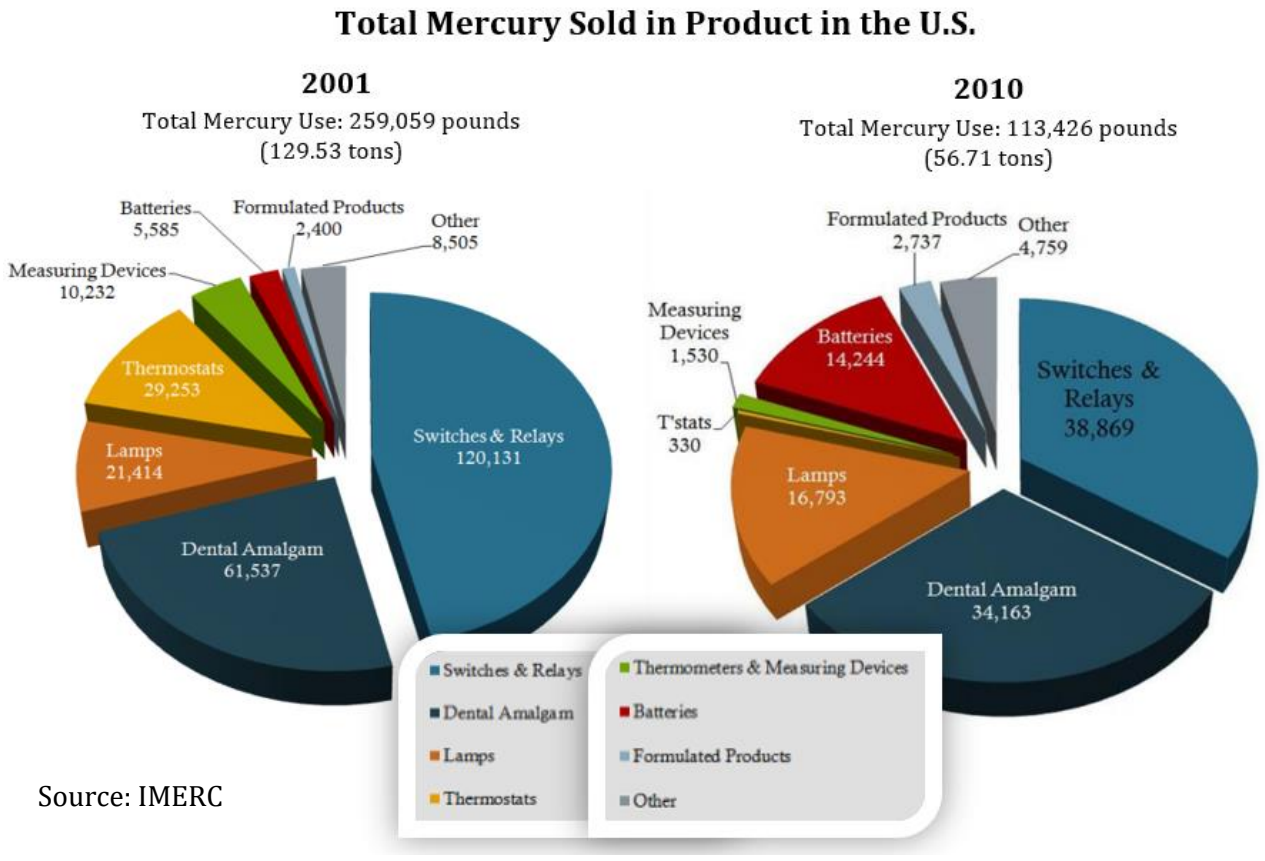
THERMOSTAT RECYCLING CORPORATION EMPLOYEES

Ryan Kiscaden
Executive Director

Danielle Myers
Operations and Compliance Manager (Recently Promoted)

THE MERCURY'S FALLING AFTER 20 YEARS

Mercury from products put into the waste stream is declining. Recently, this public health issue has been best highlighted with the revision of guidelines of certain fish consumption. The Environmental Protection Agency (EPA) along with the Food and Drug Administration (FDA) have loosened these guidelines with the implication being that the source of mercury contamination from these sources has decreased. The fish consumption guideline changes may indirectly reflect the findings of the Interstate Mercury Education and Reduction Clearinghouse (IMERC). In 2010, IMERC provided data on the use of mercury sold in products in the U.S. The graphs illustrated devices such as switches/relays, dental amalgam, lamps, batteries and thermostats. The juxtaposition of these two pie charts compared 2001 to 2010. As highlighted in the thermostat slice, there was a noticeable change in mercury in thermostats during this time period as a percentage of the overall pie. In fact, IMERC published that by 2007, mercury use in the production of thermostats was basically nonexistent[1]. According to IMERC's fact sheet, "There are non-mercury alternatives that may be suitable for replacing mercury thermostats. Programmable thermostats can save energy and money, by enabling users to automatically adjust the temperature or turn off the heat or air conditioning depending on the time of day." Logically, any decline in thermostat collections can be explained with these overarching constraints.



Source: IMERC

[1] http://www.newmoa.org/prevention/mercury/imerc/factsheets/thermostats.cfm

Looking specifically at the TRC collection data, there has been an irrefutable downward trend in thermostats (on the average) inside the program's recycling containers. What's more is the program's national collections peaked by 2014. At that time, the program would have been in operation at least seven years from last production (2007) of mercury containing thermostats. Or at the beginning of the decline of mercury thermostat production which would have been 10 years (2004). Thus, the further TRC moves from the range of mercury thermostat production (2004-2007), the less the program can reasonably expect to collect since these collected products are fungible. This past year's mercury thermostat collections do, in fact, demonstrate a decline (-2% less than 2016 nationally)[2]. Despite the obvious softening of collections, TRC has recycled more than 2.1 million thermostats, diverting more than 10 tons of mercury from the ecosystem across 48 contiguous states, all within these twenty short years of operation. This is quite an incredible feat.

Amidst the resulting decline in collections, how does the program collect devices that were once widespread in use, do not have a downstream recycled commodity market, and are not uniformly tracked following purchase and installation? The only answer is that you focus on deploying precious resources at targeting the best opportunities within the most promising sectors. You use data, hunches, or metrics. You choose to focus on where there have been consistent numbers inside of the recycling containers and you lean on the stakeholders that make the program a success. In 20 years of operation, we have learned that stakeholders such as the regulatory community, our paying members, the collection points, and vendors hold the keys to our success as an organization. Without them, we do not have a successful recycling program, nor does the environment. Utility driven thermostat replacement programs, the installing HVAC industry, and the waste recycling sector consistently demonstrate that they can stimulate these devices for recycling and are willing actors. To pursue other channels has proven to be inefficient and ineffective. We plan to stay vigilant in the face of the changing thermostat product adoption cycles and the evolving market forces. The reality is that these focuses are not dissimilar to where the program started twenty years ago. These core values of TRC will not and have not changed. No longer is mercury rising and we are proud to willingly have participated in its decline.

Ryan L Kiscaden
Executive Director, Thermostat Recycling Corporation

[2] Graphs illustrating these two points are available in the 2017 State Specific Collections and Evaluation section of the annual report, see table of contents for page number.

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PENNSYLVANIA

2017 COLLECTIONS AND EVALUATION

SECTION 0: Program Overview

The following analytical report details the annual program performance for mercury thermostat collection in the state of Pennsylvania (PA) in 2017. A few of the program highlights for 2017 are included below:

- In 2017, the program **collected 94.4 lbs of mercury** in Pennsylvania**.** Since 2008, the mercury collected in Pennsylvania has increased by an annual average of 6% per year. During the same period, total mercury collected nationally increased by 4% per year.
- The program collected **10,674 whole thermostats in 2017**, a 10% increase from 2016 and a 41% increase from a decade ago. The increase in number of thermostats collected annually in PA was an average of 8% since 2008.
- **The number of whole thermostats collected per bin in 2017 was 51 thermostats.** This was less than the 19-year state average of 81 thermostats per bin.
- The Pennsylvania counties that returned the most bins in 2017 were **Montgomery (23 bins), Chester (21 bins),** and **Bucks (20 bins).** The counties that returned the most thermostats in 2017 were **Bucks (1,081 thermostats), Montgomery (1,010 thermostats),** and **Lehigh (944 thermostats).**
- In 2017, **41% of partner locations returned at least one bin** compared to a national average of 32%.
- In 2017, **56 site visits were conducted and 37 'miss you' calls were placed in Pennsylvania.** No statistically significant relationship between number of bins returned and calls or visits was found.
- In addition to 10,674 whole thermostats, 576 loose switches were collected, bringing the total number of "thermostat equivalents" returned in 2017 to 11,093, an increase of 10% from 2016.

SECTION 1: Program Analytics

Section 1 of this report examines the annual performance of the thermostat collection recycling program in terms of bins, thermostats, and mercury collected as well as the year-over-year progression of the program.

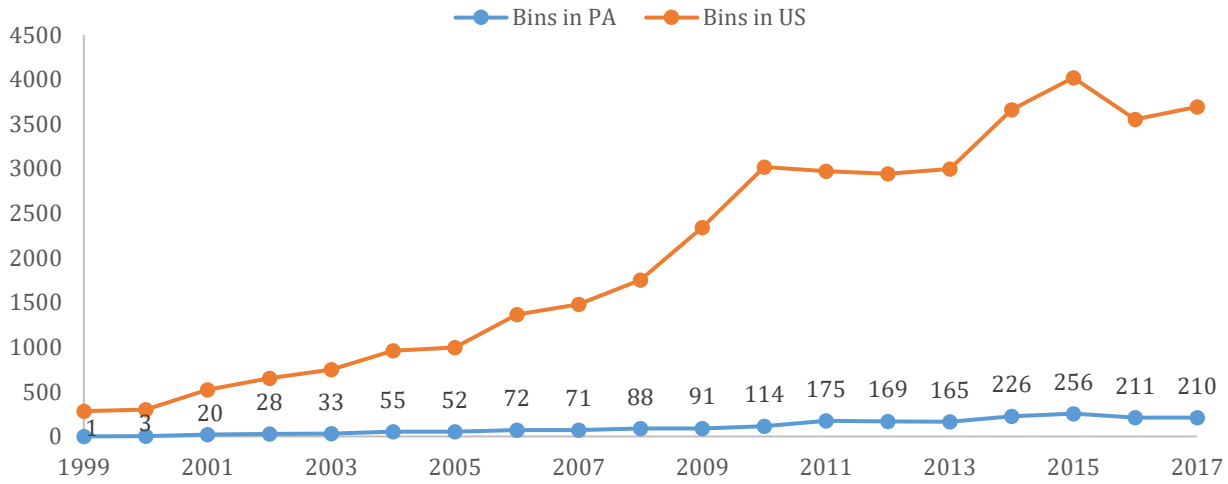
On average, the program has **collected 71.3 lbs of mercury and 7,443 whole thermostats per year** since 1999. In 2017 the program **collected 94.4 lbs of mercury from 10,674 whole thermostats and 576 loose switches**. Figure 1.1 displays the total number of bins, thermostats, and quantity of mercury collected in the state since the beginning of the program.

FIGURE 1.1: PROGRAM PERFORMANCE OVER TIME

Year	Number Bins	Number Stats	Lbs Mercury
1999	1	150	1.0
2000	3	278	2.5
2001	20	1,632	16.8
2002	28	2,242	25.8
2003	33	2,548	25.8
2004	55	4,632	46.2
2005	52	4,968	46.0
2006	72	7,019	59.4
2007	71	6,175	64.2
2008	88	7,560	72.2
2009	91	7,320	82.7
2010	114	9,500	99.1
2011	175	14,411	133.2
2012	169	11,406	114.8
2013	165	12,696	119.5
2014	226	14,201	133.0
2015	256	14,338	130.1
2016	211	9,676	88.8
2017	210	10,674	94.4
Average	*107*	*7,443*	*71.3*
Total	*2,040*	*141,426*	*1,355.4*

Figure 1.2 displays the number of bins collected in the state over time as well as the total number of bins collected nationally over the same period. The number of bins collected in Pennsylvania has risen gradually since the start of the program in 1999.

FIGURE 1.2: BINS COLLECTED OVER TIME IN THE STATE AND NATIONALLY



Since 2008, **mercury collection in Pennsylvania has increased by 6% per year on average**. During the same period, the quantity of mercury collected nationally increased by 4% per year. **In 2017, the quantity of mercury collected increased by 6% from 2016**. Figure 1.3 displays the quantity of mercury collected in the state over time as well as the annual percent increase (or decrease) in the state and nationally.

FIGURE 1.3: QUANTITY OF MERCURY COLLECTED IN PROGRAM AND ANNUAL CHANGES IN THE STATE AND U.S.

Year	Total Lbs Hg	% Change State	% Change U.S.
1999	1.0	N/A	104%
2000	2.5	156%	11%
2001	16.8	570%	89%
2002	25.8	54%	14%
2003	25.8	0%	11%
2004	46.2	79%	17%
2005	46.0	0%	11%
2006	59.4	29%	32%
2007	64.2	8%	2%
2008	72.2	12%	16%
2009	82.7	14%	16%
2010	99.1	20%	26%
2011	133.2	34%	4%
2012	114.8	-14%	-5%
2013	119.5	4%	-5%
2014	133.0	11%	13%
2015	130.1	-2%	-1%
2016	88.8	-32%	-15%
2017	94.4	6%	-7%
Average Since 2008	*106.8*	*6%*	*4%*

The state of Pennsylvania collected 10,674 thermostats in 2017. This was a **10% increase from 2016 and a 41% increase from a decade ago**. The average of annual increases in thermostats collected in Pennsylvania is **8% since 2008**. Yearly increases in the U.S. averaged 4% over the same period. Figure 1.4 displays the total number of thermostats collected in the state and nationally, and Figure 1.5 displays the underlying data as well as the annual percent change.

FIGURE 1.4: NUMBER OF WHOLE THERMOSTATS COLLECTED OVER TIME IN THE STATE AND NATIONALLY

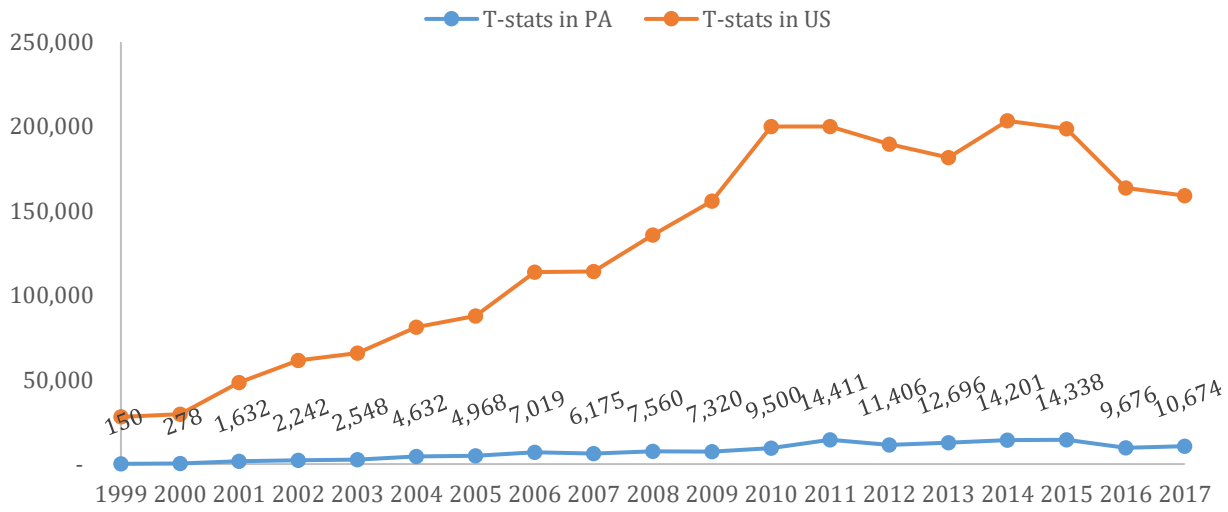
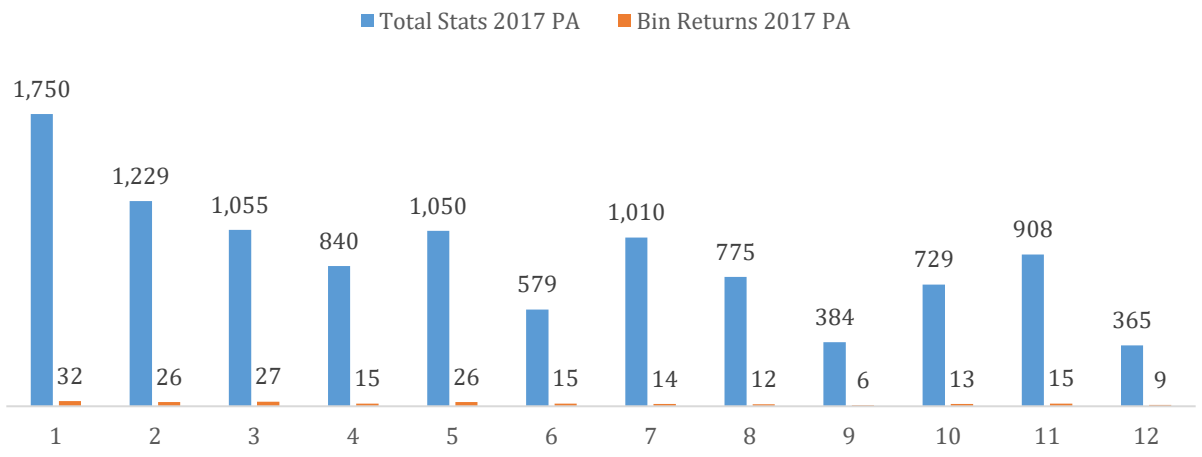


FIGURE 1.5: WHOLE THERMOSTATS COLLECTED IN THE STATE AND U.S. OVER TIME

Year	T-stats in PA	T-stats in U.S.	% Change State	% Change U.S.
1999	150	27,965	-	-
2000	278	29,637	85%	6%
2001	1,632	48,350	487%	63%
2002	2,242	61,422	37%	27%
2003	2,548	65,778	14%	7%
2004	4,632	81,115	82%	23%
2005	4,968	87,754	7%	8%
2006	7,019	113,658	41%	30%
2007	6,175	114,158	-12%	0%
2008	7,560	135,646	22%	19%
2009	7,320	155,731	-3%	15%
2010	9,500	200,064	30%	28%
2011	14,411	199,918	52%	0%
2012	11,406	189,619	-21%	-5%
2013	12,696	181,600	11%	-4%
2014	14,201	203,346	12%	12%
2015	14,338	198,603	1%	-2%
2016	9,676	163,606	-33%	-18%
2017	10,674	159,046	10%	-3%
Average Since 2008	*11,178*	*178,718*	*8%*	*4%*

Figure 1.6 displays the monthly distribution of bins and thermostats collected in the state in 2017. Most bins were returned in **January (32 bins) and March (27 bins).** The most thermostats were returned in **January (1,750 thermostats), February (1,229 thermostats), and March (1,055 thermostats).**

FIGURE 1.6: WHOLE THERMOSTATS AND BINS COLLECTED PER MONTH 2017



The highest number of thermostats per bin occurred in **July (72 thermostats per bin) and August (65 thermostats per bin).** Figure 1.7 shows the average number of thermostats per bin per month for the year.

FIGURE 1.7: AVERAGE THERMOSTATS PER BIN RETURNED PER MONTH

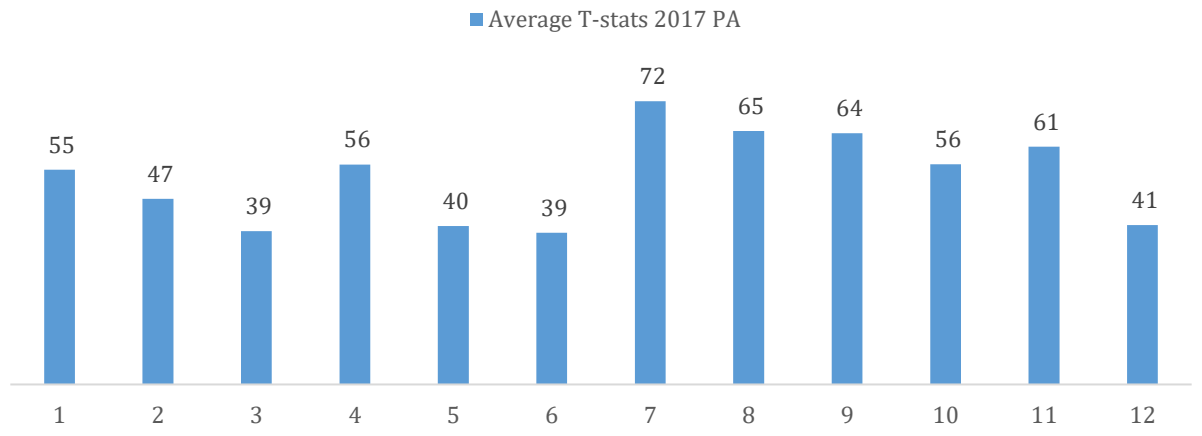


Figure 1.8 displays the average number of thermostats returned per bin in the state and nationally since the beginning of the state program. Nationally, the number of thermostats per bin has been decreasing annually since 2000, and a similar pattern is observed in Pennsylvania except in years 2003 to 2005. Pennsylvania has been continuously above or equal to the national average since 2004.

FIGURE 1.8: AVERAGE NUMBER OF THERMOSTATS PER BIN OVER TIME IN THE STATE AND NATIONALLY

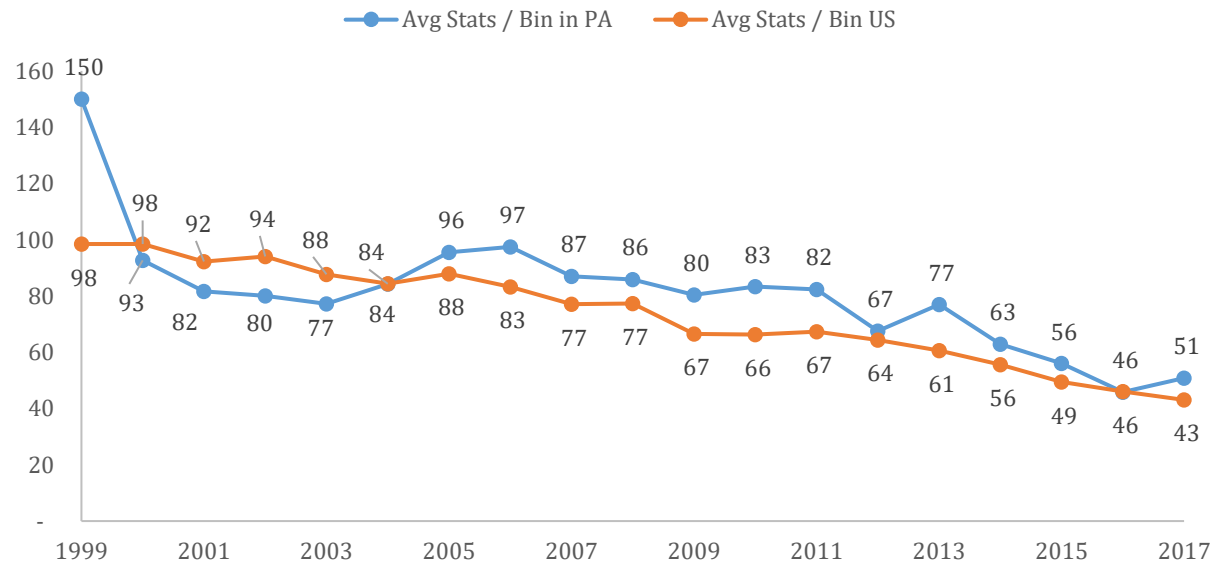
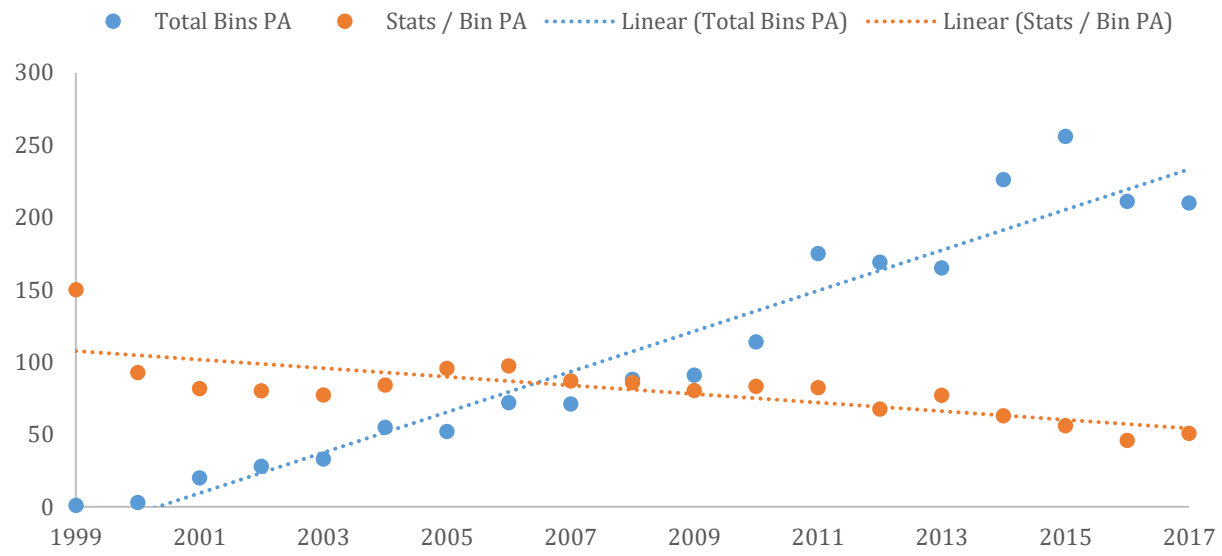


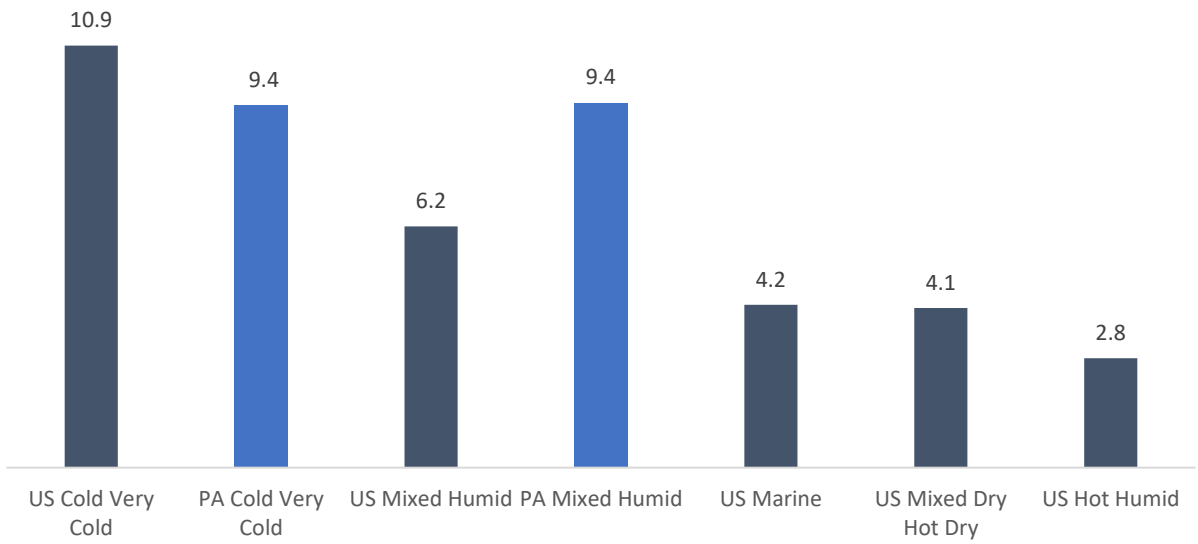
Figure 1.9 plots the total bins returned over time along with the average number of thermostats per bin over the same period to determine a relationship between the two. Excluding the first year where only one bin was returned with 150 thermostats, a negative correlation between total bins returned and number of thermostats per bin is supported by a statistical analysis. From 2000 to 2017, as the number of bin returns increased, the number of thermostats per bins decreased on average.

FIGURE 1.9: BINS AND AVERAGE NUMBER OF THERMOSTATS PER BIN OVER TIME



A climate zone analysis on number of thermostats returned per 10,000 residents was conducted. These zones were defined using the criteria from the U.S. Department of Energy Building America Program. These criteria are coded by county. The state of PA is in two climate zones: cold very cold zone and mixed humid zone. Figure 1.10 shows that the state returned 9.4 thermostats per 10,000 residents which is slightly below the national average in the cold very cold zone of 10.9 thermostats per 10,000 residents. However, PA returned 9.4 thermostats per 10,000 residents in the mixed humid zone which is above the 6.2 national average. Nationally, the cold very cold zone returned significantly more thermostats than the next highest zone, the mixed humid zone.

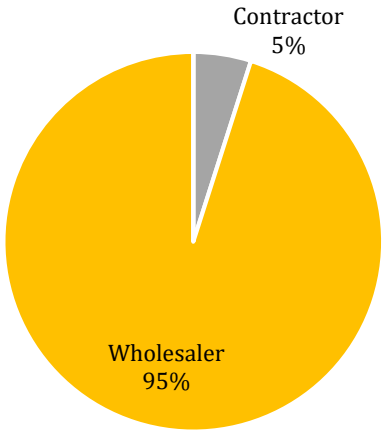
FIGURE 1.10: THERMOSTATS RETURNED PER 10,000 RESIDENTS BY CLIMATE ZONE



SECTION 2: Channel Partner Analysis

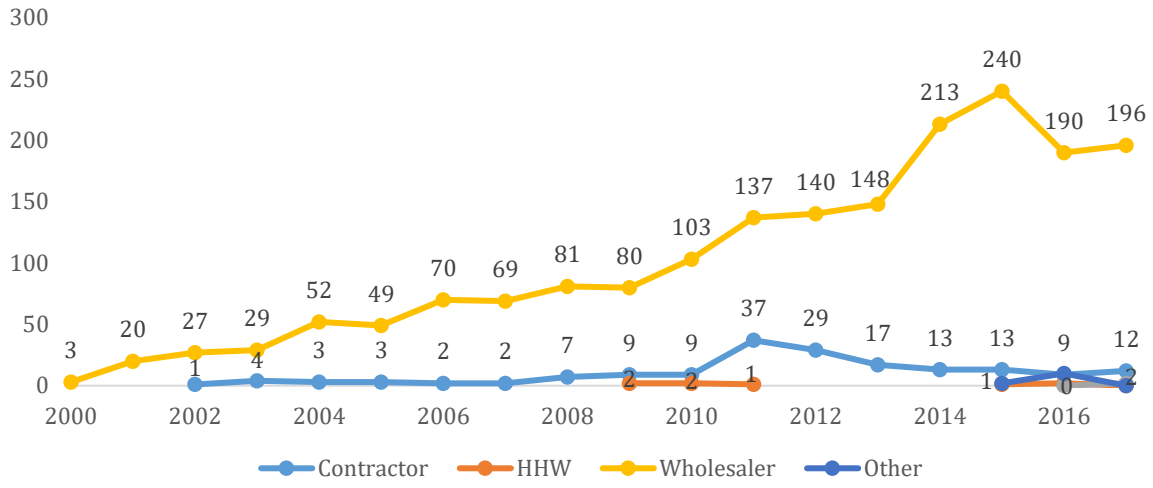
Section 2 of the report examines the partner locations in more detail. Most thermostats collected in the state were through **wholesalers (95%)** with the remaining collected by **contractors (5%)**. Figure 2.1 shows the distribution of thermostats collected by location type in 2017.

FIGURE 2.1: THERMOSTATS COLLECTED BY LOCATION TYPE IN 2017



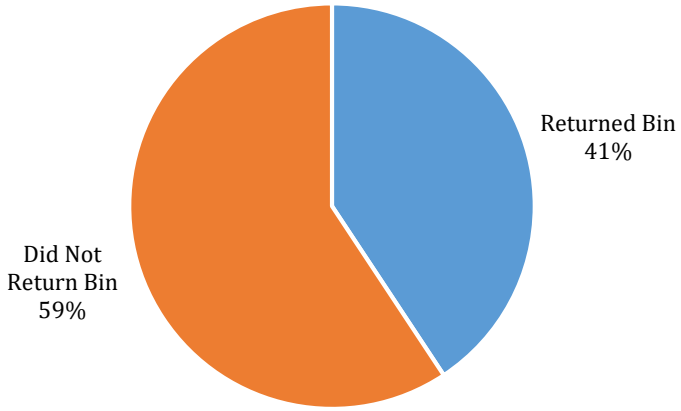
The number of bins returned by wholesalers decreased from 240 to 190 bins from 2015 to 2016 and increased slightly in 2017 to 196 bins. The number of bins returned by contractors and hazardous household waste facilities was comparable to 2016 levels. Figure 2.2 displays the change in the number of bins returned by thermostat collection type over time in the state.

FIGURE 2.2: THERMOSTAT BINS RETURNED BY LOCATION TYPE OVER TIME



In 2017, **41% of the locations** with a bin in Pennsylvania sent back at least one bin for recycling. The distribution is displayed in Figure 2.3.

FIGURE 2.3: PERCENTAGE OF STORES RETURNING A BIN IN 2017



An analysis of the top performing counties revealed **Montgomery (23 bins), Chester (21 bins), and Bucks (20 bins)** returned the most bins in 2017. The counties that returned the most thermostats in 2017 were **Bucks (1,081 thermostats), Montgomery (1,010 thermostats), and Lehigh (944 thermostats).** Figure 2.4 displays the total bins and thermostats returned by county in 2017.

FIGURE 2.4: TOTAL BIN AND THERMOSTATS RETURNED IN 2017 BY COUNTY

County Name	Total T-stats	Total Bins	County Name	Total T-Stats	Total Bins
Bucks	1,081	20	Butler	122	2
Montgomery	1,010	23	Blair	103	3
Lehigh	944	15	Indiana	95	2
Chester	774	21	Luzerne	92	6
Delaware	683	18	Venango	91	1
Allegheny	651	11	Fayette	77	1
Dauphin	621	9	Mercer	73	1
Cumberland	617	11	Cambria	71	2
Berks	485	6	Somerset	61	1
York	442	6	Centre	52	2
Lancaster	380	5	Washington	43	1
Westmoreland	374	6	Northumberland	40	2
Erie	320	8	Clearfield	27	1
Philadelphia	299	6	Lackawanna	23	2
Northampton	290	6	Schuylkill	18	1
Franklin	222	3	Adams	17	1
Crawford	198	2	Lycoming	7	1
Lebanon	132	1	Tioga	7	1
Mifflin	132	2			

TRC partner locations **R.E. Michel Company (3,268 thermostats), Johnstone Supply (1,792 thermostats), and United Refrigeration (788 thermostats)** were the top three performing partners in Pennsylvania. In addition, 11 partner locations returned more than 100 thermostats, 31 returned 10 or more thermostats, and four returned more than 1 thermostat in 2017. Figure 2.5 displays the top performing partners in terms of total thermostats returned in 2017.

FIGURE 2.5: TOP PERFORMING TRC PARTNERS IN THE STATE

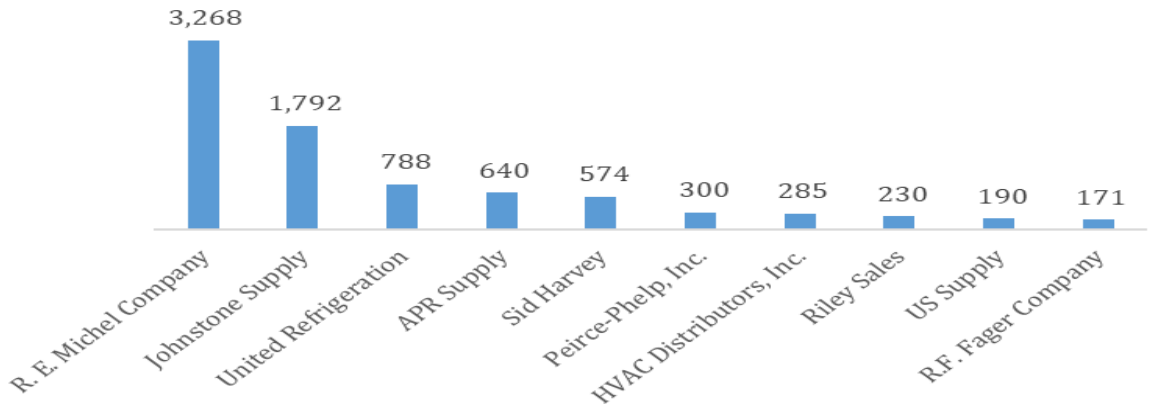


Figure 2.6 looks at the top performers in more detail. The figure includes the top performers for the year by each of the following categories: total bins returned, total thermostats returned, and average number of thermostats per bin.

FIGURE 2.6: TOP PERFORMING PARTNERS BY TOTAL BINS AND THERMOSTATS

Company Name	No. of Thermostats	No. of Bins	Thermostats / Bin
R. E. Michel Company	3,268	46	71
Johnstone Supply	1,792	26	69
United Refrigeration	788	18	44
APR Supply	640	16	40
Sid Harvey	574	9	64
Peirce-Phelp, Inc.	300	8	38
HVAC Distributors, Inc.	285	5	57
Riley Sales	230	3	77
US Supply	190	7	27
R.F. Fager Company	171	3	57

TRC conducted several activities in 2017 to increase the number of bins and thermostats returned in the state. In 2017, 56 site visits were conducted and 37 'miss you' calls were placed in Pennsylvania. Figure 2.7 displays the relationship between the number of site visits per month, bins returned per month, and the number of thermostats (in 100's) returned per month. The majority of visits occurred in May and June, with a handful of visits taking place in March and November as well. For visited locations, more than one-third of all bins returned in 2017 were returned within a visit month.

FIGURE 2.7: RELATIONSHIP BETWEEN SITE VISITS AND BINS AND THERMOSTATS RETURNED PER MONTH

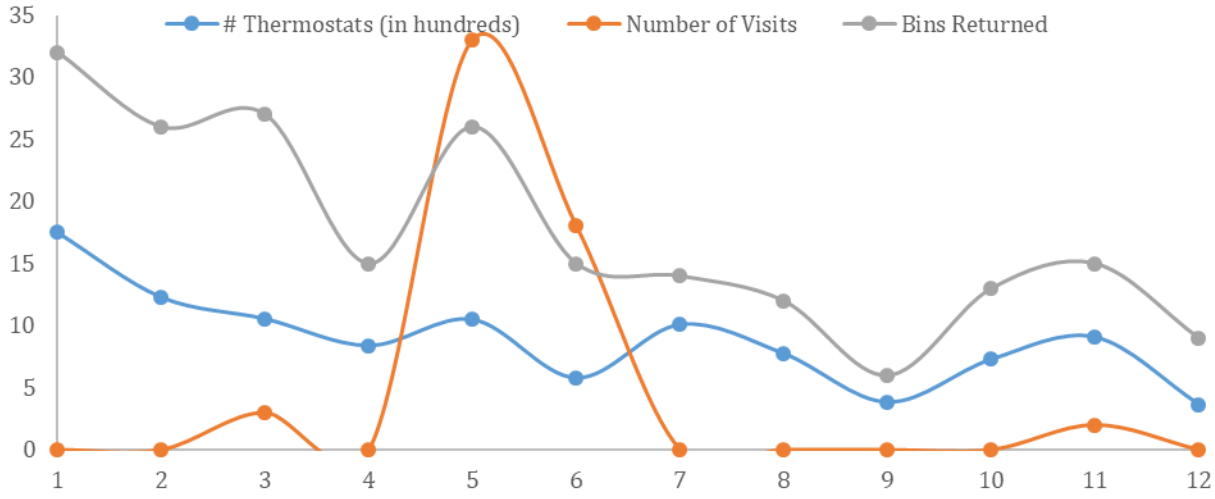


Figure 2.8 displays the relationship between number of calls per month, bins returned per month, and number of thermostats (by 100's) returned per month. Almost all of the calls were placed in January. Although the most returns also occurred in January, a statistically significant relationship between calls and the number of bins returned could not be determined.

FIGURE 2.8: RELATIONSHIP BETWEEN 'MISS YOU' CALLS AND BINS AND THERMOSTATS RETURNED PER MONTH

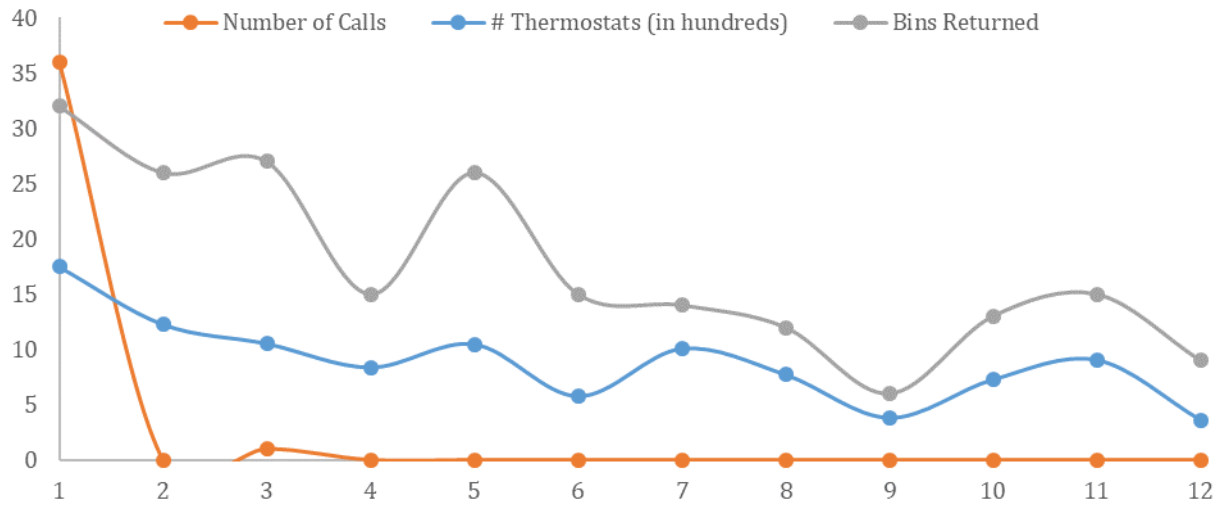


Figure 2.9 examines the return rates of four groups – locations that did not receive a call or visit, locations that received at least one visit, locations that received at least one call, and locations that received both a call and visit. The rate of active participation (which refers to locations that returned at least one bin) in 2017 is significantly greater for locations that received some sort of reminder compared to locations that received no reminder. Locations that received both a call and visit had the highest active participation rate of 80%, and locations that received only a visit had an active participation rate of 70%. In contrast, locations that did not receive a reminder had an active participation rate of 35%.

FIGURE 2.9: PERCENT CHANGE IN BIN AND THERMOSTAT RETURNS FOR LOCATIONS THAT RECEIVED A VISIT OR CALL OVER LOCATIONS THAT DID NOT RECEIVE EITHER

	No Visit or Call	Visit	Call	Visit & Call
Number of Participating Locations	294	47	32	5
Rate of Active Participation*	35%	70%	44%	80%
Bins per Participating Location	0.5	0.9	0.6	0.9
Thermostats per Participating Location	30	34	22	10
Thermostats per Bin	59	39	38	13

*Fraction of participating locations that returned one or more bins during 2017

SECTION 3: Comparisons to national and other states' data

To compare how state collection partners performed in 2017, the national average for the number of bins returned per locations that returned at least one bin was calculated and compared to the state average since 2012. The average number of bins does not include locations that did not return any bins in a given year. It should be noted when making comparisons that each state has different regulations, housing type mixes, local policies, and incentives that may have a unique impact on returns. Overall, the average number of bins returned per location per year was lower in Pennsylvania than the U.S. average, as shown in Figure 3.1.

FIGURE 3.1: AVERAGE NUMBER OF BINS RETURNED PER LOCATION PER YEAR

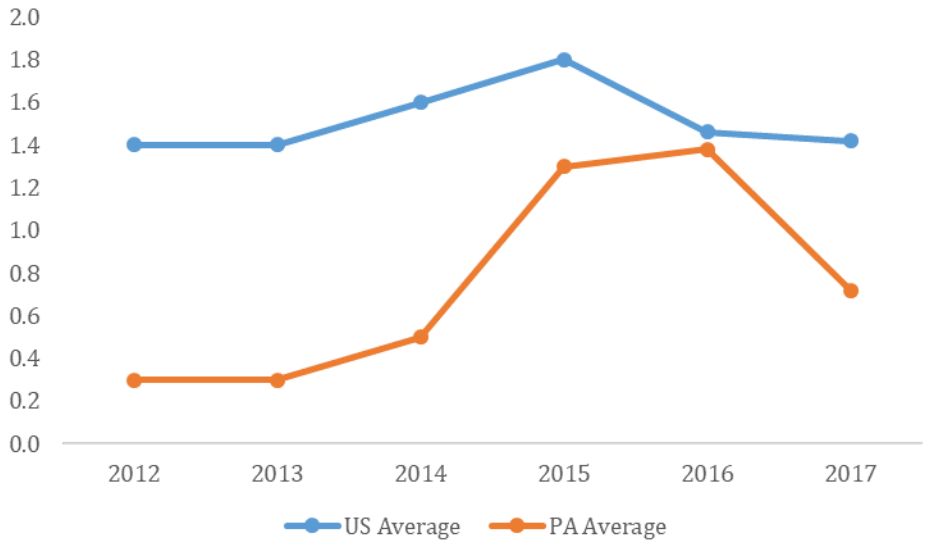


Figure 3.2 displays the locations in Pennsylvania that returned three or more bins in a given year since 2014, and Figure 3.3 displays the top 10 partners in the U.S. over the same period in terms of number of bins returned. R.E. Michel Company, Johnstone Supply, Sid Harvey Industries, and Ferguson Enterprises all appear in the top partners in Pennsylvania and nationally.

FIGURE 3.2: PARTNER LOCATIONS IN PENNSYLVANIA RETURNING THREE OR MORE BINS PER YEAR 2014-2017

Location	2014 Bins
R.E. Michel Company	63
APR Supply Company	25
United Refrigeration	17
Johnstone Supply	15
Peirce-Phelps, Inc	15
Meier Supply Company, Inc.	8
Sid Harvey Industries	7
Lennox Industries Inc	6
HVAC Distributors Inc.	5
Goodman Distribution Inc.	5
Ferguson Enterprises	4
Trane Supply	4
Thos. Somerville Co.	4
Riley Sales	3
R.F. Fager Co.	3
Hannahbery HVAC	3
Conestoga Supply	3
Location	**2015 Bins**
R.E. Michel Company, Inc.	39
Johnstone Supply Co.	33
United Refrigeration	22
APR Supply Company	21
Johnson Controls (York UPG)	11
Sid Harvey Industries	11
Meier Supply Co. Inc.	9
HVAC Distributors, Inc.	7
Lyon Conklin Co. Inc.	7
Peirce-Phelps, Inc.	7
Riley Sales	7
Robertson Heating Supply Co.	7
Trane Parts Center	6
EPSCO	5
Lennox Industries Inc.	4
Scott Electric	4
Goodman Distribution, Inc.	3
Grove Supply Inc.	3
UGI HVAC	3
US Supply	3

Location	2016 Bins
R.E. Michel Co.	37
APR Supply Company	23
United Refrigeration	17
Johnstone Supply	14
Sid Harvey Industries	9
York Upg	8
Peirce-Phelps, Inc.	7
HVAC Distributors, Inc.	5
Meier Supply Co Inc	5
Binghamton Hardware & Hvac	5
Robertson Heating Supply Co.	4
Location	**2017 Bins**
R. E. Michel Company	46
Johnstone Supply	26
United Refrigeration	18
APR Supply	16
Sid Harvey Industries	9
Ferguson Enterprises	8
Peirce-Phelp, Inc.	8
UPG Stores	7
US Supply	7
Meier Supply Company, Inc.	6
HVAC Distributors, Inc.	5

FIGURE 3.3: TOP PERFORMING PARTNER LOCATIONS NATIONWIDE IN BINS RETURNED 2014-2017

Location	2014 Bins
R. E. Michel Company	461
Johnstone Supply	460
US Air Conditioning Distributors	127
Ferguson Enterprises	119
United Refrigeration	114
Goodman Distribution Inc.	95
Honeywell Inc.	77
Gustave A Larson Company	67
Refrigeration Supplies Distributor	60
Lennox Industries Inc.	60
C.C. Dickson Company	55

Location	2015 Bins
Johnstone Supply	519
R. E. Michel Company	336
Ferguson Enterprises	184
United Refrigeration	176
US Air Conditioning Distributors	106
Goodman Distribution Inc.	70
Gustave A Larson Company	62
Refrigeration Supplies Distributor	54
Lennox Industries Inc	51
Baker Distributing Company	50

Location	2016 Bins
Johnstone Supply	444
R. E. Michel Company	292
United Refrigeration	237
Lennox Industries Inc.	131
Ferguson Enterprises	104
US Air Conditioning Distributors	70
Ace Supply Co. Inc.	66
Goodman Distribution, Inc.	66
Lux Products	54
F.W. Webb	47
Baker Distributing Company	46
Refrigeration Supplies Distributor	46

Location	2017 Bins
Johnstone Supply	515
R. E. Michel Company	285
United Refrigeration	192
Ferguson Enterprises	144
Lennox Parts Plus	89
US Air Conditioning Distributors	73
Refrigeration Supplies Distributor	71
F.W. Webb	64
Goodman Distribution	60
Sid Harvey Industries	52

Figure 3.4 displays total percentage of locations that actively participated in the program (active participation defined as sending back at least one bin) in 2017, for all the states that mandate thermostat returns reporting as well as the U.S. national average for all states (reporting and non-reporting). In 2017**, 41% of the locations in Pennsylvania returned at least one bin** compared to a **national average of 32%.** The highest percentage of locations returning a bin in 2017 amongst states that mandate thermostat returns reporting was Rhode Island (61%).

FIGURE 3.4: MANDATORY REPORTING STATES' PERCENTAGE OF LOCATIONS RETURNING A BIN IN 2017

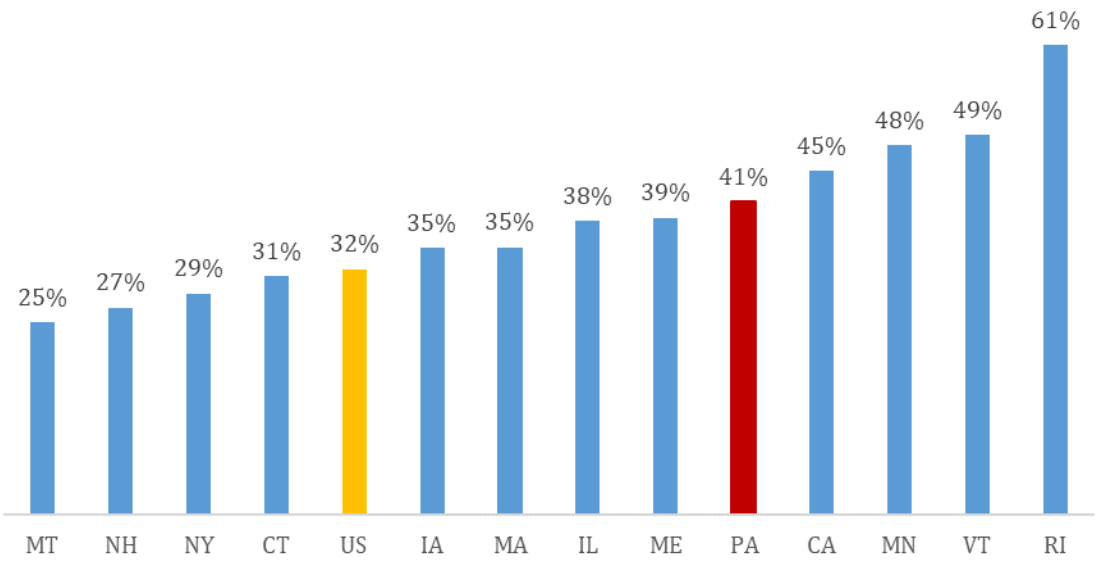


Figure 3.5 compares the state and national rates for several analytics in 2017. These include: the total whole thermostats, bins, and loose switches collected, the number of thermostats collected by total locations and per actively participating locations, the number of thermostats per bin returned on average in 2017, the equivalent average, the number of mercury thermostat equivalents returned in 2017 and finally the percent change in mercury thermostat conversion from 2016 to 2017. The equivalent average is an average of the number of switches in whole thermostats collected in the state, and it is used to calculate the number of thermostats represented by returned loose switches. The thermostat equivalent number includes the totals of whole thermostats returned plus the number of thermostats estimated from loose switches. The states displayed are those that mandate thermostat returns reporting and the U.S. average is for all states that return bins (reporting and non-reporting).

FIGURE 3.5: COMPARISONS OF MANDATORY REPORTING STATES AND U.S. AVERAGES AMONG SEVERAL CATEGORIES

State	Whole Thermostats	Bins	Loose Switches	Thermostats returned per total # of locations with bins	Average Thermostats/ bin	Average Thermostats collected per location that returned at least one bin in 2017	Equivalent Average	Thermostat Equivalents in 2017	% Change over 2016
CA	17,976	637	2,588	19	28	43	1.8111	19,405	20%
CT	4,246	101	1,798	19	42	62	1.2302	5,708	115%
IA	3,152	61	107	25	52	73	1.1680	3,244	44%
IL	10,671	284	1,069	18	38	47	1.1827	11,575	8%
MA	8,444	166	628	25	51	73	1.2154	8,961	61%
ME	3,956	121	30	16	33	41	1.0660	3,984	-18%
MN	8,471	120	586	55	71	114	1.2265	8,949	-7%
MT	173	7	1	6	25	25	1.0603	174	-64%
NH	2,420	63	113	11	38	42	1.1251	2,520	0%
NY	7,703	204	618	15	38	51	1.4685	8,124	12%
PA	10,674	210	576	29	51	71	1.3738	11,093	10%
RI	3,028	55	86	51	55	84	1.1031	3,106	-19%
VT	2,579	130	24	12	20	23	0.9096	2,605	13%
U.S. Avg.	6,423	166	633	23	42	58	1.4461	6,881	14%

Figure 3.6 further compares this state and national data by showing how each state ranked in each of these categories, from highest to lowest. Pennsylvania ranked in the top five for every category except loose switches and percent change in thermostat equivalents over 2016. The states compared are those that mandate thermostat returns reporting and the U.S. average is for all states that return bins (reporting and non-reporting).

FIGURE 3.6: COMPARISON OF MANDATORY REPORTING STATES AND U.S. AVERAGE AMONG SEVERAL CATEGORIES, RANKINGS

	Whole Thermostats	Bins	Loose Switches	Thermostats returned per total # of locations with bins	Average Thermostats per bin	Average Thermostats collected per location that returned at least one bin in 2017	Equivalent Average	Thermostat Equivalents in 2017	% Change over 2016
1	CA	CA	CA	MN	MN	MN	CA	CA	CT
2	PA	IL	CT	RI	RI	RI	NY	IL	MA
3	IL	PA	IL	PA	IA	IA	US Avg.	PA	IA
4	MN	NY	US Avg.	IA	MA	MA	PA	MA	CA
5	MA	US Avg.	MA	MA	PA	PA	CT	MN	US Avg.
6	NY	MA	NY	US Avg.	CT	CT	MN	NY	VT
7	US Avg.	VT	MN	CT	US Avg.	US Avg.	MA	US Avg.	NY
8	CT	ME	PA	CA	NH	NY	IL	CT	PA
9	ME	MN	NH	IL	NY	IL	IA	ME	IL
10	IA	CT	IA	ME	IL	CA	NH	IA	NH
11	RI	NH	RI	NY	ME	NH	RI	RI	MN
12	VT	IA	ME	VT	CA	ME	ME	VT	ME
13	NH	RI	VT	NH	MT	MT	MT	NH	RI
14	MT	MT	MT	MT	VT	VT	VT	MT	MT

2017 COLLECTIONS BY BRAND

In Pennsylvania, Thermostat Recycling Corporation (TRC) recovered the equivalent of 11,093 mercury thermostats from 10,674 whole mercury thermostats plus 576 mercury switches removed from thermostats. A total of 94.4 pounds of mercury was diverted from solid waste. *Please note the explanation of the converted thermostats or thermostat equivalents below.[3] An example of the mercury ampoule is shown in [Figure 4.0].

Figure 4.0

As required by the state statute, a table of thermostat brand holder with the corresponding thermostats, count of switches and pounds of mercury recycled is below. It is important to note that there still remain non-members whose thermostats the TRC collection program recycles. They are listed in the table as "Non-Member Brands".

[3] A mercury thermostat contains a variable amount of mercury ampoules or "switches" attached to the subbase of the thermostat. These glass ampoules often times are collected in the recycling container without the intact thermostat attached to them. TRC collects and counts these loose ampoules and recycles them. To derive the converted thermostat or thermostat equivalent, the program takes the following calculations to develop the converted thermostat or thermostat equivalent. First, TRC will count the total whole (intact) thermostats collected in the recycling bins. From these units, there is an intact ampoules count. TRC then takes the intact ampoules divided by the whole (intact) thermostats or otherwise known as the conversion ratio. After the conversion ratio is calculated, TRC will multiple the loose mercury switches by the conversion ratio. Lastly, we add this result to the whole (intact) thermostats to produce the converted thermostats or thermostat equivalents.

Brand Holder	Thermostats	Count Switches	Pounds Mercury
Bard Manufacturing Corporation	5	7	0.0434
Burnham Holdings, Inc.	11	11	0.0682
Carrier Corporation	196	200	1.841
Chromalox	0	0	0
Climate Master, Inc.	0	0	0
Crane Company	1	1	0.0062
Daikin Applied	10	40	0.248
ecobee	0	0	0
Emerson Electric Corporation/White Rodgers	868	1041	6.4542
Empire Comfort Systems	1	1	0.0062
General Electric Corporation	42	117	0.7254
Goodman Global	74	149	0.9238
Honeywell Corporation	8340	10772	66.7864
Hunter Fan Company	0	0	0
ITT Corporation	5	5	0.031
Lear Siegler (Original Charter Corporation)	1	4	0.0248
Lennox International, Inc.	255	420	2.604
Lux Products Corporation	28	30	0.186
Marley-Wylain Company	5	5	0.031
Nest	0	0	0
Nortek Global HVAC	32	41	23.1116
Rheem Manufacturing Company	79	143	0.8866
Schneider Electric Systems USA	26	28	0.1736
Sears Holdings	40	47	0.2914
Taco Comfort Solutions	0	0	0
TPI Corporation	5	18	0.1116
Trane Residential Systems	428	970	6.014
Uponor, Inc.	0	0	0
Vaillant Corporation	0	0	0
W.W. Grainger, Inc.	18	34	0.2108
York/Johnson Controls	157	252	1.5624
–Non-Member Brands–––––––			
ADDISON	1	4	0.0248
AMERICAN STABILIS	3	3	0.0186
ASYSTAT	1	2	0.0124
ces	11	24	0.1488
chevron	1	1	0.0062
Climatrol	1	1	0.0062
EARTH SYSTEMS	1	2	0.0124
EFM	16	16	0.0992
E-F-M	1	1	0.0062
EVCON	1	2	0.0124
FLORIDA HEAT AND PUMP	1	4	0.0248
Florida Heat Pump	3	10	0.062
Mini Vector	1	2	0.0124
PSG Controls	1	1	0.0062
REPCO	1	1	0.0062
TETCO	2	4	0.0248
––NOM (Manufacturer not identifiable) ––––			
Loose Switches	0	576	3.5712
NOM	1	2	0.0124
TOTAL	**10,674**	**14,992**	**94.40**

2017 ACCOUNTING OF THE PROGRAM EXPENSES

Below is a summary of program expenses for the Pennsylvania collection program in 2017. 2017 program expenses are unaudited and are for management purposes only. Prior to submittal of this annual report, the expenses were reviewed by Halt, Buzas & Powell, LTD.

Program Component	2016	2017	Difference ($'s)
Direct Expense for Marketing & Outreach	4,295	1,928	(2,367)
Incentive/Promotional Payments	249	-	(249)
Legal	-	-	0
New Collection Containers	-	-	0
Recycling Costs	15,634	34,916	19,282
Travel	2,273	1,265	(1,008)
TRC Staff and Administration	10,149	6,778	(3,371)
Total (expenses)	**32,600**	**44,887**	**12,287**

TRC Staff and Administration: Any costs for a specific state will take the hours worked at the TRC employee level multiplied by each individual's hourly rate.

2017 PENNSYLVANIA ANNUAL REPORT

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All state specific annual reports are posted on our website at the following weblink:
https://www.thermostat-recycle.org/resources/media_center

APPENDICES

HOW MERCURY THERMOSTAT WASTE IS HANDLED

WASTE MERCURY-ADDED THERMOSTAT MANAGEMENT THROUGH VEOLIA ES TECHNICAL SOLUTIONS, LLC.

Beginning December 19, 2016, bins with waste mercury-switch thermostats were received at a new fulfillment/inventory center in Port Washington, Wisconsin (WIR000130591). The facility is owned and operated by Veolia ES Technical Solutions, L.L.C. (Veolia) under contract with TRC.

All recycling containers, including pails and bins are received at the loading dock and sent to the TRC inventory area. The bin and plastic liner are opened and the contents are identified, sorted, and tallied. The following data is recorded for each bin returned and processed: bin number, business name (location name), city, state, zip code, date returned, number of thermostats and mercury switches by manufacturer and any non-conforming material.

The containers are returned to the location that sent it in with a new prepaid address label within 72 hours of receipt. The thermostats are stored and staged in a plastic lined carton in a storage area for final processing. The containers are dated and processed in order received, first in-first out.

The thermostats and any loose bulb collected from the bins are consolidated into a special 55-gallon drum which is labeled and dated according to regulations. The drum is sealed with a band and is only opened when contents are being added to it. Special negative pressure venting assures any fumes are captured and vented when the drum is opened.

The 55-gallon drum is then shipped to Veolia's mercury recovery facility (WID988566543) for final processing of the mercury ampoules (switches) Veolia Environmental Services meets or exceeds all local, state, federal and EPA regulations for the management of the product.

The containers are returned from the storage area to the mercury recovery processing area to have the mercury bulbs removed from the plastic housing. Universal Waste Regulations require the recycling and disposal of waste within 12 months of acceptance at the processing facility.

Small quantities of thermostats are removed from the container, which is then closed again, a spillage. The bulbs are removed from the thermostats and placed into processing vessel at the work station. Once the processing vessel is full, the vessel is loaded into the mercury recovery retort oven.

If a bulb breaks and the mercury spills, the work area is designed to contain the spillage and the operators are trained in the clean-up and disposal of mercury. The TRC inventory and processing areas are equipped with special mercury vacuum cleaners and the work area is vacuumed at the end of the work day to assure that any spillage is cleaned up and not left to evaporate.

Veolia meets or exceeds all local, state, federal and EPA regulations for the management of the product. The mercury recovery facility and process are permitted by the Wisconsin Department of Natural Resources. Veolia's approvals for mercury recovery/recycling include:

- EPA - identification WID988566543
- Hazardous Waste Storage License #6008
- Hazardous Waste Treatment License (Mercury Recovery Operations) #4585
- Air Operation Permit #246076050-S01
- Storm Water General Permit #WI-S067857-4

In addition to the regulatory permits, both Veolia Port Washington facilities have developed and maintains management systems in accordance with ISO 14001-2004, OHSAS 18001-2007, and Responsible Recycling (R2:2013) Practice. All persons who handle mercury thermostats as part of the TRC operation receive training in the handling of Hazardous Waste and Universal Waste.

The mercury containing ampules are retorted at Veolia's Port Washington Mineral Springs facility. The mercury is removed during the retort process. The post retort debris consists of broken glass ampules. The debris is tested for residual mercury to document the removal of the mercury to levels below the US EPA Land Disposal Restriction (LDR) levels. The debris is then disposal of as a non-hazardous solid waste at Advanced Disposal Glacier Ridge Landfill, LLC in Horicon, Wisconsin.

A site evaluation of the Veolia Processing Center in Port Washington, WI was conducted by TRC staffer, Danielle Myers, in early October 2017. From this audit, a new design flow for processing bins was discovered, as well as more efficient ways to return bins back to participating facilities and contractors. Updates to packaging instructions were also a result, and will include new marketing collateral, incentives, and small pails.