

Turning Up The Heat

**Exposing the manufacturers' lackluster
mercury thermostat collection program**



February 2010

Acknowledgements

Mercury Products Campaign Partners

Clean Water Action

Clean Water Fund

Clean Wisconsin

Environmental Law & Policy Center

Illinois Environmental Council

Mercury Policy Project

NYPIRG

Oregon Center for Environmental Health

VPIRG

We would like to thank the Garfield Foundation and New York Community Trust for their support that helped to make this report possible.

The contents of this report are the sole responsibility of the campaign partners.

This report is available on the Web at www.mercurypolicy.org.

Executive Summary

Throughout the United States, mercury poses a severe health and environmental threat. The federal Centers for Disease Control and Prevention estimates that between 300,000 and 630,000 infants are born in the United States each year with mercury levels that are associated with the loss of IQ.

Mercury containing thermostats are a significant source of preventable mercury pollution. The U.S. Environmental Protection Agency (EPA) estimated that 2-3 million thermostats come out of service each year. Each thermostat contains about four grams of mercury.

While intact mercury-containing thermostats do not pose a public health risk, when they are disposed of in landfills or incinerators, the mercury can be released into the environment where it makes its way into lakes, rivers, and streams and contaminates fish.

Over the last fifteen years, the use of mercury in U.S. thermostat manufacturing has been reduced from 15-21 tons annually to less than one ton per year. This striking reduction can be attributed to state legislation banning the sales of new mercury thermostats, and the subsequent ending of mercury thermostat production by the “Big 3 manufacturers,” Honeywell, White-Rodgers, and General Electric.

However, ending the production and sale of new mercury thermostats addresses only part of the problem. **Tens of millions of mercury thermostats containing several hundred tons of mercury are still in use in U.S. homes and businesses.** Given that mercury-containing thermostats can last 15 to 30 years or more, this vast reservoir of mercury currently on the walls in homes and businesses will be making its way into landfills and incinerators for decades to come unless effective collection programs are created.

In 1998, the Big 3 manufacturers developed a voluntary recycling program, administered by a non-profit entity they created called the Thermostat Recycling Corporation (TRC). TRC provides participating

wholesalers with collection bins where HVAC contractors drop off old mercury thermostats. When the bins are full, they are shipped to TRC for recycling.

Unfortunately, TRC collection data indicates that their voluntary program has failed to collect the vast majority of mercury thermostats coming out of service. From 1999 to 2008, TRC collected 3.65 tons of mercury. During that same period, the EPA conservatively estimated 70-100 tons of mercury in thermostats came out of service. **Over the past decade, TRC has collected less than 5% of what EPA estimated came out of service.**

In many states, the TRC program barely functions, capturing only a tiny fraction of discarded mercury thermostats. It’s clear that the TRC program is capturing only the tip of the iceberg, and certainly not meeting its own program objective of “recycling every end of use mercury-containing thermostat.”¹

However, the TRC program results are much better when financial incentives are included. In 2006, Maine enacted the nation’s first comprehensive mercury thermostat collection law and has the highest per capita mercury thermostat collection rate in the country. Among other requirements, the law obliges thermostat manufacturers to collect mercury thermostats and provide a \$5 financial incentive to encourage professionals and homeowners to recycle thermostats. A project in Vermont and a nationwide review of collection programs also found a financial incentive to be a critical factor for motivating program participation.

Adopting strong state laws with financial incentives and performance standards for recycling mercury thermostats is the most important change needed to drastically improve the TRC program and prevent mercury pollution. This report reviews the threat posed by mercury thermostats and makes recommendations for state programs. The full set of recommended changes is detailed at the end of the report.

Introduction

Mercury's Health and Environmental Threats

Even in small quantities, mercury can cause significant health and environmental problems. Mercury released into the atmosphere can be transported long distances and deposited in aquatic ecosystems, where it converts to methyl mercury, the most toxic form of mercury.

Mercury is a danger to the development of the human fetus and young children. The federal Centers for Disease Control and Prevention estimate that between 300,000 and 630,000 infants are born in the United States each year with mercury levels that are associated, at later ages, with the loss of IQ.²

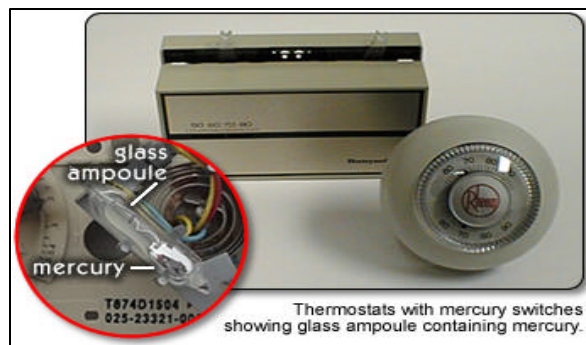
New evidence indicates that methyl mercury exposure may increase the risk of cardiovascular disease in humans, especially adult men.³

Methyl mercury bioaccumulates and biomagnifies in the food chain, so for most people, the main source of exposure is fish consumption. If mercury accumulation reaches levels that pose risks to human health, states issue fish consumption advisories to provide information to their residents on the amount and types of fish that are safe to eat.⁴ In 2008, 80% of all fish advisories in the United States were due to the presence of mercury, covering all 50 states, one U.S. territory, and three tribes. **Twenty-seven states have statewide advisories for all their fresh water lakes and rivers, and 13 states have statewide advisories for all their coastal waters.**⁵

Similarly, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) advise women who may become pregnant, pregnant women, nursing mothers, and young children to avoid some types of fish and to eat fish and shellfish that are lower in mercury.⁶

Mercury Use in Thermostats

Mercury thermostats use mercury switches to control room temperature through communication with heating, ventilating, and air conditioning (HVAC) equipment. Older thermostats often contain mercury. The photo shows some common mercury thermostats and the glass ampoule under the cover, which contains the mercury.



Mercury thermostats have bi-metal coils that contract and expand with room temperature. When the coil contracts or expands, it activates the mercury switch, which opens or closes a circuit to make the furnace, heat pump, or air conditioner turn on or off.⁷

The amount of mercury in each thermostat largely depends upon the number of switches it contains, which will depend on how many heating and cooling systems it activates. According to TRC, mercury thermostats contain an average of 1.4 mercury switches, with a minimum of 2.8 grams of elemental mercury per switch. **Therefore, the total amount of mercury used in each mercury thermostat averages to about four grams.**⁸

The mercury in a thermostat will pollute the air, land or water if not managed properly at the end of its useful life. **As TRC correctly observes on its website, “a mercury-switch thermostat poses a risk to the environment... when improperly disposed in solid waste” because the mercury will be released if the thermostat is broken, crushed, or burned during waste handling or at a landfill or incinerator.**⁹ Since mercury is volatile at room temperature, even mercury releases during crushing or breakage typically becomes part of the mercury pollution problem.

Alternatives to Mercury Thermostats

Excellent alternatives to mercury thermostats are available, many of which have the added benefit of being energy efficient. The best alternatives are programmable, digital thermostats, which can be set to change the temperature at specific times of the day.

EPA's Energy Star program notes that a properly programmed digital thermostat can save a family \$180 a year in energy costs.¹⁰ Several electric utilities around the country offer rebates of \$25-\$100 to encourage the purchase of programmable thermostats in order to reduce energy use.¹¹

Although programming the thermostat is no more difficult than adjusting a digital watch, many new thermostats are "smart" – meaning they come pre-programmed with energy efficient settings. This way, even those not adept at working digital gadgets can immediately start accruing cost savings and environmental benefits from their non-mercury thermostat.

The Phase-Out of Mercury Thermostats

For decades, mercury-added thermostats occupied a dominant share of the U.S. market place, particularly after Honeywell's introduction of the popular T-87 round model in 1953. Even after electronic non-mercury thermostats were introduced several decades ago, millions of mercury-added thermostats were still manufactured.

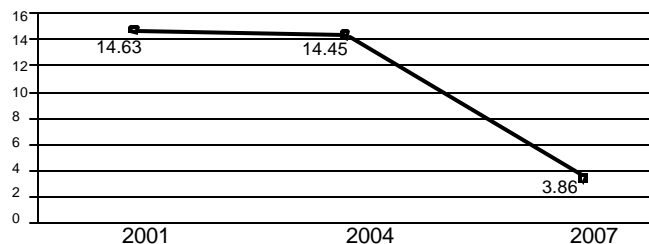
EPA estimated 15-21 tons of mercury was used to manufacture thermostats in 1997.¹² In 2001, thermostat manufacturers used 14.63 tons of mercury to manufacture thermostats, according to the reports they filed with the Interstate Mercury Education and Reduction Clearinghouse (IMERC).¹³ Virtually all of this mercury was reportedly used by the Big 3, as indicated by the IMERC report they filed collectively.¹⁴

Even in 2004, 14.45 tons of mercury were reportedly used to manufacture thermostats, again mostly by the Big 3. **However, by 2007 mercury use dropped by 73%.** (See Exhibit 1.)

This dramatic drop in mercury use from 2001-2007 can be attributed in large part to the passage of legislation in 15 states prohibiting the sale of new mercury

Exhibit 1

Annual Mercury Use in Thermostat Manufacturing 2001-2007 (Tons)



Mercury use in thermostats dropped 73% from 2001-7 in large part due to state laws banning the sale of mercury-containing thermostats.¹⁵

thermostats. In the face of shrinking market availability for their mercury products, Honeywell announced in 2006 that it would end its production of mercury thermostat switches, and the other companies in the Big 3 have reportedly followed suit. Based on these announcements, post-2007 mercury use can be expected to decline to under one ton.¹⁶

This 73% reduction in thermostat mercury use mirrors a smaller but still substantial drop of 46% in overall mercury use in U.S. product manufacturing. IMERC reports decreases by various product categories, largely due to state product restrictions. (See Exhibit 2.)

Exhibit 2

2001-2007 Mercury Consumption U.S. Mercury Product Manufacturing

Products & Components	Total Mercury Sold in U.S. (Tons)		
	2001	2004	2007
Switches & Relays	57.81	51.78	30.77
Dental Amalgam	30.77	30.39	16.48
Thermostats	14.63	14.16	3.86
Lamps	10.16	9.56	10.63
Miscellaneous	5.11	2.40	2.78
Batteries	2.95	2.53	2.07
Chemicals & Solutions	1.03	0.91	1.43
Sphygmomanometers	2.15	1.11	0.83
Thermometers	1.70	1.40	0.30
Manometers	0.97	1.27	0
Barometer	0.18	0.12	0
Total	~129.4 tons	~115.2 tons	~69.2 tons

Mercury use in U.S. product manufacturing dropped by 46% from 2001 to 2007.¹⁷

The Failing Industry Thermostat Collection Program

Tons of Mercury in Thermostats Awaiting Collection

While very few new mercury thermostats will be manufactured in the United States,¹⁸ there are many millions of mercury thermostats still in use from historic sales. **Conservative estimates show these thermostats contain 230 tons or more of mercury.** Thermostats can effectively operate for 30 years or more, and in fact are more routinely replaced as a result of building renovations or heating/cooling system upgrades than product failure.

In 1994, EPA estimated 70 million mercury thermostats were installed in domestic residences, and based on three grams of mercury per thermostat, calculated that 230 tons of mercury were on the wall in American homes.¹⁹ The 230 tons may have been an underestimate of the mercury reservoir attributable to thermostats insofar as only thermostats in homes (and not commercial or other buildings) were considered, and the average mercury thermostat contains about four grams of mercury.²⁰

Of course, not all these thermostats will come out of service at the same time. **EPA estimated that 2-3 million mercury thermostats come out of service each year, amounting to 7-10 tons of mercury,** again assuming only three grams of mercury per thermostat.²¹ This EPA value must also be considered a very conservative estimate, since that same year, in consultation with Honeywell as part of the economic support for the universal waste rulemaking, EPA estimated about 4.5 million mercury thermostats were removed from service annually, 3.4 million from households and the remainder from businesses.²²

Similarly, TRC (through its consultant) recently provided the State of California its estimate of how many mercury thermostats are available for recycling annu-

ally in that state. Estimating only 22%-46% of thermostats from businesses and 27%-47% of thermostats from households in California contain mercury, TRC calculated between 237,000 - 490,000 mercury thermostats will be discarded this coming year state-wide.²³ Significantly, the midpoint of this TRC estimate (363,500) is larger than the uppermost range of EPA's very conservative 1994 estimate, based upon California's per capita portion of this estimate.²⁴

The Thermostat Recycling Corporation

In 1998, the Big 3 established a non-profit entity called the Thermostat Recycling Corporation (TRC), and began a voluntary industry take back program to collect mercury thermostats in nine states. The TRC program expanded to an additional 13 states in 2000, and became a national program (excluding Alaska and Hawaii) in 2001.²⁵

Under the base TRC program, thermostat wholesalers voluntarily enroll to receive a TRC-supplied container for thermostat collection. HVAC contractors are then encouraged to drop off mercury thermostats at participating wholesaler locations when they purchase new thermostats or other supplies.

When the collection container is full, the wholesaler ships it, at TRC expense, to a Honeywell facility in Minnesota, where the thermostat is dismantled and the mercury switch is sent to a commercial mercury recovery facility. A new collection box is sent to the wholesaler after receipt of the shipped container, free of charge, so the out-of-pocket cost for the participating wholesaler is limited to a one-time charge (now \$25.00) for the initial collection box.²⁶

TRC Program Collection Data

Unfortunately, TRC collection data indicate the base program has failed to collect the vast majority of mercury thermostats coming out of service. Exhibit 3 provides the national program collection data through 2008, the last year for which data are publicly available.

Over this ten year period, TRC collected 7,300 pounds, or 3.65 tons of mercury. **Compared to the conservative EPA estimate of 70-100 tons of mercury in thermostats coming out of service, the TRC program captured 3.7-5%.**

Even looking at just 2008, the program's most successful year, TRC collected 6.4-9.2% of the EPA mercury estimate.

Another way to evaluate TRC program effectiveness is to examine the state-by-state program performance data. Exhibit 4 provides the 2008 state collection data, sorted by per capita rates. In almost half of the states where TRC collected thermostats in 2008 (21 of 45), TRC collected less than 1,000 thermostats. TRC collected more than 5,000 thermostats in only nine states.

Exhibit 3
TRC National Annual Collection Summary

Year	Thermostats Collected	Mercury lbs. Collected
1999	27,780	237
2000	31,611	256
2001	48,215	402
2002	90,501	762
2003	64,957	626
2004	80,094	729
2005	87,899	820
2006	113,658	1,083
2007	114,158	1,103
2008	135,604	1,282

Over the past decade, TRC has collected 7,300 lbs. of mercury – less than 5% of what EPA conservatively estimated came out of service.

Using TRC's own estimate of the number of mercury thermostats discarded in California, TRC collected only 1-3% of the available thermostats in that state.

Other evaluations of the TRC program come to a similar conclusion. For example, the Northeast Waste Management Officials' Association (NEWMOA) recently estimated TRC collected approximately 3% of the mercury thermostats coming out of service in Massachusetts during 2006. Capture rates for other northeast states ranged from 1.3% in New York to 12.7% in Maine.²⁷

TRC as Spin Doctors

Rather than working to address these meager collection rates, TRC is working to spin the results of their program. In its 2008 Annual Report, TRC is "ecstatic" about the 19% overall increase in thermostats collected versus 2007, and the "double digit" increases in 27 states.²⁸

However, a closer look at TRC's data indicates this method of measuring program performance by annual improvement mostly identifies state collection rates moving from paltry to pathetic.

Exhibit 5 reproduces Table 1 of TRC's 2008 Annual Report providing the state-by-state 2007 and 2008 comparisons. The chart demonstrates, almost invariably, the states with the highest growth rates collected fewer than 1,000 thermostats in 2007, thus even with triple digit increases in collection rates, thermostat collection in these states remains extremely poor.

Accordingly, many of the states with the highest growth rates (i.e., Georgia, Texas) still rank among the lowest in per capita collection rates (compare Exhibits 4 and 5). For example, Georgia is ranked first with a 1050% improvement, but still barely collected 500 thermostats statewide and ranks near the bottom in per capita collection rates.

The objective of thermostat collection is to ensure the mercury in thermostats is not released into the environment at their end of life. Measuring program performance based on its ability to capture mercury thermostats coming out of service is the best indicator of achieving this objective.

In contrast, measuring effectiveness through annual program improvements masks the amount of mercury

Exhibit 4
TRC 2008 Per Capita
State Collection Data

State	Thermostats Collected	Population 2008	Thermostats collected per 10,000 residents
Maine	5,555	1,316,456	42.2
Minnesota	12,724	5,220,393	24.4
Vermont	1,367	621,270	22.0
Maryland	10,207	5,633,597	18.1
Wisconsin	8,663	5,627,967	15.4
Virginia	8,191	7,769,089	10.5
Oregon	3,072	3,790,060	8.1
Delaware	681	873,092	7.8
North Dakota	483	641,481	7.5
Ohio	8,571	11,485,910	7.5
Michigan	7,436	10,003,422	7.4
Indiana	4,614	6,376,792	7.2
Florida	12,410	18,328,340	6.8
Pennsylvania	7,560	12,448,279	6.1
Nebraska	998	1,783,432	5.6
Connecticut	1,838	3,501,252	5.2
Iowa	1,536	3,002,555	5.1
Washington	3,336	6,549,224	5.1
Kansas	1,317	2,802,134	4.7
Montana	435	967,440	4.5
Massachusetts	2,770	6,497,967	4.3
New Hampshire	546	1,315,809	4.1
Idaho	565	1,523,816	3.7
North Carolina	3,407	9,222,414	3.7
Kentucky	1,571	4,269,245	3.7
Rhode Island	370	1,050,788	3.5
Illinois	4,336	12,901,563	3.4
New Jersey	2,756	8,682,661	3.2
West Virginia	455	1,814,468	2.5
South Dakota	173	804,194	2.2
New York	3,774	19,490,297	1.9
California	7,007	36,756,666	1.9
Missouri	895	5,911,605	1.5
Tennessee	880	6,214,888	1.4
Arizona	763	6,500,180	1.2
Nevada	254	2,600,167	1.0
Colorado	482	4,939,456	1.0
South Carolina	376	4,479,800	0.8
Texas	1,820	24,326,974	0.7
Arkansas	212	2,855,390	0.7
Oklahoma	248	3,642,361	0.7
Georgia	506	9,685,744	0.5
Mississippi	142	2,938,618	0.5
Louisiana	183	4,410,796	0.4
Alabama	119	4,661,900	0.3
Alaska		686,293	0.0
D.C.		591,833	0.0
Hawaii		1,288,198	0.0
New Mexico		1,984,356	0.0
Utah		2,736,424	0.0
Wyoming		532,668	0.0
Totals	135,604	304,059,724	4.5

Exhibit 5
TRC 2007 to 2008 State Comparisons
of Number of Thermostats Collected

State	2007	2008	Growth
Georgia	44	506	1050.00%
Texas	344	1820	429.07%
Rhode Island	81	370	356.79%
Nevada	58	254	337.93%
North Dakota	112	483	331.25%
Idaho	166	565	240.36%
West Virginia	153	455	197.39%
Delaware	229	681	197.38%
Montana	174	435	150.00%
Michigan	3135	7436	137.19%
Kentucky	674	1571	133.09%
Connecticut	839	1838	119.07%
Nebraska	562	998	77.58%
Arkansas	122	212	73.77%
Kansas	836	1317	57.54%
New York	2396	3774	57.51%
Virginia	5817	8191	40.81%
Massachusetts	2024	2770	36.86%
South Carolina	280	376	34.29%
Ohio	6544	8571	30.97%
Pennsylvania	6175	7560	22.43%
California	5750	7007	21.86%
Maine	4656	5555	19.31%
New Jersey	2329	2756	18.33%
Minnesota	10795	12724	17.87%
Maryland	8765	10207	16.45%
North Carolina	2994	3407	13.79%
Oregon	2796	3072	9.87%
Florida	12261	12410	1.22%
Illinois	4367	4336	-0.71%
Colorado	490	482	-1.63%
Washington	3398	3336	-1.82%
Arizona	838	763	-8.95%
New Hampshire	615	546	-11.22%
Iowa	1735	1536	-11.47%
Indiana	5490	4614	-15.96%
Vermont	1665	1367	-17.90%
Wisconsin	11542	8663	-24.94%
Missouri	1332	895	-32.81%
Louisiana	391	183	-53.20%
South Dakota	564	173	-69.33%
Alabama	540	119	-77.96%

TRC's measure of program effectiveness, the percentage improvement over the previous year, ignores the fact that most mercury thermostats are still not collected and often highlights the states with the worst performing programs.

cluding the collection program and potentially released to the environment due to improper waste management.

It is essential to include performance goals in state programs because absent such goals, program success is undefined. This vacuum allows TRC to tout the collection of less than 1,000 thermostats in almost half their states as “successful,” simply because the total number of thermostats collected grows a little bit each year.

Getting By On A Shoestring

TRC’s poor program performance reflects the relatively meager resources manufacturers devote to the program.

For 2008, TRC spent about \$275,000 to support its program nationwide, according to information TRC

provided to the Maine Department of Environmental Protection.²⁹ Of this total, \$160,405 reflects the cost associated with transporting, processing and recycling the thermostats.³⁰ An additional \$77,542 supported the TRC Executive Director and overhead. Of the remaining amount, TRC devoted \$21,024 to education and outreach in Maine, and virtually nothing on education and outreach anywhere else (besides general website maintenance).

With only one dedicated staff person for the entire country, and no significant budget for education and outreach (except where a new law forced the issue), the TRC program results are not surprising. Perhaps what is surprising is that TRC has been able to squeeze by with so little financial investment for so long. Again, without meaningful performance standards, the easy and cheaper road will remain available to TRC.

State Action to Promote Thermostat Collection Programs

In response to the lackluster TRC program, states and local governments have undertaken initiatives to improve thermostat collection rates. Two of the most important initiatives, from Maine and Vermont, are highlighted here.³¹

Maine’s Leading Program

In 2006, Maine enacted the first comprehensive mercury thermostat collection law in the nation.³² The legislation includes the following components:

- Mercury thermostat manufacturers who sold thermostats in Maine are required to establish a collection program serving both HVAC professionals and homeowners.
- The sale of *any* thermostat in Maine by manufacturers not complying with the collection requirement is prohibited.

- Manufacturers are required to provide a financial incentive with a minimum value of \$5 to both professionals and homeowners for returning a mercury thermostat to their collection locations.
- Manufacturers are required to provide collection services to wholesalers and household hazardous waste (HHW) facilities.
- Wholesalers which sell thermostats must participate in the manufacturer collection programs.
- Aggressive performance goals were established for the manufacturer collection programs based on the amount of mercury collected from thermostats coming out of service.

As a result of implementing this legislation, Maine has achieved the highest per capita mercury thermostat collection rate in the country by far, almost twice as high as the second best state, and almost 10 times the national average (see Exhibit 4).

The Vermont Pilot

In 2007, the Vermont Agency of Natural Resources (VT ANR) launched a thermostat collection pilot project in collaboration with 86 retail hardware stores. For two months, homeowners were provided an in-store credit of \$5 usable for any item in the store if they returned their used mercury thermostats for recycling.

During these two months, almost 1,200 mercury thermostats were collected, more thermostats than TRC had collected in Vermont in five years (from 2002-2006).³³ As the VT ANR indicated in its report on the pilot to the Vermont Legislature:

...a financial incentive coupled with adequate program advertising and convenient recycling can yield substantial increases in mercury thermostat recycling. Through contact with homeowners who participated in Vermont's pilot program, there seemed to be a variety and often a combination of factors that motivated individuals to participate, including the cash incentive, convenient recycling, and environmental concerns....

Was the cash incentive a significant motivating factor in the collection program? It was significant enough that of all the thermostats collected, only about 40 of the thermostats did not have a cash incentive payout (and some of this was due to a limit of 3 thermostat rebates per customer when a customer turned in more than three thermostats).

The [ANR] has seen disappointing results in thermostat collection at wholesaler locations when only outreach and convenient recycling have been provided as motivators....we believe that a similar financial incentive offered for mercury thermostats returned primarily by contractors to wholesale locations would yield significant increases in thermostat collection.³⁴

This successful pilot led to the adoption of a Vermont thermostat collection law in 2008 that includes, among other provisions, a requirement that thermostat manufacturers provide a minimum \$5.00 financial incentive for each mercury thermostat that is turned in for recycling by either professionals or homeowners.³⁵

These practices are in line with the results of a report the state of Massachusetts contracted from NEWMOA to identify mechanisms that could be used to enhance the recycling of thermostats. The report reviewed thermostat collection and recycling programs from several states and by TRC in order to determine best practices. The report recommends four characteristics of successful programs, namely: 1) a mandated financial incentive for contractors and homeowners that collect and recycle thermostats, 2) an effective education program about disposal ban requirements, 3) accessible and convenient collection sites, and 4) outreach about the environmental and health benefits of thermostat recycling.³⁶

Policy Recommendations

Based on the experiences of states with collection programs, and reinforced by the NEWMOA report, there are several key steps that state governments should take immediately to prevent mercury thermostats from entering the waste stream, and ultimately, contaminating the environment.

1.) States should ban the sale of mercury thermostats. While the Big 3 U.S. manufacturers report that they have ended mercury thermostat production, other smaller domestic or overseas manufacturers may continue to sell mercury thermostats where permitted by law. Fifteen states have already prohibited the sale of mercury-containing thermostats. With viable non-mercury thermostats now dominating the market, all states should ban the sale of mercury-containing thermostats.

2.) States should ban the disposal of all mercury-containing thermostats into the solid waste stream. To both encourage active participation in collection programs and to prevent mercury pollution in the environment, states should require that all mercury thermostats be recycled.

3) States should require manufacturers to finance thermostat collection systems and provide a financial incentive to encourage participation in the program. The collection and recycling of mercury thermostats should be made a legal obligation for manufacturers who sold mercury thermostats. The TRC program could meet this obligation, if it provides convenient collection options for both contractors and homeowners, enhanced education and outreach, and a financial incentive to encourage contractor and homeowner participation. The financial incentive has been demonstrated to significantly improve collection rates.

4) States should require that manufacturer take-back programs be held accountable to meaningful and quantifiable performance standards. Because the goal is to reduce mercury pollution, the TRC program must be held to meaningful performance standards based on the percentage of annually discarded mercury thermostats collected. Program performance should be evaluated periodically against the standards to determine if program enhancements are required.

5) States should require wholesalers to provide bins and consumer education as part of a collection program. Wholesalers selling thermostats to contractors must participate in the manufacturer collection program to ensure convenient collection locations are available to contractors. Wholesalers must inform their contractor customers of the presence of the bins in their stores, and the legal and environmental necessity of returning mercury thermostats for recycling.

6) States should require HVAC contractors to participate in the collection program as part of their licensing arrangement with the state. Contractors replacing mercury thermostats for homeowners should assume responsibility for complying with this collection requirement. Recycling mercury thermostats should become a condition of contractor professional licensing, where such licensing requirements exist.

7) All government agencies and low-income housing facilities should establish procurement preferences for energy efficient programmable thermostats. Even among non-mercury thermostats, there are often significant differences in efficiency. Purchases involving taxpayer dollars should be encouraging the production and use of the more energy efficient models.

End Notes

1. Thermostat Recycling Corporation (TRC) Website <http://www.thermostat-recycle.org/FAQ>, as viewed on January 14, 2010.
2. CDC's National Health and Nutrition Examination Survey (NHANES) <http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5343a5.htm>
3. Choi, AL, P Weihe, E Budtz-Jørgensen, PJ Jørgensen, JT Salonen, T-P Tuomainen, K Murata, HP Nielsen, MS Petersen, J Askham and P Grandjean. 2008. Methylmercury exposure and adverse cardiovascular effects in Faroese whaling-men. *Environmental Health Perspectives* <http://ehp.niehs.nih.gov/docs/2008/11608/abstract.html>
4. Northeast States Succeed in Reducing Mercury in the Environment <http://www.newmoa.org/prevention/mercury/MercurySuccessStorySummary.pdf>
5. U.S. Environmental Protection Agency (EPA) National Listing of Fish Advisories General Fact Sheet: 2008 National Listing <http://www.epa.gov/waterscience/fish/advisories/fs2008.html>
6. EPA and FDA Advice. What You Need to Know about Mercury in Fish and Shellfish 2004 <http://www.epa.gov/waterscience/fish/advice/index.html>
7. Interstate Mercury Education and Reduction Clearinghouse (IMERC) Fact Sheet Mercury Use in Thermostats Last Update: July 2008 <http://www.newmoa.org/prevention/mercury/imerc/factsheets/thermostats.pdf>
8. See discussion below and IMERC Fact Sheet: Mercury Use in Thermostats <http://www.newmoa.org/prevention/mercury/imerc/factsheets/thermostats.pdf>
9. TRC Mercury Thermostat Facts <http://www.thermostat-recycle.org/mercuryfacts>
10. Energy Star Programmable Thermostats http://www.energystar.gov/index.cfm?c=thermostats.pr_thermostats
11. Million Car Carbon Campaign <http://www.millioncarmacampaign.com/thermostatrebates.php>
12. Use and Release of Mercury in the United States, EPA/600/R-02/104, December 2002 (hereafter "EPA Report"), available at <http://www.epa.gov/nrmrl/pubs/600r02104/600r02104prel.pdf>, Exhibit 3 -8.
13. IMERC was created in 2001 to facilitate implementation of state mercury product legislation, including the collection and analysis of data submitted by product manufacturers pursuant to notification requirements in the legislation. Fourteen states are now members of IMERC. For more information on IMERC, see <http://www.newmoa.org/prevention/mercury/imerc/about.cfm>.
14. See IMERC notification report at <http://www.newmoa.org/prevention/mercury/imerc/Notification/totals.cfm?total=417&filing=1162>.
15. Presentation of Adam Wienert, IMERC Coordinator, November 2009 (hereafter "IMERC Presentation"), available at http://www.newmoa.org/prevention/mercury/conferences/sciandpolicy/presentations/Wienert_Session3B.pdf.
16. The Big 3 used 2.95 tons of mercury to manufacture thermostats in 2007, and based on their announcements, it can be presumed this mercury use ended shortly thereafter. See National Electrical Manufacturers Association (NEMA) notification to IMERC dated April 11, 2008.
17. IMERC Presentation.
18. The import and sale of mercury thermostats may still occur, thus legislation restricting mercury thermostat sales is still advised, as discussed below.

19. EPA Report at 29.
20. As noted in Exhibit 3, the 135,604 thermostats TRC collected in 2008 contained 1,282 pounds of mercury. This 1,282 pounds corresponds to 581,505 grams of mercury, or 4.29 grams of mercury per thermostat.
21. EPA Report at 30.
22. Analysis of Potential Cost Savings and the Potential for Reduced Environmental Benefits of the Proposed Universal Waste Rule, EPA 530-R-94-023, April 1994, p. 3 -10.
23. Skumatz Economic Research Associates, Mercury-Containing Thermostats: Estimating Inventory and Flow from Existing Residential & Commercial Buildings, December 28, 2009, Tables 1.1 and 1.5 (hereafter "TRC California Report"), available at http://www.dtsc.ca.gov/HazardousWaste/upload/TRCThermostat-Report-12_09.pdf.
24. California accounts for about 12% of the USA population, so 3,000,000 thermostats x 0.12 = 360,000 thermostats.
25. Other manufacturers have now joined the TRC collection program, in response to state laws requiring thermostat collection in Maine and elsewhere (see discussion below).
26. See generally the TRC website, at <http://www.thermostat-recycle.org/howitworks>
27. Review and Assessment of Thermostat Recycling Activities in the Northeast, NEWMOA, June 2008 (hereafter "NEWMOA Report"), pp. 6 -8, available at <http://www.newmoa.org/prevention/mercury/publications.cfm>.
28. TRC 2008 Annual Report, p. 3, available at <http://www.thermostat-recycle.org/files/2008%20TRC%20Annual%20Report.pdf>.
29. TRC's 2008 Annual Collection Report to Maine DEP, January 30, 2009, Table 4.
30. Because of TRC's accounting methods, the 2008 recycling expenses reflect the actual recycling costs in 2007. Since 114,158 thermostats were collected in 2007, TRC's recycling costs average to about \$1.41/thermostat.
31. For a description of other state and local government initiatives, see the NEWMOA Report.
32. For the Maine law, see 38 MRSA §1665-B <http://www.mainelegislature.org/legis/statutes/38/title38sec1665-B.html>
33. Mercury Thermostats: Methods to Increase Recycling, VT ANR Legislative Report, January 15, 2008 (hereafter "VT Pilot Report"), pp. 3 -4, available at <http://www.mercvt.org/PDF/ThermostatFINAL.pdf>.
34. Vermont Pilot Report, p. 6.
35. For a copy of the Vermont law, see <http://www.leg.state.vt.us/docs/legdoc.cfm?URL=/docs/2008/acts/ACT149.HTM>
36. See the NEWMOA Report.