NEWMOA

NORTHEAST WASTE MANAGEMENT OFFICIALS' ASSOCIATION

Mercury Lamp Collection & Recycling Research Project

By the Northeast Waste Management Officials' Association (NEWMOA)
Prepared for the Massachusetts Department of Environmental Protection
Submitted July 31, 2021; Revised March 22, 2022

Background

The demand for lighting is an important part of electricity consumption in the U.S. The U.S. Energy Information Administration (EIA) estimated that in 2019, lighting was approximately five percent of total U.S. electricity consumption. The advantages of mercury-containing lighting have historically included energy-savings and a longer lamp lifespan compared with incandescent bulbs. However, mercury is a highly toxic metal. Potential problems caused by the use and release of mercury and mercury compounds into the environment are well known.[1] Many states in the U.S. have implemented measures that require manufacturers to report on their use of mercury in products, label those products to inform consumers, and in some cases phase-out their use of mercury in those products. Mercury-containing products, historically, include batteries, dental amalgams, electrical switches and relays, laboratory chemicals, paints/pigments, pesticides, pharmaceuticals, thermometers, measuring devices, and lamps. In Massachusetts, used mercury-containing lamps remain one of the greatest universal waste streams generated by businesses or institutions that typically would not, otherwise, generate universal or hazardous waste as part of their daily operations.

Massachusetts promulgated regulations at 310 CMR 75.00, pursuant to amendments to the Massachusetts Mercury Management Act (M.G.L. Chapter 21H, Section 6J) as of July 30, 2014, that require manufacturers that sell or distribute mercury-added lamps in the Commonwealth to pay an annual registration fee into an expendable trust through 2024. The funds are collected to pay for costs associated with the Department's administration, access, communication, enforcement, and education for proper mercury-containing lamp recycling or disposal. A spending plan has been developed and it describes activities that the Department will implement to further support the safe management of mercury-added lamps. This research project supports efforts described under the spending plan.

Project Goals and Objectives

The goal of this research project is to assess the current state of recycling and diversion in the State and make recommendations on how to increase the recovery and safe management of mercury-containing lamps. To achieve this goal, the Department established a partnership with the Northeast Waste Management Officials' Association (NEWMOA). NEWMOA completed a variety of tasks for this project, building upon the success of projects undertaken in previous years[2] and conducting research to identify the target audiences and gaps in coverage for the development of outreach, education, and assistance efforts. The overall goal of this effort is to improve the recovery and proper management of mercury-containing lamps in Massachusetts.

[1] https://www.epa.gov/mercury/health-effects-exposures-mercury
[2] http://www.newmoa.org/prevention/mercury/lamprecycle/

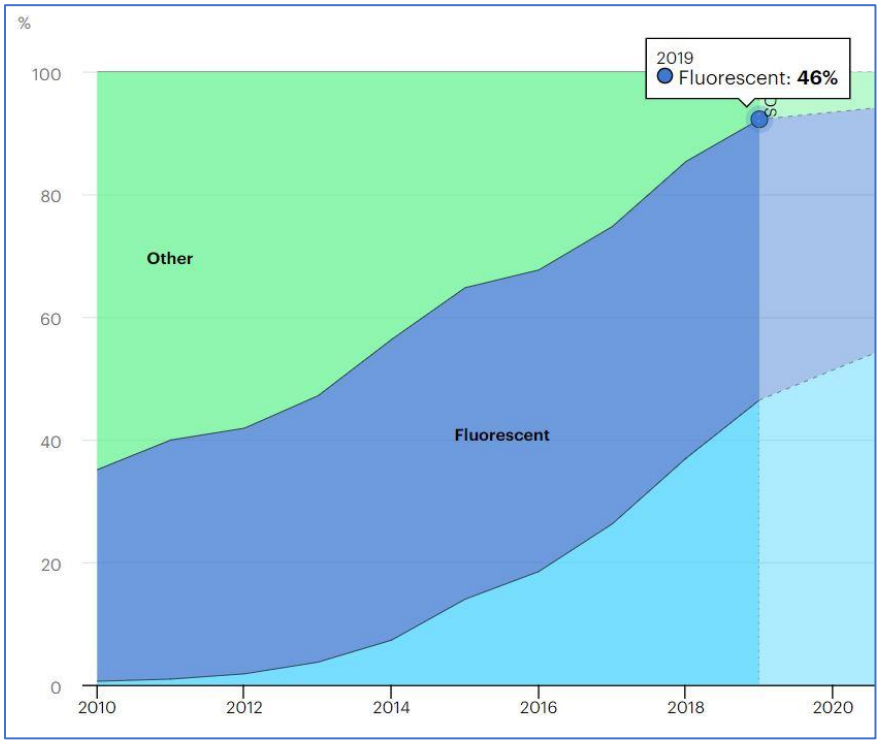
NEWMOA assisted the Commonwealth in evaluating the current state of mercury-containing lamp collection and recycling by:

1) Assessing the effectiveness of existing lamp diversion programs Municipal Waste Combustion (MWC) Material Separation Plans (MSP), municipal collection programs, and collection services offered by qualified recyclers and retailers.
2) Identifying gaps or potential areas of improvement in collection and recycling services.
3) Reviewing available resources to help educate consumers on mercury lamp recycling.

The Market for Mercury-Containing Lamps

A report of the International Energy Agency (IEA) shows that global sales of fluorescent bulbs peaked in 2015 at 51 percent of the lamp market.[3] According to IEA data. the market share of these bulbs has shrunk by roughly one percent annually since that time. IEA reported that in 2019, sales of light-emitting diode (LED) and fluorescent lighting held an equal share of the market at 46 percent (see Figure 1 below). However, growth of LED market share from 2015-2019 rose from 14 percent to 46 percent; and much of this growth was largely at the expense of other types of lighting and not fluorescents.[4] That said, IEA expects sales of LEDs to continue to gain market share and represent as much as 87 percent of the total lighting market by 2030.[5]

Figure 1. Lighting Sales by Type in the Sustainable Development Scenario, 2010-2020 (IEA)



In addition to IEA's market segmentation data, the data reported for 2016 to the Interstate Mercury Education and Reduction Clearinghouse (IMERC)[6] by manufacturers of mercury-added products, in

[3, 4, 5] Source: IEA (2020), Lighting, IEA, Paris https://www.iea.org/reports/lighting

[6] The Interstate Mercury Education and Reduction Clearinghouse (IMERC) was formed under NEWMOA to provide: ongoing technical and programmatic assistance to states that have enacted mercury education and reduction legislation; and, a single point of contact for industry and the public for information on mercury-added products and

accordance with Massachusetts' and other states' mercury-added product notification requirements, show a steady decline in the annual amount of mercury used in lighting.[7]

NEWMOA's efforts to gather comprehensive data on the sale of lamps in the Commonwealth were unsuccessful. NEWMOA staff appealed to numerous retailers and trade associations for sales data. In addition, a large percentage of the sales data provided to the State by lamp manufacturers in compliance with the State's Mercury Management Act was not available to NEWMOA due to confidential business information (CBI) protections. Any lamp manufacturer that requested CBI protections of the data they provided to MassDEP were granted such protections. Due to the lack of available data, NEWMOA was unable to assess the trends in mercury lamp sales in the Commonwealth. To address this shortcoming in accessible data, throughout this Report, the authors assume that the international sales trends reported by the IEA also apply in Massachusetts.

Data Collection and Analysis

NEWMOA evaluated several aspects of lamp collection efforts in Massachusetts, from planning to implementation. To assess the efficacy of these efforts, NEWMOA analyzed data on lamp collection rates from across the State from both municipal waste combustors and lamp recyclers. Lastly, NEWMOA performed sub-analyses in the Boston area and environmental justice (EJ)[8] communities across the State. The findings from this review and analysis are discussed below.

Waste-to-energy facilities in Massachusetts are required to develop material separation plans (MSP) for the removal of mercury-containing products from the solid waste stream to prevent mercury releases under the State's Municipal Waste Combustor Rule. The facilities are also required to implement their MSPs and submit annual progress reports to MassDEP, which include data on the numbers of discarded products prevented from entering their facility.

NEWMOA analyzed the elements of the MSPs related to lamps to identify commonalities, differences, and successful strategies to promote lamp collection and recycling (see "MWC MSP Assessment.docx", attached). The overall approaches to lamp collection in the MSPs are similar across facilities and companies, and include:

- Municipal reimbursement for local collections
- Collection from municipal departments
- Informational mailings to small business lamp manufacturers

The WIN MSPs (formerly Wheelabrator) also highlight a limited use of retail outlets as drop-off locations for spent bulbs. In addition to reviewing the MSPs, NEWMOA also reviewed the MSP Annual Reports from Covanta and WIN facilities and found little to no mention of mercury-containing lamp activities.

In addition to reviewing the MSPs and annual reports, NEWMOA collected data from reclamation facilities - Complete Recycling Systems (CRS) and Veolia - and MWCs for both total annual collections by bulb type and annual collection by municipality by bulb type.[9] See Figure 2 for annual collection rates

member states' mercury education and reduction programs. The IMERC state members include Connecticut, Louisiana, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, Vermont, and Washington.

[7] IMERC Fact Sheet Mercury Use in Lighting, December 2018 http://www.newmoa.org/prevention/mercury/imerc/factsheets/lighting_2018.pdf

[8] Massachusetts defines Environmental Justice as follows: "Environmental Justice (EJ) is based on the principle that all people have a right to be protected from environmental hazards and to live in and enjoy a clean and healthful environment. EJ is the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits. https://www.mass.gov/environmental-justice

[9] CRS was not able to provide municipal level data. They did however provide State-wide annual total data by bulb type.

over time for CRS and Veolia. Total collections through the reclamation facilities have been consistent over this time. An analysis of the collection data reported by the MWC (WIN), and the recycling facility (Veolia) shows a significant difference (see Figure 3 below). This might simply be a function of differing sources of mercury collected by the two, but it warrants more investigation to eliminate the possibility of errant reporting.

Figures 4 and 5 below provide a break-out of collections by bulb type in 2019 for CRS and Veolia, respectively. Over the period analyzed, straight fluorescents accounted for 72-83 percent of the lamps recycled, and CFLs accounted for 9-17 percent of the lamps recycled. (See "CRS and Veolia 2017-2020 Trend by Lamp Type.xlsx" attached.)

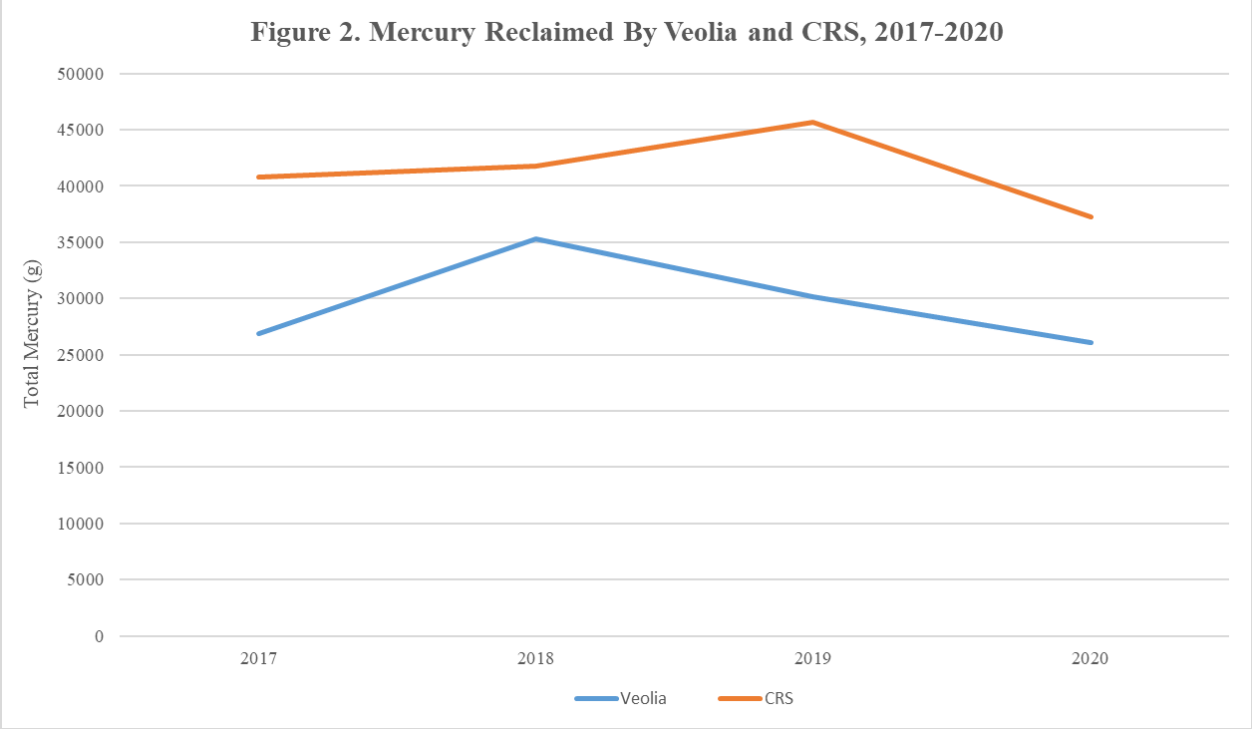


Figure 3. Collection By Municipality, Reported by WIN and Veolia

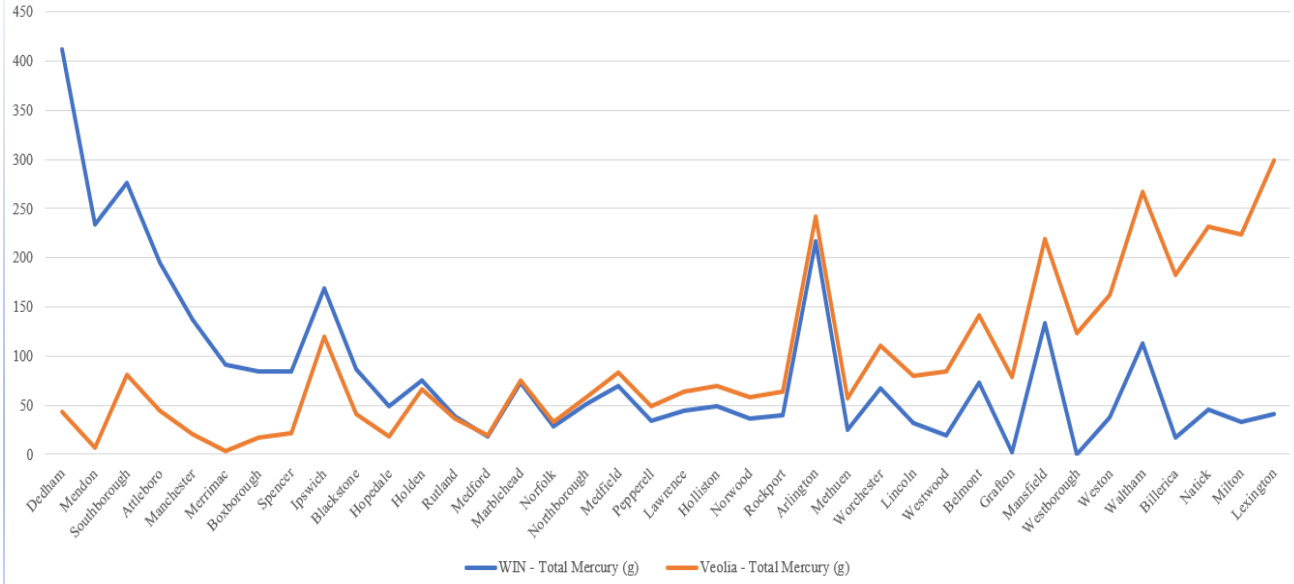


Figure 4. CRS Total Mercury Reclaimed By Lamp Type, 2019

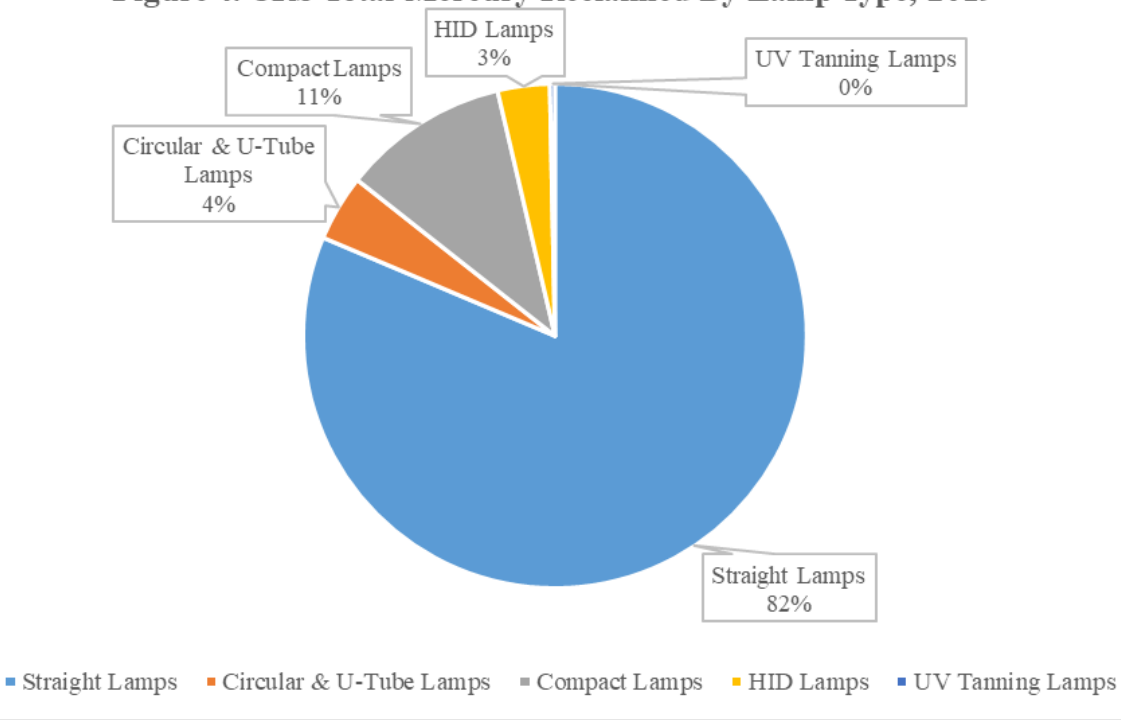


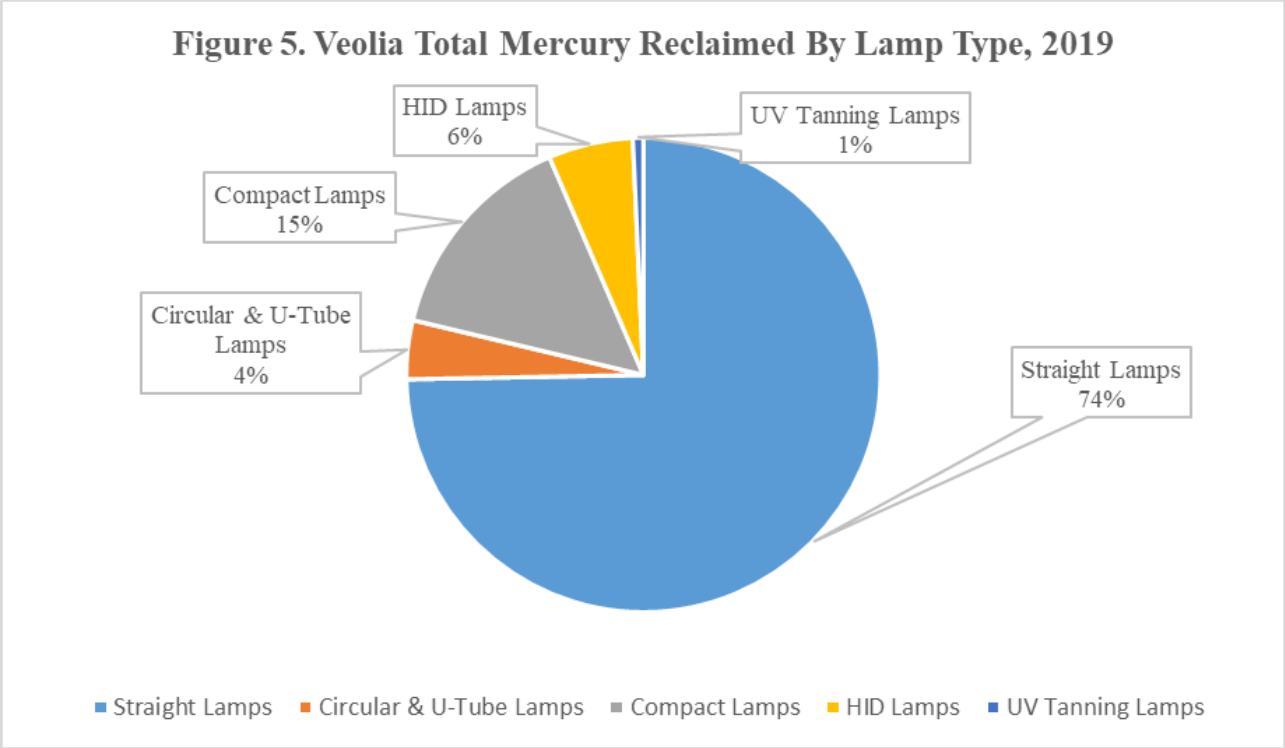
Table 1. Higher Performing Communities
Covanta and WIN Collection Data, Combined – 2019

City	Municipal - Per Capita (mg/person)	Percent of Population in EJ Block Group
Mendon	40.0	0
Southborough	28.3	0.0
Manchester	26.6	0.0
West Newbury	17.5	0.0
Boxborough	16.9	50.4
Tyngsboro	16.7	7.1
Dedham	16.6	32.4
Bedford	15.2	10.7
Truro	14.5	0.0
Merrimac	14.3	0.0
Eastham	13.0	35.9
Ipswich	12.9	28.4
Sherborn	11.0	0.0
Danvers	9.8	8.5
Blackstone	9.7	19.2
Middleton	8.8	0.0
Hopedale	8.3	0.0
Plympton	8.1	0.0
Maynard	8.1	0.0
Carlisle	8.0	0.0

Table 2. Lower Performing Communities
Covanta and WIN Collection Data, Combined - 2019

City	Municipal - Per Capita (mg/person)	Percent of Population in EJ Block Group
Lawrence	0.6	100
Worcester	0.4	82.5
Methuen	0.5	65.2
Medford	0.3	62.2
Wareham	0.4	48.6
Milford	0.3	47.2
Grafton	0.1	36
Weymouth	0.5	32.3
Acushnet	0.9	32.1
Fairhaven	0.7	29.4
Billerica	0.4	26.2
Dracut	0.8	25.6
Carver	0.3	25.3

Bridgewater	0.2	25.1
Marion	0.9	15.4
Rockland	0.9	9.4
Franklin	0.4	8.8
Dighton	0.9	0
North Reading	0.8	0
Norwell	0.6	0



Projections of current and future sales rates for fluorescents indicate a need for lamp recycling programs and infrastructure for the foreseeable future (see Figure 1). Lamps currently sold will remain in use for thousands of hours of operation and will require proper handling at the end of their useful life. Despite slowly declining sales of fluorescent lamps, data on recent collection rates show consistent collection rates year-over-year (see Figure 2). Data collection and analysis under this research highlight a need for improved data collection, management, and quality assurance. Collection rate data should be reviewed annually for anomalies, inconsistencies, and failures to report (see Figure 3). According to collection data analyzed, straight fluorescent lamps dominate lamp collections, followed by compact fluorescent lamps (CFLs) (see Figures 4 & 5). Future efforts should seek to strengthen collection of these lamps through programs such as retail take-back, universal waste collection, and mail-in programs.

In addition to the analysis of collection by lamp type, NEWMOA analyzed the available data across municipalities to identify higher- and lower-performing communities for further analysis. There was a great degree of variability in per-capita collection rates across the Commonwealth, with the highest performing municipality at roughly 40 mg/person/year (Mendon) and the lowest performing municipalities reporting zero collections. Straight lamps are the greatest volume of lamps collected, followed by CFLs.

For the subset of higher- and lower-performing communities, NEWMOA staff added environmental justice (EJ) census block data to assess any differences. (See Tables 1 and 2 below, taken from Compiled Data.xlsx, "EJ Leaders Analysis" and "EJ Laggards Analysis" tabs.)[10]

From this initial screening, NEWMOA identified a sample of higher- and lower-performing communities, for further investigation. NEWMOA staff collected additional information on the communities' lamp collection infrastructure, access, and education and outreach activities through online searches, email inquiries, and phone interviews as described below.

Stakeholder Interviews

The staff conducted phone interviews with municipal officials, lamp collection service providers, and other stakeholders. NEWMOA developed a standard set of interview questions to help guide the conversations (see Summary of Interviews.docx for a list of interviewees, the interview questions, and a summary of findings). NEWMOA had success in reaching contacts in high-performing municipalities, however there were challenges in reaching contacts in low-performing municipalities.

There was a large difference in recycling performance comparing the higher performing communities and lower performing communities. The following factors seem to affect the variability in recycling rates at the municipal level based on information reported to NEWMOA by interviewees:

- Staff who take ownership of the program and are invested in its success
- Everyday access to permanent drop-off locations
- Access to collection at retail outlets
- Financial support for collection activities
- Small business access to municipal drop-off locations

Key Findings from Data Analysis & Interviews

The following is a summary of key observations from the information gathered and data analyzed, and points offered during the interviews:

- According to the IEA, fluorescent lamp use will continue for the foreseeable future, and these lamps will continue to require proper handling at the end of their useful life.
- The collection of straight lamps from energy efficiency retrofits are the largest source of recycled fluorescent lamps in the State.
- Overall, mercury-added lamp collections at recycling facilities have remained consistent over the four-year period analyzed.
- Based on data from mercury reclamation facilities, recycling of mercury-containing lamps, overall, did not take a significant downturn in 2020, contrary to all the changes that took place during the pandemic.
- Permanent collection facilities are the single greatest factor positively impacting municipal lamp collection rates.
- Small businesses that have access to their municipal collection site are more likely to properly manage their fluorescent lamps.
- Local Departments of Health play a key role in ensuring small businesses are complying with spent lamp management in accordance with the Universal Waste Rule.

[10] The 2010 census data was used in the analysis because, at the time of the report, the 2020 census data was yet to be released for all municipalities. The 2020 EJ Block Data was used because it was the data available through the mass.gov website and provided a more current reflection of the EJ population within communities.

- The importance and need for effective education and outreach materials was a consistent theme in conversations with interviewees.
- Nominal handling charges on lamps (~$0.50) in some communities in Central and Western Massachusetts pose an impediment to participation.
- Maintaining a current, statewide list of collection sites poses some maintenance challenges.
- Lamp collection programs are so mature that they largely operate in the background. There is little to no active outreach to spent lamp generators other than direct marketing from recyclers and media messaging from MWCs.
- Best practices at municipal collection sites could increase efficiencies and decrease accidental breakage.
- A misconception persists that LEDs are significantly more expensive than fluorescents.
- There is reportedly a lack of compliance with lamp management requirements at electrical supply houses.
- Targeted enforcement across stakeholder groups would catalyze better practices and increase lamp recycling.

Lamp Recycling in EJ Communities

In general, there is limited access to permanent lamp collection services throughout the Commonwealth, as detailed on the Keep Mercury from Rising website. NEWMOA's research discovery and interviews revealed that many disadvantaged communities lack information, or access to information, on proper handling of lamps at the end of their useful life because of language and other barriers. "Approximately 528,324 Massachusetts residents ages 18 and over speak limited English, self-reporting that they speak English less than "very well".[11] This equates to just under 10 percent of the adult population. Figure 6 provides the breakdown of Massachusetts adults by English speaking ability.[12] The 10 percent or so of the adult population in Massachusetts communities who lack proficiency in English are much less likely to be able to access information on the proper handling of lamps at the end of their useful life because the educational materials that are available are in English.

In EJ communities, permanent drop-off locations are not accessible to many and, where they do exist, they require residents without cars to transport their spent lamps on public transportation. The same is true of annual household hazardous waste events, another outlet for spent lamps. Various municipalities in the lower-performing communities reported during interviews that there is a lack of succinct information on lamp handling and points of collection. Another impediment to lamp recycling in these communities, particularly in urban areas, is ready access to recycling services including household hazardous waste (HHW) collection events and permanent lamp drop-off locations.

Greater than 80 percent of municipalities with low to zero collection rates have some population in EJ block groups. Approximately half of the higher-performing municipalities have some percentage of the population in an EJ block groups. Based on this review, it appears that lamp collection efforts in EJ communities are likely to be underperforming. NEWMOA recommends that MassDEP investigate the reasons for this discrepancy and accelerate efforts to increase lamp collection and diversion efforts in EJ communities.

---

[11] The U.S. Census Bureau collects information regarding a person's ability to speak English. Respondents who report that they speak a language other than English at home are asked if they speak English "very well," "well," "not well," or "not at all". For the context of this report, respondents are considered "limited-English speakers" if they respond, "not at all," "not well," or "well". Respondents who speak English only or speak English "very well" in addition to another language are considered proficient in English.

[12] "Demographic Profile of Adult Limited English Speakers in Massachusetts", The Boston Planning & Development Agency, February 2019, http://www.bostonplans.org/getattachment/dfe1117a-af16-4257-b0f5-1d95dbd575fe.

Figure 6. Demographic Profile of Adult Limited English Speakers in Massachusetts

Language Spoken at Home	LES Massachusetts Adults	Percent of LES Massachusetts Adults
Spanish	205,573	38.9%
Portuguese	65,695	12.4%
Chinese	37,482	7.1%
Haitian	30,891	5.8%
Vietnamese	23,360	4.4%

The City of Boston

Under the direction of MassDEP, NEWMOA directed its evaluation to the lamp collection infrastructure and data in the City of Boston. The City includes a significant portion of the State's population and the urban setting poses unique challenges. NEWMOA analyzed collection rate data for Boston boroughs from various sources and cross-referenced them with EJ census block data.[13] 79.5 percent of Boston's population falls within an EJ block group. Boston does not currently have any permanent mercury lamp public drop-off locations for residents. The City hosts four HHW events per year, each in a different borough. Although there is geographic distribution of the events, they are not readily available to large sections of the population. This raises concerns about accessibility and transportation issues. Another concern is that Boston only conducts education and outreach through a mobile app or website. Many community members may not have a smart phone or computer and only limited access to the internet through their local libraries.[14] They are left to rely on the limited information provided through print and radio advertising.

Overall Recommendations

Based on its research and interview findings, NEWMOA offers the following recommendations to help inform MassDEP's efforts to increase mercury-containing lamp collection and recycling in the Commonwealth:

- Assist municipalities with establishing permanent drop-off locations, such as collection sheds at Department of Public Works' (DPW) facilities where they are lacking.

- Create standardized outreach messaging for handouts, posters, print, electronic, and social media campaigns for use by municipalities and others. Topics to include:
    - Why mercury-containing lamps need to be separated from regular household trash.
    - Lamp drop-off locations or household hazardous waste events.
    - Guidance for safe storage and handling of lamps.
    - Proper handling of broken lamps.

- Produce hard-copy and electronic outreach materials (e.g., flyers, posters, e-newsletter articles) and distribute them through multiple channels (e.g., through local utility bills and in public spaces, such as public transit electronic bulletin boards).

- Investigate the reasons for underperforming in lamp collection efforts in EJ communities.

[13] Boston lamp recycling data includes public, institutional, and office buildings. Residential data was not available.
[14] According to MassINC, 30,000 homes in Massachusetts "Gateway Cities" lack a computer or laptop at home, 5,840 of them being in Boston. https://massinc.org/2020/05/05/gateway-cities-at-the-center-of-the-digital-divide-in-massachusetts/ See the U.S. 2015 Census Data for a detailed break-out of homes without computers or broadband internet access. https://data.census.gov/cedsci/table?q=S2802&tid=ACSST1Y2018.S2802

- Ensure information is available in different languages: Spanish-, Portuguese-, and Chinese-(Mandarin and Cantonese), Haitian-, and Vietnamese-speaking households are the largest non-English speaking populations in the state.

- To the extent practical, tailor efforts to improve outreach and collection to the needs of each local community.

- Maintain a repository of mercury-containing lamp collection data from MWCs, consolidators, and mercury lamp recyclers for tracking trends year-over-year.

- Increase enforcement of the rules governing lamp collection reporting, waste disposal bans, universal waste management, lamp management information from distributors, and lamp generator recycling practices.

About NEWMOA

NEWMOA is a non-profit, non-partisan, interstate association whose membership is composed of the state environment agency programs that address pollution prevention, toxics use reduction, sustainability, materials management, hazardous waste, solid waste, emergency response, waste site cleanup, underground storage tanks, and related environmental challenges in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

Mission

NEWMOA provides a strategic forum for effectively solving environmental problems through collaborative regional initiatives that advance pollution prevention and sustainability, promote safer alternatives to toxic materials in products, identify and assess emerging contaminants, facilitate adaption to climate change, mitigate greenhouse gas sources, promote reuse and recycling of wastes and diversion of organics; support proper management of hazardous and solid wastes, and facilitate clean-up of contaminant releases to the environment.

Goals

NEWMOA's long term goals are to:

- Support and strengthen state efforts to implement policies, regulations, and programs
- Promote interstate coordination and develop innovative strategies to solve critical and emerging environmental problems
- Develop and enhance the capabilities and knowledge of state officials so that they are well trained, able to adjust to rapid changes in technology, and respond effectively to emerging environmental challenges
- Articulate state program views on federal policy developments, programs, and rulemakings
- Cultivate and enhance relationships among member states, federal agencies, colleges and universities, and stakeholders
- Engage with and educate the regulated community and the public

Core Programs

- Hazardous Waste
- Solid Waste and Sustainable Materials Management
- Waste Site Cleanup
- Interstate Mercury Education and Reduction Clearinghouse (IMERC)
- Interstate Chemicals Clearinghouse (IC2)
- Pollution Prevention and Sustainability
- Cross Program Initiatives

NEWMOA is an equal opportunity employer and provider.
For more information, visit www.newmoa.org.

Acknowledgements
NEWMOA appreciates the funding that was provided by the Massachusetts Department of Environmental Protection to support this Report. NEWMOA thanks the following staff who wrote this report and provided the direction for the research project:

- Andy Bray, NEWMOA Project Manager
- Krishana Abrahim-Petrie, NEWMOA Project Staff
- Terri Goldberg, NEWMOA Executive Director
- Lynn Cain, Massachusetts DEP
- Richard Blanchet, Massachusetts DEP
- Veronica O'Donnell, Massachusetts DEP

Disclaimer

The views expressed in this report do not necessarily reflect those of each of the NEWMOA-member states. Mention of any company, process, or product name should not be considered an endorsement by NEWMOA or the NEWMOA-member states.