

ELECTRONIC WASTE COLLECTION: A RURAL-URBAN COMPARISON IN PENNSYLVANIA

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ABSTRACT: *Over the last several years a growing number of non-mandated Pennsylvania municipalities have cancelled, suspended, and/or strongly considered suspending, their recycling programs, particularly for electronics and covered devices collection programs and services in rural areas. This study uses primary data from a web-based survey of all Pennsylvania counties including the counties mandated as well as those counties non-mandated to recycle. Specifically, this study investigates the status of recycling programs in Pennsylvania from 2010-2019, focusing on the geographic extent and availability of electronics and covered devices recycling collection programs and services, and the differences in program availability in urban versus rural areas. The findings suggest an urgent need for the state to examine ways to increase access to electronics recycling collection for residents, especially in rural areas.*

Keywords: *Electronics, Waste, Recycling, Pennsylvania*

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INTRODUCTION

Electronic waste, or e-waste, consists of cell phones, computers, printers, television sets, and other electronic devices that are discarded or given to a recycler. The EPA (2020) estimates that only about 25% of electronic waste is collected for recycling, with the remainder disposed of primarily in landfills, where the high-quality plastics, and valuable metals such as aluminum, copper, platinum, silver, gold, and rare-earth metals contained in most electronic devices cannot be recovered. Furthermore, electronic waste is also a source of toxic and hazardous chemicals that can contaminate air, surface water, groundwater, and soil. Electronic waste collection programs are vitally important, therefore, to the recovery of valuable materials, as well as reducing the negative environmental impacts associated with landfilling and/or illegal disposal of electronic waste. Unfortunately, many communities often lack readily available collection programs, particularly in rural communities (EPA 2020; Zou 2020; Mihai 2017).

In Pennsylvania, The Municipal Waste Planning, Recycling, and Waste Reduction Act of 1988 (Act 101) currently mandates recycling in 475 municipalities, accounting for 68% of Pennsylvania's residents, and more than 586 other municipalities have voluntarily implemented recycling collection programs. In total, over 94% of Pennsylvania residents have access to public recycling programs (Brennan 2020; Commonwealth of Pennsylvania 2017; Pennsylvania Recycling Markets Center 2019; Pennsylvania General Assembly 1988). However, in the last several years, increasing costs associated with collection, and decreasing revenues associated in large part with a decrease in the prices received for materials collected in recycling programs, have led to several non-mandated Pennsylvania municipalities cancelling, and/or strongly considering suspending, their recycling programs (Bobb 2018; Crable 2018; Cruden and Rosengren 2020; Lester 2019; Maile 2019; Mataloni 2019; Richards and Kendron 2019).

This paper focuses on the geographic extent and availability of electronics and covered devices recycling collection programs and services in Pennsylvania from 2010-2019, and in particular on the differences in program and services availability in urban versus rural areas. The emphasis on recycling programs in rural counties across Pennsylvania is of particular concern for two reasons. First, studies demonstrate that illegal dumping and littering is concentrated in rural counties in the Commonwealth compared to urban counties (Nestor Resources 2014; The Center for Rural Pennsylvania 2009). Second, unlike their urban counterparts where funding from the private sector is often directed, rural counties have had to adjust their collection of recyclable items or eliminate their recycling programs altogether due to financial limitations (Commonwealth of Pennsylvania 2017). In many rural communities, the decision to maintain a recycling program is often a matter of budgetary constraints. The municipality is forced to

weigh the costs of providing recycling collection or other services, such as snow removal and road maintenance. Only those communities that are mandated to recycle by Act 101 must continue to offer curbside recycling, while others are free to do away with their collection programs. This study aims to develop a better understanding of the challenges posed by recent changes and associated impacts on residential programs, and to better understand the geographic extent and availability of electronic and covered devices recycling programs and services offered to residents in urban versus rural Pennsylvania counties and municipalities.

DATA AND ANALYSIS

The time period for data collection and analysis spanned 2010 to 2019. The 2010 baseline was selected due to data availability associated with the 2010 Census, and the rural/urban divide as defined by the Center for Rural Pennsylvania. The Center's 2010 municipal definition of rural is as follows: a municipality is rural when the population density within the municipality is fewer than the 2010 statewide average density of 284 people per square mile, or the total population is less than 2,500, unless more than 50 percent of the population lives in an urbanized area as defined by the U.S. Census Bureau. All other municipalities are considered urban. Thus, according to the Center's definition, there are 48 rural counties and 19 urban counties in Pennsylvania (see Map 1). In 2020, nearly 3.4 million residents called these rural counties home, or 26 percent of the state's 13.0 million residents. At the municipal level, 1,592, or 62 percent, of the state's 2,562 municipalities are defined as rural and 970 municipalities, or 38 percent, are urban (Haney and Bodenman 2021). To establish a baseline and draw comparisons, the researchers collected primary data from a web-based survey of all Pennsylvania counties, both from the counties mandated to recycle, as well as from the counties non-mandated to recycle.

The researchers followed the guidelines set forth by Dillman and colleagues (2014) for designing and implementing the survey as well as increasing response rates. The survey was pilot tested among a small population to obtain feedback, survey questions were modified as needed, and the Qualtrics software was used for the design and delivery of the survey. The names and email addresses of county recycling coordinators were obtained through ReTRAC Connect, a web-based platform that allows government agencies and organizations to increase efficiency of the management and monitoring of their solid waste and recycling programs at both the county and municipal levels in Pennsylvania (Emerge Knowledge Design Inc. 2019). The researchers acquired permission to access this database from Charles Fritz, Director of Governmental Services/Recycling Coordinator for the Town of Bloomsburg.

The county survey was deployed via Qualtrics Online Survey Platform and responses were collected between June 1 and July 10, 2020. The format of the survey instrument used can be found in Haney and Bodenman (2021). In accordance with Dillman and colleagues' (2014) method for web-based surveys, the initial survey invitations were sent out via email to all respondents on June 1. Reminders were also sent out via email to all county survey respondents on June 4, June 10, June 29, and July 7. The final county dataset included responses from 35 of 67 counties resulting in a 52% response rate: a total of 26 rural counties and nine urban counties responded to the survey). The margin of error for the survey was +/- 12%, with a desired 95% confidence level. This study, focused on electronics and covered devices recycling and services availability, utilized a subset of survey responses and data from Haney and Bodenman (2021).

SURVEY RESULTS

The survey directed at county recycling coordinators asked questions about mandated and voluntary recycling in their municipalities, collection techniques for curbside and drop-off locations, types of recyclable materials collected by counties, including electronics and household hazardous waste (HHW), and the provider of residential recycling collection. The results for each question are compared across rural and urban counties. Where possible, these results are also compared across the six Department of Environmental Protection (DEP) Regions for county recycling coordinators.

Nearly 54% of respondents provided access to electronics recycling for both rural and urban county residents located in the northwestern and southcentral portions of the state (see Figure 1). Over 70% of respondents residing in predominately rural counties in the northwest and northcentral regions were able to recycle electronic devices at a special event. Except for residents in the northeast and southcentral regions, urban and rural county residents had access to electronics recycling with assistance from private industry. Over half of respondents where this service was provided were found in the northwestern portion of the state. All geographic regions offered at least two methods of

collection for electronics recycling with half providing all three methods of electronics collection for urban and rural county residents in the southeast, northcentral, and northwest regions (see Figure 1).

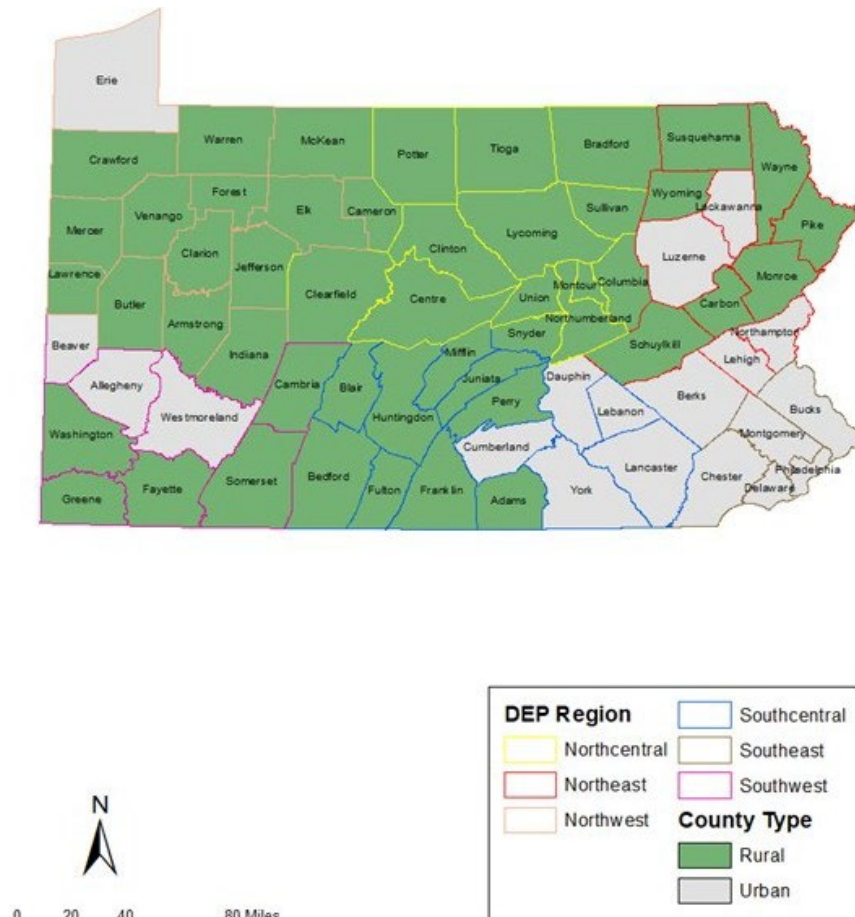


Figure 1. Urban and rural counties and designated DEP regions in Pennsylvania.

Overall, 64% of respondents from urban counties provided electronics recycling through public sector drop-off sites (see Figure 2). The remainder of urban counties also relied on special events and private industry to assist with the collection of electronic devices. Over half of rural counties offered residents the opportunity to recycle electronic items at a special event. Public sector drop-off sites and private industry also played a considerable role in electronics recycling collection in the remainder of rural counties responding.

Payment for electronics recycling collection trends is generally consistent across urban and rural counties in Pennsylvania (see Figure 3). In over 80% of rural counties that offer recycling of electronic devices, the costs are borne by county residents. While more government-sponsored programs frequently footed the bill for electronics recycling in urban counties compared to rural counties, the opposite was true for Original Equipment Manufacturer (OEM)-sponsored programs. Due to the growing global electronic waste (e-waste) problem there is an increased emphasis on the need for creators of electronic devices and appliances to accept responsibility for their items when it comes to their ultimate disposal. OEM-sponsored programs take back their products from the consumer for safe and sustainable disposal. Other parties providing payment for the collection of electronics recycling in urban and rural counties included the following: Department of Environmental Protection (DEP) grant funds, municipalities, landfills, and a combination of payment sources.

Over 75% of respondents primarily residing in rural counties in the northwest and northcentral DEP regions charge a fee to residents to provide access to electronics recycling collection. With the exception of counties located in the northeast and northcentral regions, government-sponsored programs pay for the recycling of electronic devices for rural and urban residents across the state; compared to other regions, residents in the northwest have more

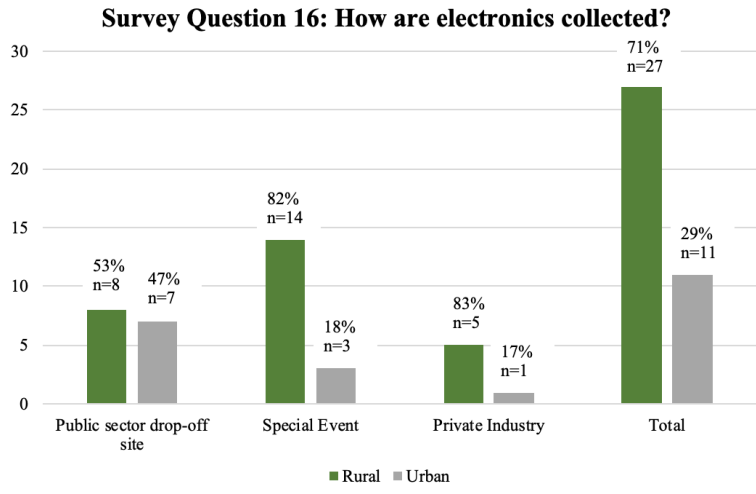


Figure 2. Electronics collection techniques by county.

opportunities for electronics recycling funded by these programs. OEM-sponsored programs were equally common in all geographic regions excluding urban counties in the southeast. At least one county in every geographic region provided electronics recycling collection to urban and rural residents funded by other means. All geographic regions reported a minimum of three funding sources for electronics recycling collection in their counties. Urban and rural counties in the southcentral and northwest regions used all four funding sources for payment of electronics recycling.

Survey Question 22: If residents in your county are able to recycle electronics (including TVs, computers, keyboards, and printers), who pays for this service?

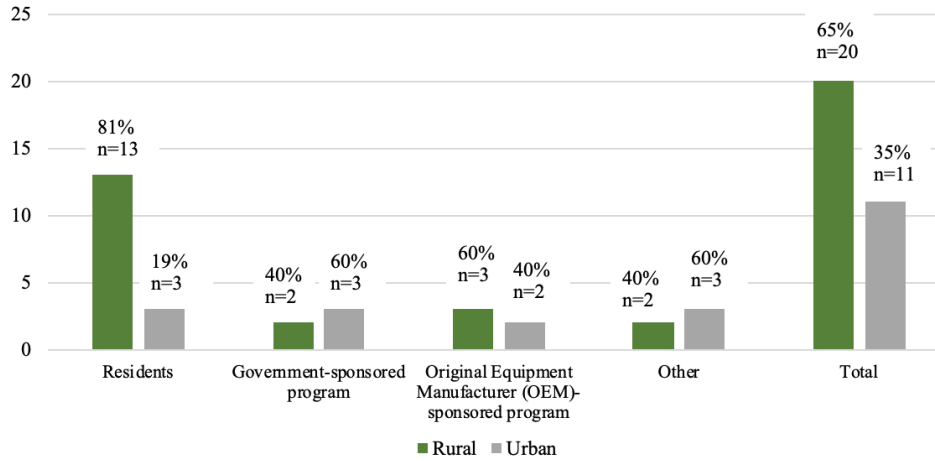


Figure 3. Payment for electronics recycling in county.

The survey directed at municipal recycling coordinators within counties found that geographic disparities exist in terms of access to electronics recycling between rural versus urban municipalities (see Figure 4). Urban municipalities reporting access to electronics recycling collection are more than twice that of rural municipalities, and rural locations with limited access to recycling and waste collection increase the likelihood of illegal dumping, particularly in less populated areas with little to no enforcement. Further, improper disposal of electronic devices like televisions, computers, cellphones, and printers which contain toxic substances like lead, mercury, and cadmium can have adverse effects on human health and the environment.

Survey Question 23: Is there a way for residents to have electronics recycled in your municipality?

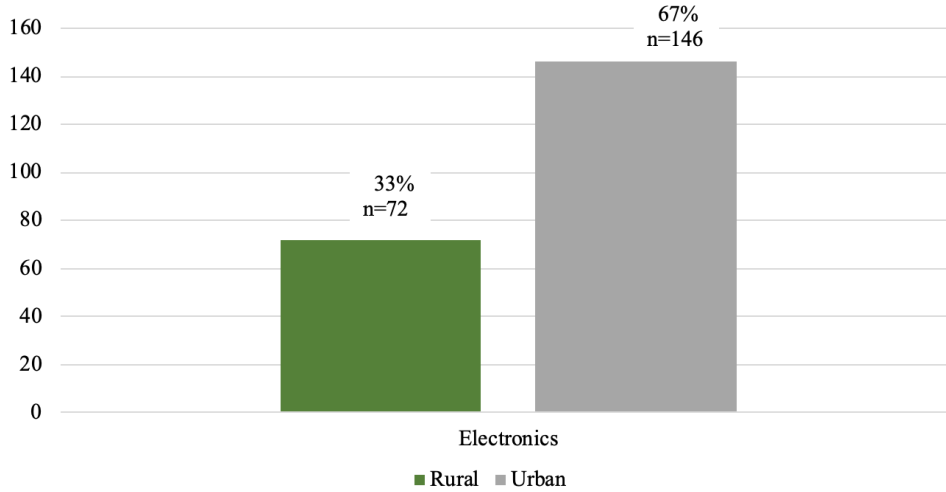


Figure 4. Access to electronics recycling in municipalities.

Of the 15 municipalities reporting five or more electronics recycling options for residents, 86% are found in urban counties compared to 14% in rural counties. These findings highlight the need for improving access to electronics recycling collection among Pennsylvania residents, which could serve to decrease opportunities for illegal dumping of electronic waste in rural locations.

For municipalities where residents have access to electronics recycling, nearly 80% are offered through special event collections or public sector-drop off sites (see Figure 5). Interestingly rural municipalities report more of these opportunities for residents (87%) compared to urban municipalities (76%). Private industry was more likely to sponsor electronics recycling collection in urban municipalities (16%) compared to rural municipalities (5%). Municipalities reporting other entities responsible for providing access to electronics recycling were also more common in urban municipalities.

Survey Question 24: How are electronics collected?

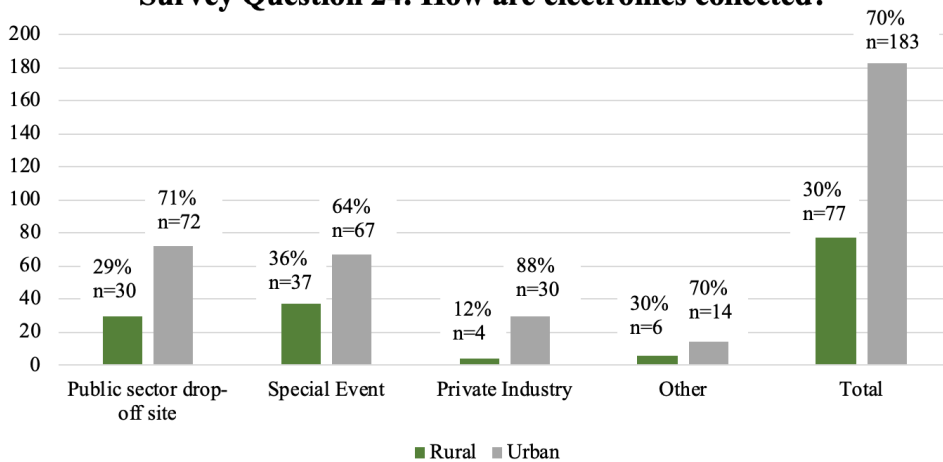


Figure 5. Electronics collection techniques in municipalities.

In those municipalities where residents have access to electronics recycling, more than 75% of collections are funded by the residents and government-sponsored programs (see Figure 6). Residents are more than twice as likely to be responsible for electronics recycling collection in urban municipalities compared to their rural counterparts. Other entities that were reported to provide funding for electronics recycling collection in municipalities include private haulers, solid waste authorities, landfills, counties, municipalities, and the state via grants. These

providers are more common in rural municipalities (23%) than urban municipalities (15%). OEM-sponsored programs are among the least common to provide funding for electronics recycling collection in municipalities (less than five %) and are primarily found in urban areas.

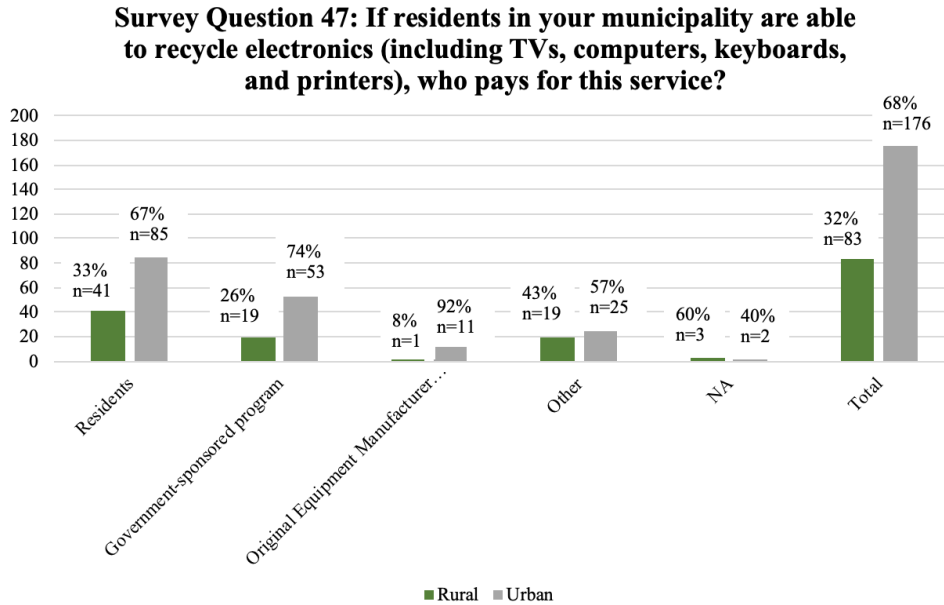


Figure 6. Payment for electronics recycling in municipalities.

In addition to asking county recycling coordinators about negative impacts on recycling collection services, it was important to get an understanding of the kinds of solutions that could be considered to improve residential access to recycling. A total of 25 counties responded to this question. Open-ended responses were analyzed and coded to create a number of categories. Given the frequency of negative impacts of recycling collection services reported by counties, consideration of related solutions is critical for the survival of these programs.

IMPROVING ACCESSIBILITY OF RECYCLING COLLECTION

One solution that was reported related to electronics and HHW recycling materials, which are cited by many county recycling coordinators as being difficult to collect due to a lack of consistent funding mechanisms and providers, as well as restrictions imposed by the Covered Device Recycling Act (CDRA) of 2010. Compared to urban counties, rural counties are at a disadvantage when it comes to disposing of electronics and HHW recyclables, which can help to explain the rise in illegal dumping in those areas and decline in drop-off locations due to frequent abuse. As a result, it is vital to examine ways in which access to electronics and HHW recyclables can be increased for county residents, especially those in rural locations. This could provide a wealth of economic and environmental benefits to Pennsylvania and improve the sustainability of recycling collection programs.

Overwhelmingly, municipalities reported the critical need for electronics recycling collection to be reexamined in Pennsylvania and called for increased access for residents where disposal generates a profit rather than imposes fees to dispose of items like televisions and computers. This in turn would provide an economic incentive for both residents and collectors as well as decrease the likelihood of illegal dumping. For example, state investment in the creation of local or domestic markets for and processors of recyclable materials can make it easier for counties to identify partners, expand, and perhaps, even diversify their collection programs, and draw economic activity to the state through job creation and revenue from collection and processing of recyclable materials. Similarly, municipalities indicated the need for establishing local markets as well as collection and processing facilities for recyclable materials, so their programs are not reliant on foreign processors, which ultimately drive down the market value of collected materials. Benefits to the state, including job creation and establishment of new products and markets for recycled materials, were frequently cited as ways to provide a much-needed incentive for residents to recycle. As reported by county recycling coordinators, municipalities argued that federal responsibility was crucial

for recycling collection services to thrive. In particular, they stressed the need for manufacturers of difficult-to-recycle materials, like plastics, to have a mandate requiring them to redesign packaging of their products in favor of materials that are easily recyclable. In addition, it was stressed by county recycling coordinators that manufacturers need to take financial responsibility for the disposal of difficult-to-recycle materials, rather than imposing the costs on consumers, and ultimately on county and municipal recycling collectors and processors. Overall, these findings suggest that re-evaluation of the state's current recycling laws including Act 101 and the CDRA could dramatically improve the sustainability of recycling collection programs in both counties and municipalities, thus removing additional burdens from rural programs in particular.

Solutions are needed that address bulk waste, electronics, and HHW and federally mandated manufacturer accountability for product disposal and recycling. Counties expressed their frustration and difficulty in collecting these items due to a lack of consistent funding, in addition to restrictions imposed by the CDRA. It is critical for the state to examine ways to increase access to electronics and HHW recyclables for county residents, especially in rural locations. By doing so, this could lessen illegal dumping in those areas as well as create economic and environmental benefits for Pennsylvania in the way of jobs and increased revenue.

Likewise, more than 8% of municipalities, overwhelmingly rural, proposed solutions related to offering and/or expansion of drop-off collection. Some municipalities stressed the need for drop-off locations reserved for special collection recyclables like bulky items, electronics, and HHW which would be available year-round to residents in multiple municipalities. Other municipalities proposed a shared regional drop-off facility that could reach residents that did not have access to recycling collection services in their communities, which could serve to increase participation in recycling. Rural municipalities in particular reported the difficulty of staffing existing drop-off locations which influences hours of operation for residents and can also impact the abuse of drop-off sites. Having drop-off locations shared by multiple municipalities can allow for more flexibility and also result in extended hours of operation making it more convenient for residents to recycle, thus minimizing opportunities for illegal dumping and abuse of drop-off sites. Similarly, some municipalities stressed the need for stronger policing and enforcement of laws related to littering and illegal dumping in rural municipalities which could improve both the efficiency and accessibility of drop-off collection sites.

SUMMARY AND CONCLUSIONS

Access to electronics recycling collection varied in urban and rural counties. Interestingly, residents in rural counties have increased access (almost 70%) to electronics recycling collection as well as more collection techniques than residents in urban counties. While the majority of urban counties provided electronics recycling through public sector drop-off sites, rural counties were more likely to offer residents the opportunity to recycle electronic items at a special event. Although rural counties identified more variety in the parties responsible for the payment of electronics collection compared to urban counties, with the exception of charging a fee to residents, payment for electronics recycling collection trends were generally consistent across urban and rural counties. There were urban-rural distinctions in the funding of electronics recycling services, with urban municipalities reporting residents as more likely to be responsible for electronics recycling collection.

Both counties and municipalities expressed their frustration and difficulty in collecting electronic recyclables due to a lack of consistent funding, in addition to restrictions imposed by the CDRA. The CDRA requires manufacturers of covered devices, including computers and TVs, to register with the state if they wish to sell new items and create a plan for the collection, transportation, and recycling of those devices. Manufacturers who fail to comply face a penalty of up to \$10,000 for the first violation and up to \$25,000 for the second and each subsequent violation, all of which will be deposited into the Electronic Materials Recycling Account. Section 506 of the CDRA also placed a ban on the disposal of these items in a municipal solid waste facility, which took effect in 2013. A few legislative bills have been introduced over the past few years that aimed to address some of the problems associated with the CDRA including Senate Bill 52 and House Bill 179 of 2019, and House Bill 2299 of 2020, however none were enacted.

These findings suggest the critical and urgent need for the state to examine ways to increase access to electronics recycling collection for residents, especially in rural areas. By doing so, this could minimize illegal dumping in those locations as well as create economic and environmental benefits for the Commonwealth in the way of jobs and increased revenue. Similar to suggestions reported for creating a recycling education initiative, there must be a dialogue with counties and municipalities, particularly in rural areas lacking access to recycling opportunities. Some municipalities stressed the need for drop-off locations reserved for special collection materials like bulky items

and electronics, which would be available year-round to residents in multiple municipalities. This is certainly a starting point for expanding the dwindling access to electronics collection in Pennsylvania, as well as a lesson to communities outside of Pennsylvania regarding the importance of access to electronics collections programs, particularly in rural areas.

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