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Impacts of Pay-As-You-Throw and Other Residential Solid Waste Policy Options: Southern Maine 2007–2013

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Impacts of Pay-As-You-Throw and Other Residential Solid Waste Policy Options:

Southern Maine 2007–2013

by Travis Blackmer and George Criner

Managing municipal solid waste in Maine is a challenging and costly endeavor. Not only is waste management a large budget item, but designing new, or changing existing, solid waste management programs is often controversial, divisive, and time consuming. This article presents an analysis of four residential municipal solid waste policy options used in Maine and evaluates the associated impacts on municipal residential recycling levels, information that may prove useful as state and local policymakers consider the impacts of various waste management options.

INTRODUCTION

In recent decades, managing municipal solid waste in Maine has been a challenging and costly endeavor. Not only is waste management a large budget item during a period of tightening municipal and state budgets, but designing new, or changing existing, solid waste management programs is often controversial, divisive, and time consuming. State and local policymakers need accurate and timely information regarding the impacts of waste management options. The purpose of this study is to analyze four residential municipal solid waste policy options used in Maine and to evaluate the associated impacts on municipal residential recycling levels.

Throughout history a recurring pattern has been the cycle of growing waste volume and complexity, followed by the discovery that current disposal methods are inadequate. For example, in the 1800s both river and ocean dumping were common, but these practices were eliminated as waste volumes and problems grew. More recently, in an effort to protect groundwater, local garbage dumps have been closed and replaced with sanitary landfills. These facilities include modern engineering features such as clay and composite liners, leak detection, and landfill gas collection. While modern landfills have helped protect groundwater, national concern over the growth in waste generation has continued. From 1970 to 1980, the total annual generation of municipal solid waste in the United States increased 25 percent (from 121.1 million tons in 1970 to 151.6 million tons in 1980), while per person waste generation increased 13 percent (from 3.25 pounds per day to 3.66 pounds per day).[1]

In response to this "garbage crisis," most states have become active in municipal solid waste management issues, establishing new policies and regulations. The U.S. Environmental Protection Agency (EPA) reported that, "Since the late 1980s, many states have demonstrated initiative by instituting a number of innovative source reduction policies, such as mandating reduction goals and planning requirements, legislation disposal bans, and implementing extensive education and outreach campaigns" (U.S. EPA 1998). In 1989 Maine created the Maine Waste Management Agency and charged it with creating a solid waste management plan, assisting municipalities and businesses in waste reduction and recycling efforts, and developing criteria for the selection of new landfills. Maine established a waste diversion goal of 50 percent, developed various assistance programs including an infrastructure grant program and educational efforts, and adopted a waste management hierarchy.

Maine's waste management hierarchy was reaffirmed in 2014 with "An Act to Implement the Solid Waste Hierarchy," which states that the Maine Department of Environmental Production shall "adopt rules incorporating the State's solid waste management

TABLE 1: **Composition Maine's Residential Waste Stream**

Category	Subcategory % of all waste	Category % of all waste
Organics		43.28
Organics (food)	27.86	
Organics (non-food)	15.42	
Paper		25.57
All other paper	10.68	
Compostable paper	7.93	
Magazines/Catalogs	2.88	
Newspaper	2.43	
High Quality Office	1.64	
Plastic		13.44
Plastic film	4.78	
All other plastic	3.77	
#1-#2 plastic	2.70	
#3-#7 plastic	1.38	
Grocery/Merchandise bags	0.82	
Other Waste		5.77
Construction and Demolition Debris (C&D)		3.35
Metal		3.26
Glass		2.71
Household Hazardous Waste (HHZ)		1.72
Electronics		0.92
Total		100.00

Source: Criner and Blackmer (2012)

hierarchy as a review criterion for licensing approved under this subsection" (38 MRSA §1310-N, sub-§1). The hierarchy prioritizes municipal solid waste management options. The highest priority is to reduce the amount of waste generated. The second priority is to reuse items when possible. The third priority is to recycle materials, and the fourth is to compost organic wastes. The fifth priority is to incinerate waste for energy production (waste-to-energy). The lowest priority is landfilling.

WHAT IS IN MAINE'S TRASH CANS?

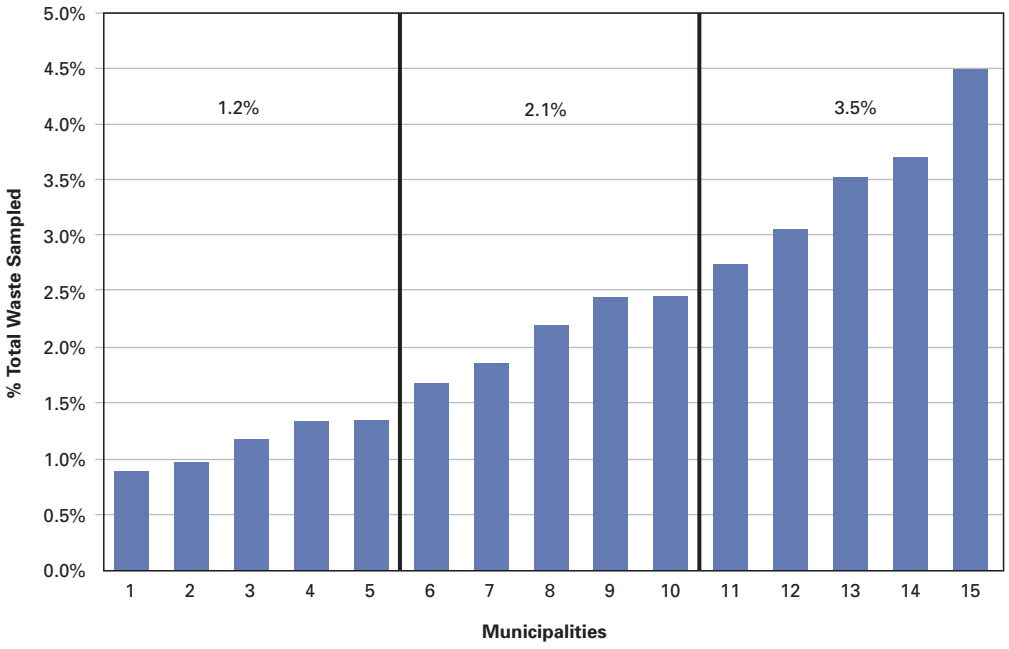
To make informed decisions about which waste management programs to adopt, municipalities need accurate information regarding their residential waste. This includes information about the composition of the waste stream. The most recent thorough analysis of Maine's residential waste stream was published by Criner and Blackmer (2012). This report describes the composition of residential "baggable" waste collected from 17 Maine municipalities in the summer and fall of 2011. The waste is identified as baggable because only residential waste that would fit in a typical 30-gallon plastic trash bag was collected for analysis. All larger "bulky" waste items such as couches, televisions, tires, and other large items were excluded from the analysis.

Table 1 lists the nine major categories of Maine's residential waste steam, from largest to smallest by weight, as identified in this study. For the three largest categories, organics, paper, and plastic, subcategories are also listed. It is important to note that this composition data represents only the contents of household trash, and does not include items diverted to the recycling bin or composted.

Most of the categories within Table 1 are self-explanatory. A more detailed discussion of the waste composition, as well as a comparison with previous trash sorts, can be found in the 2012 Criner and Blackmer report. One finding that may be surprising is that organics and paper comprise nearly 70% of the waste stream. This finding is relevant when considering waste management options for treatment and disposal, as many of the materials in these categories are suitable for composting.

While some municipalities had little recyclable material in their waste stream, others had considerably more. Figure 1 provides an example of this variation among the municipalities. It presents the percentage of newspaper found in the residential waste stream for 15 of the 17 Maine municipalities studied. The municipalities with the highest and lowest percentage of newspaper in their waste stream were discarded to focus on the middle 15. For comparison purposes, these municipalities are divided into high, middle, and low groups and averages for these three groups are shown. The average percentage of newspaper in the waste stream for the high group is three times that of the low group, showing that there is a wide range of effectiveness in removing this item from the waste stream.

FIGURE 1: **Newspaper in the Residential Waste Stream (15 municipalities, low to high with group averages).**



Source: Criner and Blackmer (2012)

OBJECTIVES AND PROGRAM OPTIONS

Evidence suggests that there are municipal policies that can influence residential recycling. However current policy impacts are not known. The objective of the research reported here is to analyze four residential solid waste programs commonly implemented in Maine and to estimate their impacts on the municipal recycling rate. The waste and recycling data for this analysis was provided by ecomaine, a nonprofit waste management company located in southern Maine.

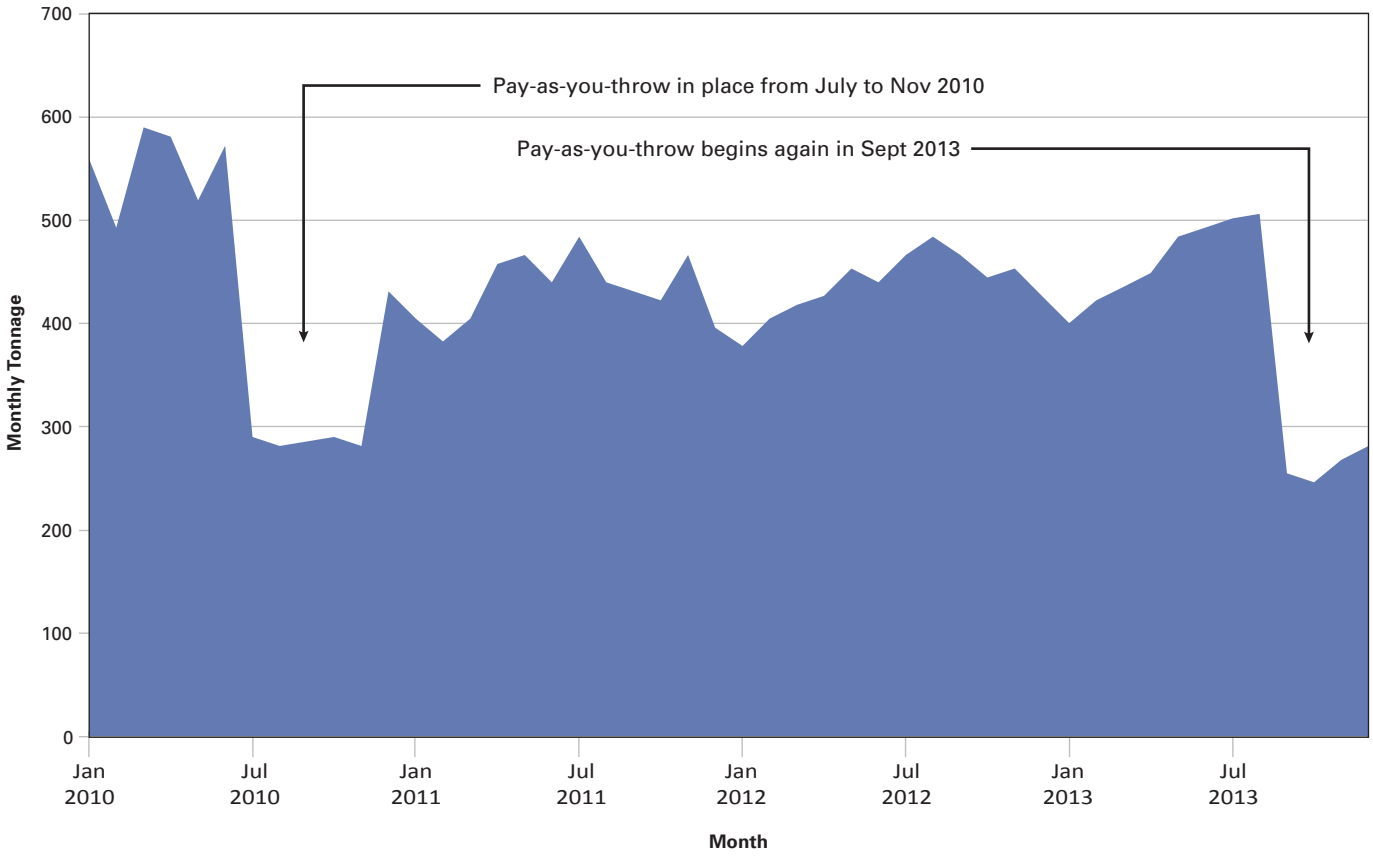
The four waste management programs we examine in this paper are

1. Curbside trash collection: The public collection of residential trash, normally at the curb of each resident.
2. Curbside recyclables collection: The public collection of residential recyclable materials, normally at the curb of each resident. Traditionally, curbside recyclables collection has required households to presort their recyclable materials prior to collection.
3. Single-stream recycling: The collection of recyclable materials where the materials are not presorted by the household prior to collection, sometimes also referred to as "single-sort," and "co-mingled."
4. Pay-as-you-throw (PAYT): The requirement that residents pay a fee for the waste they throw away. The fee can be based on volume or weight, and in Maine this is normally accomplished with a fee per trash bag, sometime called "pay-by-the-bag." Households buy official municipal trash bags, or stickers to attach to their trash bags, through local vendors.

These four waste management programs can be implemented individually, although their use is often combined. In Maine, curbside trash is normally collected weekly. Municipalities either acquire a compactor garbage truck or contract with a third party for trash collection. Curbside recyclables collection is managed similarly to curbside trash collection, although it often occurs less frequently (biweekly or monthly). Many smaller municipalities have chosen not to adopt curbside collection, and require residents to transport their own trash and recyclables to a transfer station or to contract with a third party.

Single-stream recycling is relatively new in the recycling world. Its approach takes advantage of two features: economy of size and ease of participation. Economy of size refers to the general rule that average costs decline when the volume of materials handled increases. This phenomenon holds for the collection and preparation of recyclable material for sale. The facilities that process recycled materials are called "materials recovery facilities" (MRFs). The efficiency of MRFs is due to a large extent to the use of machines and other economizing features such as a better flow of materials and storage capacity. For MRFs to obtain the large

FIGURE 2: **Waste Tonnages for Sanford, Maine 2010–2013**



Source: Authors' graph, data from Kolling-Perin (2013)

quantities of recyclable materials necessary for economizing they must draw from large and/or densely populated areas.

The second feature that makes single-stream recycling effective is its ease of participation. The ability to place all recyclable material into one large container makes it easier for households to recycle, and participation increases with more convenient programs (U.S. GAO 2006; Wagner 2013). Additionally, single-stream recycling creates savings in collection and hauling. Since no sorting of the material is required while loading recyclables onto the truck during collection, it is a faster process saving both labor and truck time.

Another advantage of single-stream recycling is that often the range of materials being collected can be expanded. Single-stream recyclable material is usually trucked to a MRF for automated sorting. The MRFs are generally located in centralized areas and are designed to have adequate area for materials storage. The larger storage capacity allows for storing sufficient materials until full truckloads of materials are attained. Despite the advantages of single-stream recycling, there are detractors who criticize the system. A primary concern is the displacement of the activity from the local area. Critics note that valuable materials are leaving the local economy (including cardboard and aluminum), and also note the loss of local jobs required for materials handling and processing.

Of the four municipal programs discussed in this report, pay-as-you-throw is by far the most controversial, both in terms of its impact and its acceptance by the public. Due to this controversy, we will include the following section to give this topic the discussion it deserves.

Pay-as-You-Throw: Discussion and Estimated Impacts

There is general agreement that pay-as-you-throw programs (PAYT) reduce the quantity of waste that households discard. However, there is considerable difference of opinion on the overall costs and benefits of PAYT. Some critics believe that residential solid waste programs should be provided as a municipal service and paid for with taxes. These individuals frequently note that if PAYT is adopted, local property taxes should decline. Advocates promote PAYT as an effective means of reducing waste disposal. They point out that PAYT systems reward households that reduce their waste and shift some of the waste management costs from the municipal general fund to those who generate the waste. However, others point out that the PAYT fee system can cost lower-income families a greater portion of their household income, resulting in what economists refer to as a regressive tax.

In two papers, Fullerton and Kinnaman evaluated the impact of unit pricing (the broader economic term for user fees, which include PAYT). In a 1996 report, they found that unit-pricing resulted in a 14 percent reduction in waste and a 16 percent increase in recycling amongst Virginia households (Fullerton and Kinnamon 1996). However, the authors reported that the estimated cost savings did not cover the administrative cost of the program. The presence of illegal waste dumping was also noted, which would reduce the estimated recycling effectiveness. In a later paper, these authors focused on the demand for waste and recycling programs and the relation between regional tipping fees and municipal trash unit price (e.g., price per bag) (Kinnaman and Fullerton 2000). In this paper they also bring up the issue of self-selection: municipalities that are well suited for a unit-pricing program are more likely to select this option. Thus the average results for PAYT and other unit-pricing systems may not be applicable to all types of municipalities.[2]

In examining actual municipal weight data, it is not uncommon for municipalities to observe an approximate 50 percent reduction in their waste tonnage after implementing PAYT (U.S. EPA 2010). Based on these results, many municipalities strongly support PAYT as a method of reducing trash and increasing recycling. The EPA also supports PAYT and provides many web resources about this waste management option for citizens, municipal governments, state officials, civic groups, and businesses. These resources include research, presentation and public outreach materials, worksheets, factsheets, bulletins, and suggested implementation outlines.

The case of Sanford, Maine, is a good example of PAYT resulting in dramatic changes in waste disposal volume (Kolling-Perin 2013). Sanford first adopted PAYT in July of 2010. In spite of the large drop in waste generation over a five-month period, citizens repealed a PAYT ordinance in November. Three years later PAYT was reinstituted, resulting in dramatic waste reduction. Figure 2 shows both periods where PAYT was instituted and where dramatic drops in waste tonnages are evident. When Sanford adopted PAYT in 2010 waste tonnages fell from a high of near 600 tons per month to under 300 tons per month. With the second adoption of PAYT similar large reductions are evident.

One difficulty in evaluating the effectiveness of PAYT is uncertainty about where the trash that is diverted from the residential waste stream is going. When a PAYT program is first implemented, results show that for every ton of material diverted to the recycling bin, about two tons of waste is either not generated or goes elsewhere. From a municipal standpoint, the waste seems to disappear. The good news is that disappearing trash aligns with the Maine waste hierarchy since the first priority is to reduce the amount of waste generated. Consumers are expected to generate less waste with PAYT programs because of the monetary incentive to do so. This can be accomplished through various methods including selecting items with less packaging, reusing items, and home composting.

Advocates promote PAYT as an effective means of reducing waste disposal.

Unfortunately, another method some households use to reduce their waste disposal costs is through illegal dumping or other inappropriate waste disposal methods. These practices include dumping trash in public places or commercial dumpsters, backyard trash burning, bringing waste to other municipalities, and disposing of household garbage at work. According to a *Bangor Daily News* report (May 12, 2013), one municipality

TABLE 2: **Factor Impact on Residential Recycling Percentage**

Factors	Statistical Significance?	Estimated Impact on Recycling
PAYT	Yes	Positive
Curbside Recycling	Yes	Positive
Curbside Trash	Yes	Negative
Population	Yes	Positive
Median Family Income	Yes	Positive
Economic Sentiment	Yes	Negative
Trend	Yes	Positive
Curbside Recycling Trend	Yes	Positive
Curbside Trash Trend	Yes	Negative
PAYT Trend	No	
Single Stream	Marginal	Positive
Unemployment Southern Maine	No	

(Presque Isle) experienced a significant increase in illegal dumping as a result of PAYT, while another (Portland) did not. An analysis published in 1995 found anecdotal evidence that illegal or inappropriate waste disposal (termed "waste shifting") was associated with the adoption of PAYT, but concluded that waste shifting was not in fact a widespread problem (Seguino, Criner, and Saurez 1995).

Analysis of Four Residential Waste Policies

In this section we discuss the estimated impact of four residential solid waste policies on the percentage of household waste recycled. The results are summarized here, and further technical details about the model and the specific data summarized are available from the authors upon request. The four policies we consider are curbside trash collection, curbside recyclables collection, single-stream recycling, and pay-as-you-throw (PAYT). We define percent recycling as the tonnage of recyclable material collected, divided by the sum of both the tonnage of recyclable materials collected plus the tonnage of waste materials collected.

The waste and recycling data for the analysis was primarily obtained from ecomaine, a nonprofit company offering a range of waste management services in southern Maine including trash and recyclables collection, materials recovery, waste-to-energy, and landfilling services. The ecomaine data contain the quantities of both materials discarded as trash and materials collected for recycling for 33 municipalities. The data period is 2007 through 2013. Due to the nature of solid waste and recycling programs, monthly tonnages of recycling or waste were not available for some towns for certain time periods. In addition to the ecomaine data, demographic and economic information was collected about the municipalities and added to the dataset. These supplemental variables included municipal population and municipal income, unemployment rate over time (using greater Portland rate as the dataset proxy), and an economic sentiment variable (the publically traded S&P 500 fund index). The unemployment and economic sentiment variables are included as different indicators of the strength of the economy. When the economy is improving consumers tend to purchase more goods, which would increase materials needing disposal. These variables are included in an attempt to capture this effect.

Table 2 presents the overall finding of the first statistical model. The first column lists the factors thought to influence percent recycling. The second column indicates whether the variable was found to be significant or not (at the 90 percent level or above), and the third column indicates the estimated impact the factor has on recycling (positive or negative).

As expected, we see that PAYT and curbside recycling have a positive impact on percent recycling. Single-stream recycling also has a positive estimated impact, but with marginal statistical significance. We suspect that the marginal significance finding is due to the lack of single-stream program variation within our dataset.[3]

Here is an example to help illustrate these results. If a municipality that was not using any of these waste management programs initiated PAYT, single-stream recycling, and curbside recycling, the estimated increase in percent recycling would be over 22 percentage points. PAYT and curbside recycling are estimated to increase percent recycling by 12 and 9.5 percentage points, respectively.

The impact of curbside trash collection was found to have a significant and negative impact on percent recycling by 5 percentage points. This finding agrees with the theoretical expectations, since curbside trash collection makes throwing materials away easier than other disposal methods including recycling. When waste disposal is more convenient, households have less incentive to recycle.

The results indicated that as a municipality's population and income increase, the municipal rate of recycling increases. The economic sentiment variable was found to have a negative influence on recycling, and the unemployment rate was not found to influence the recycling rate.

Trends are frequently observed in data, and we investigated whether some of our phenomena were trending. We found a positive trend for the recycling percentage overall, and a positive trend in the impact of curbside recycling. That is, over time the presence of curbside recycling was estimated to result in a municipality recycling more and more. A negative trend was found for curbside trash collection, implying that, over time, the presence of curbside trash collection tends to reduce the percentage of residential recycling. No trend was found for PAYT.

A second statistical model was used to explore the impact of the four policy variables.[4] Table 3 shows the estimated impact of the variables PAYT, single-stream recycling, and curbside recycling. Curbside trash collection is omitted due to the technical reason that it has no variation across any of the sampled population (all municipalities either had curbside trash collection or did not, during the entire time period).

The estimated impacts for PAYT and curbside recycling were similar but slightly smaller than those of the first model at 9.5 and 8.5 percentage points, respectively, while single-stream recycling had a larger impact at nearly 4 percentage points. The model estimates that a municipality implementing all three of these programs would increase their percent recycling by nearly 22 percentage points.

TABLE 3: **Fixed Effect Recycling Percentage (Dependent Variable is Percent Recycling)**

Factors	Statistical Significance?	Estimated Impact on Recycling
PAYT	Yes	Positive
Single Stream	Yes	Positive
Curbside Recycling	Yes	Positive

DISCUSSION AND CONCLUSIONS

Solid waste management is an expensive, dynamic, and sometimes contentious issue for many municipalities. There is no best system for all municipalities, but information exists to help municipalities in their decisions. This paper has investigated four residential solid waste programs and the effects of various municipal demographic and economic characteristics on residential and recycling percentages. Two models are developed as part of this analysis and the results have overall good statistical significance. The models support the notion that PAYT, curbside recycling, and single-stream recycling increase a municipality's percent recycling. Curbside trash collection was estimated to negatively affect percent recycling.

While the models and municipal data show significant impacts from the solid waste management options, it is important to note the limitations of this information in making large inferences for all Maine municipalities. The options of PAYT, single-stream recycling, and curbside recycling have been available for less time than curbside trash collection. In rural areas curbside recycling and trash collection may not be economically feasible due to a low population density.

Creating a PAYT program that forces individuals to pay for each bag of waste is an option that many Maine municipalities have found creates a minimal inconvenience, although the experience reportedly varies. Some municipalities have found temporary or long-term illegal dumping. Anecdotal information suggests that in some cases PAYT is not a good match for municipalities with temporary residents, such as vacation spots or college towns. For example, it might be a challenge to educate short-term renters and out-of-state summer residents as to where and how to acquire special PAYT bags for disposal. Additionally, PAYT may be difficult to implement in highly urban areas where trash is often collected in dumpsters.

Municipalities should also be aware that there are residential solid waste management policy options beyond the four examined in this study. For example, some municipalities have a mandatory recycling ordinance. These may or may not be effective, as they take fortitude in enforcement. Another program a municipality might explore is mandatory composting as roughly 40 percent of the residential waste stream is compostable. A municipality might opt to collect compostable waste in a split compactor truck and alternate its collection with single-stream recyclables on a weekly basis.

The questions surrounding the future of municipal solid waste in Maine are complex and the best solution is subjective to the opinions, experiences, and beliefs of the individuals attempting to analyze the situation.

Municipalities looking to alter their program offerings can employ these estimates to evaluate the impacts of an intended change on their combined waste and recycling stream.

ENDNOTES

1. U.S. Department of Environmental Protection. 2014. Municipal Solid Waste Generation, 1960–2012. http://www.epa.gov/epawaste/nonhaz/municipal/
2. A study by Allers and Hoeban (2010) on 458 Dutch municipalities found that self-selection was not present and the impacts of PAYT were much larger.
3. For most of our dataset, single-stream programs were present, with few cases of "no single-stream." Without a good number of data observations with and without single-stream, finding statistical precision can be difficult.
4. The model employed is a fixed-effect model, which allows each municipality and time period to have its own unique effect that incorporates the unobservable characteristics with the observable ones.

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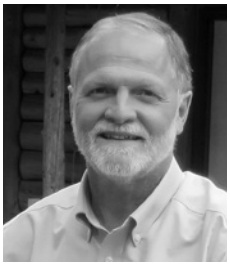

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