Recycling in Maine Municipalities:

What Makes it Tick?

Background and Purpose

Although Maine has long had a strong recycling rate relative to the nation, recycling in Maine has experienced virtually no growth in the last decade. In fact, recycling in Maine has declined since 1997, when it peaked at a rate of 42%. The most recent numbers (for 2006) put Maine's recycling rate at 36.2%. Since 1989, it has been the official goal of the State of Maine to reach a recycling rate of 50%.

Given the potential benefits of increased recycling—both economic and environmental—surprisingly little research has been done on what factors lead people to recycle at the residential level, and the relative importance of these various factors. This is a particularly important issue for the State of Maine, whose recycling rate has stagnated while other states have significantly improved their rates.

In order to examine this issue, this study has been designed in order to identify factors that influence residential recycling rates in Maine at the municipal level. One of the primary questions this study seeks to explore is whether municipal recycling success is influenced more by nature or nurture—in other words, is recycling influenced more heavily by demographic factors or by municipal policies that seek to promote recycling?

Residential recycling rather than commercial recycling was chosen as the focus of this study for a number of reasons. Not only is it a critical part of statewide recycling, but it is also very difficult to make comparisons of commercial recycling between towns since there is such great variation in the extent to which commercial recycling and waste is handled or tracked by each municipality.

Furthermore, in order to measure the influence of demographic factors, it only really makes sense to look at residential recycling rates. After all, a very large number of Mainers work for (or even own) businesses in towns in which they do not reside; thus, commercial recycling in a town can not be validly linked to that town's demographics. Moreover, many recycling policies that towns implement (curbside recycling, pay as you throw, etc.) only really affect residents; as a result, including commercial recycling would only obscure the impact of the policies.

By exploring both demographic factors and various municipal recycling policies, this study aims to first identify what successful recycling programs tend to have in common, and then to provide general recommendations for methods of increasing recycling rates in Maine towns.

In terms of organization, this report is divided into two main parts. The first is a statistical, quantitative section exploring demographic and municipal factors that may influence recycling, and the second is a qualitative section with case studies of recycling programs in Maine towns. By combining these two approaches, this report can hopefully provide a more comprehensive account of what may influence recycling rates—both on the broader level of differences between towns, and the more focused level of recycling issues within individual towns.

Note: this study and subsequent report was the project for the Program's 2008 summer intern, Nicholas Miller.

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Methodology

Data Sources

For recycling rates and data on the various policies and waste breakdowns in each municipality, information was obtained from the 2006 annual reports submitted by each municipality to the State Planning Office's Waste Management and Recycling Program.

As a specific measure of recycling rates, this study utilizes the 'Adjusted Recycling Rate' as calculated by the Program. The Adjusted Rate is calculated by taking the percentage of total waste that was recycled or reused, adding 5 points as a bottle bill credit, and then adding up to ten points based on the level of backyard composting activities in the town. This measure is designed to provide a slightly more comprehensive benchmark than the simple ratio of recyclables to waste since composting is an important means of recycling that is often unaccounted for.

Another measure used is the 'Municipal Recycling Rate,' which is the percentage of non-bulky household waste that is recycled—in other words, small items like cardboard, paper, glass, milk bottles, tin cans and not bulky items such as furniture, yard and leave waste, or wood. This isolates the rate at which a municipality recycles the most basic household materials, and allows for the analysis of how various policies and demographic factors affect different types of recycling.

Demographic data was taken from the 2000 census and an updated 2006 population estimate for Maine towns. 2006 voter registration data was obtained from the Maine Bureau of Corporations, Elections, and Commissions website. Information in the case studies is derived from 'one on one' interviews with municipal officials in each town.

Selection of Municipalities

In order to examine the effects of demographic factors and municipal policies on residential recycling in Maine, the 308 towns and regions that report recycling data to the State were narrowed down to a sample of 61 municipalities by applying the following criteria:

1) the municipality must have submitted recycling data in 2006.

2) the municipality must have reported recycling data as an individual town/city, and not as part of a region.

3) the municipality must have reported only residential waste and recycling, and not included any commercial recycling and waste in its totals.

4) the municipality's data must be free of any obvious flaws in accuracy, specifically in regards to known undercounts of trash or over counts of recyclables.

5) the municipality must have a population of at least 200

The first and fourth criteria were established to ensure reasonably accurate data and protect the validity of any findings, while the second criterion was established in order to make measurement of demographic factors possible. Since census data is reported at the level of the individual municipality, it was not possible to obtain reliable demographic data on the regional recycling groups. The third criterion was established in order to focus on residential recycling, which ensures the comparison of "apples to apples," so to speak, while the fifth criterion was used to prevent any skewing of the data by the particularities of exceedingly small towns.

Towns were selected for case studies in order to represent a reasonable range of demographic characteristics and municipal policies, and to illuminate the different paths towns can take to achieve successful recycling rates. Proximity to Augusta was also a consideration since visits were made to each transfer station to conduct the interviews.

Selected Demographic Variables for Study

1. Income Level

Measure: Median household income
Hypothesis: Higher income correlates with higher recycling rates

2. Level of Education

Measure: Percent of population 25 and older with bachelor's degree or higher
Hypothesis: More educated towns recycle at higher rates

3. Age

Measure: Median age
Hypothesis: Towns with older populations recycle less

4. Population

Measure: Total population, population density
Hypothesis: Larger/more densely populated towns recycle at higher rates

5. Political Party Affiliation

Measure: Percent of population registered as Democrats or Greens
Hypothesis: Towns with more registered Democrats and Greens recycle more

6. Level of Homeownership

Measure: Percent of households occupied by their owners
Hypothesis: Higher homeownership levels correlate with higher recycling rates

7. Seasonal Residents

Measure: Ratio of seasonal households to year-round households
Hypothesis: Towns with higher levels of seasonal residents recycle less

Selected Municipal Policies for Study

1. Materials Accepted

Measure: The number of different categories of material the municipality reported recycling in 2006, with mixed paper counted as 3 since it encompasses several categories
Hypothesis: More materials accepted as recyclables correlates with higher recycling rates

2. Town Ordinance

Measure: Does the municipality have a recycling/solid waste ordinance?
Hypothesis: Promotes recycling by establishing town rules and guidelines

3. Mandatory Recycling

Measure: Does the municipality have a mandatory recycling policy?
Hypothesis: Promotes recycling by making it official town policy

4. Pay as You Throw

Measure: Does the municipality charge residents by the bag for trash?
Hypothesis: Promotes recycling by providing economic incentive to limit trash and recycle

5. Curbside Trash Collection

Measure: Does the municipality provide or contract for curbside collection of trash?
Hypothesis: Little effect when coupled with curbside recycling, discourages recycling when provided on its own

6. Curbside Recycling

Measure: Does the municipality provide or contract for curbside collection of recyclables?
Hypothesis: Promotes recycling by making it more convenient

7. Recycling Committee

Measure: Does the municipality have a recycling/solid waste committee?
Hypothesis: Promotes recycling through to advocacy and oversight

Statistical Methods

In order to gauge the impact of various demographic factors and municipal policies—both individually and in concert—a variety of statistical measures were used in a cross-sectional analysis of 2006 recycling data for the selected municipalities. These measures include basic descriptive statistics such as mean, median, and standard deviation, as well as tests for correlation between variables.

Since recycling rates can be increased in several different ways—either by increasing the proportion of waste that is recycled, decreasing the amount of waste produced, or both—this study

will also examine the influence of the different variables on the amount of recyclables and waste per person in order to determine the mechanism by which each variable affects recycling rates.

While these metrics can not definitively prove causation, this is an unavoidable issue in the social sciences. The use of correlation measures do at least determine the strength and direction of a relationship between variables, allowing for reasonable inferences about the data. Furthermore, in a phenomenon as complex and multifaceted as recycling behavior, these tools allow us to examine the broad range of factors that may influence recycling.

Rather than a rigorous statistical study, this should be viewed as a statistical snapshot of residential recycling in Maine based on the best information available. Due to the criteria used to select municipalities with comparable, reliable data, the sample of towns is not random, which makes direct inferences about the overall population of Maine municipalities difficult. However, given that the study includes more than a fifth of all recycling programs in Maine with a broad range of demographic characteristics and municipal policies, it is probable that the findings are indeed applicable to much of Maine.

Selected Municipalities

Applying the five selection criteria (described earlier) yielded 61 municipalities to study. A full list of the municipalities is below, followed by a summary of the sample's characteristics.

Acton	Eliot	Mercer	South Portland
Alton	Falmouth	Monroe	Standish
Arrowsic	Freeport	Mount Vernon	Stetson
Athens	Georgetown	Naples	Stockton Springs
Belmont	Glenburn	Newburgh	Swanville
Berwick	Gray	North Yarmouth	Van Buren
Burnham	Greene	Orrington	Veazie
Buxton	Hebron	Otisfield	Vienna
Canaan	Hollis	Parsonfield	West Bath
Canton	Lagrange	Penobscot	Westbrook
Cape Elizabeth	Lamoine	Pownal	Winterport
Casco	Lebanon	Raymond	Woolwich
Chester	Levant	Sanford	York
Chesterville	Limerick	Scarborough	
Clifton	Limington	Searsport	
Cumberland	Mechanic Falls	South Berwick	

Demographic Variable	Average	Median	Standard Dev.	Range
Income	$42,223	$40,811	$10,307	$20,038-$72,359
Education	22.73%	20%	11.69%	6.8%-58.7%
Age	38.67	37.95	2.51	33.8-45.2
Population	4,554	2,557	5,112	509-23,784
Party Affiliation	30.87%	30.2%	6.27%	19.6%-61.3%
Homeownership	82.72%	84.85%	7.94%	54.4%-92.6%
Seasonal Residents	.215	.119	.259	.002-1.202

Municipal Policy	Towns w/ Policy	Towns w/o Policy	% with Policy
Pay as You Throw	10	51	16.39
Mandatory Recycling	14	47	22.95
Curbside Recycling	21	40	34.42
Town Ordinance	30	31	49.18
Curbside Trash Collection	38	23	62.29
Recycling Committee	33	28	54.09
	Average Number	**Range**	
Materials Accepted	10.16	1-18	

Recycling Measures	Average	Median	Standard Dev.	Range
Adjusted Recycling Rate	29.21	26.99	15.92	7.65-67.82
Municipal Recycling Rate	13.31	10.97	7.80	0-33.46
MSW per Person (Tons)	.639	.615	.195	.262-1.24
Recyclables per Person (tons)	.144	.095	.128	.008-.613

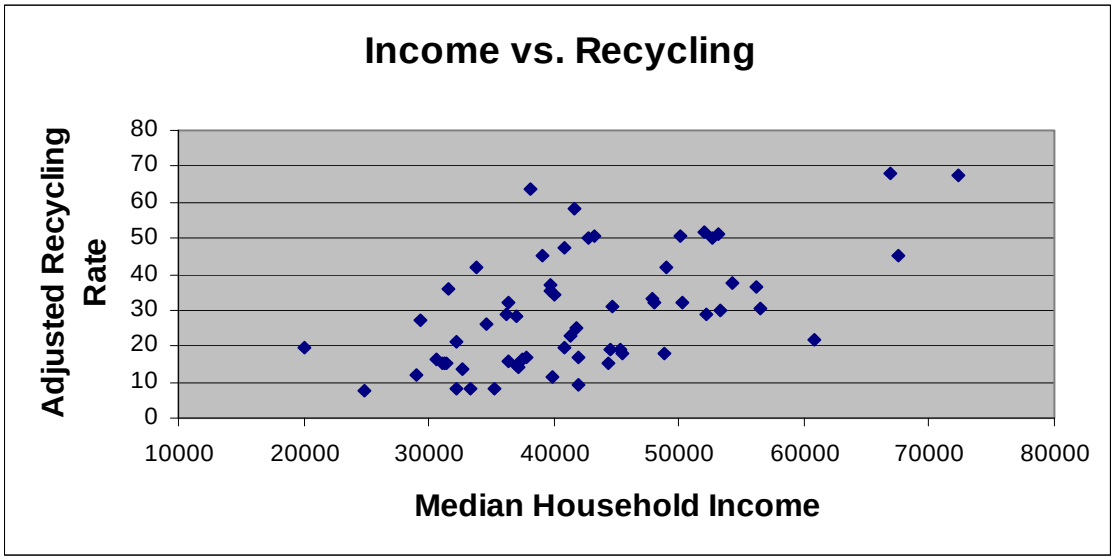
As far as geography goes, the table below breaks down the number of municipalities in the study by county. Because of the criteria used to select towns for this study, certain geographical areas are more represented than others simply because of the way their towns collected and reported their data. For example, may of the more rural areas are under-represented simply because regional recycling programs are more prevalent than municipal programs in those settings.

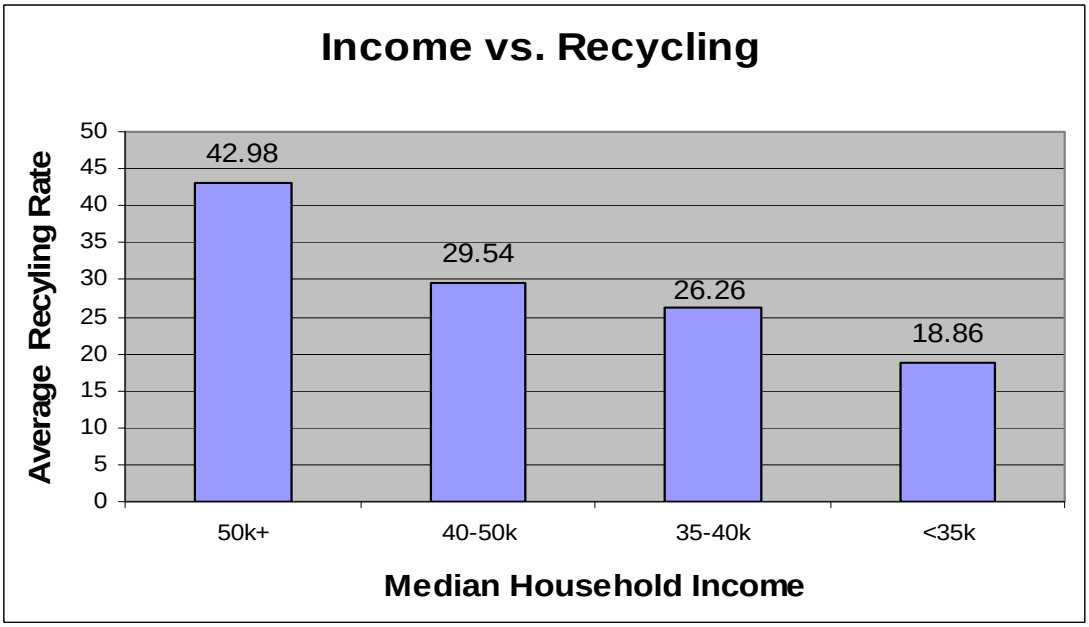
County	# of Towns in the Study		County	# of Towns in the Study
Androscoggin	2		Oxford	3
Aroostook	1		Penobscot	10
Cumberland	14		Piscataquis	0
Franklin	1		Sagadahoc	4
Hancock	2		Somerset	3
Kennebec	2		Waldo	7
Knox	0		Washington	0
Lincoln	0		York	12

Demographic Factors: Results and Analysis

1. Income

Results: Of all the demographic factors examined in this study, income was the best predictor of recycling success. The correlation coefficient between income and recycling rate for municipalities was .572—quite a strong relationship, especially in the social sciences. As the two graphs below illustrate, there is a pronounced and positive association between the two variables.





Towns whose median household incomes are greater than $50,000 a year recycled at an average rate close to 43, which is more than 46% percent higher than the average town in the sample. Conversely, towns with median household incomes below $35,000 had an average recycling rate

of 18.86%-- only 64% of the average town's rate. Towns in the middle range—between $35,000 and $50,000 a year—had an average recycling rate very close to the sample's mean of 29.21.

As the table below illustrates, higher income was not correlated with higher levels of waste per person as some might predict, but was significantly correlated with higher levels of recyclables per person, thus driving the higher recycling rates. The correlation with municipal recycling rates was virtually the same as with adjusted rates.

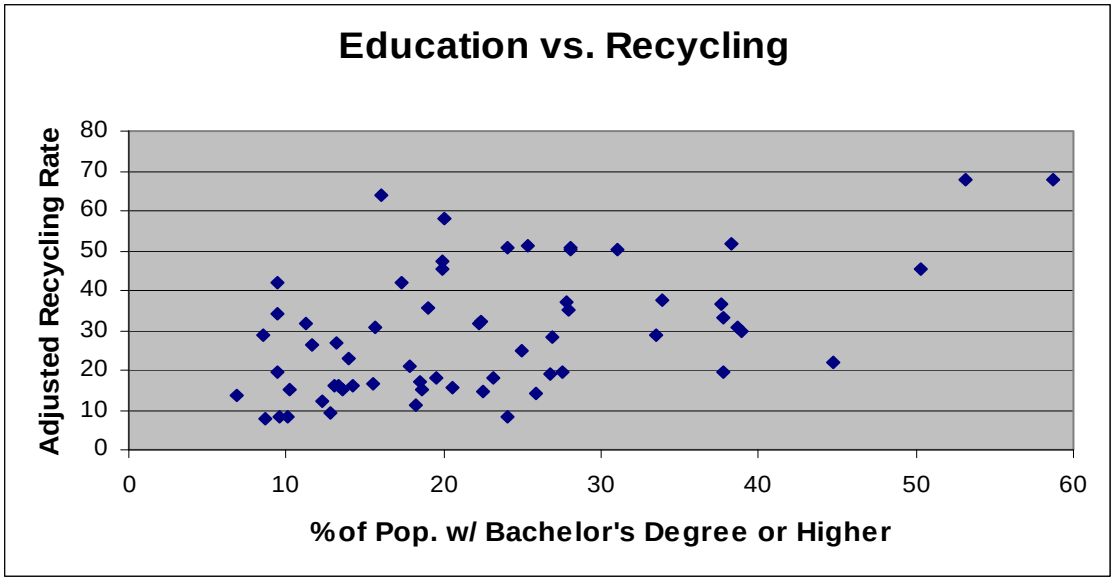
Measure	Pearson Correlation Coefficient*
Waste per Person	.002
Recyclables per Person	.384
Adjusted Recycling Rate	.572
Municipal Recycling Rate	.563

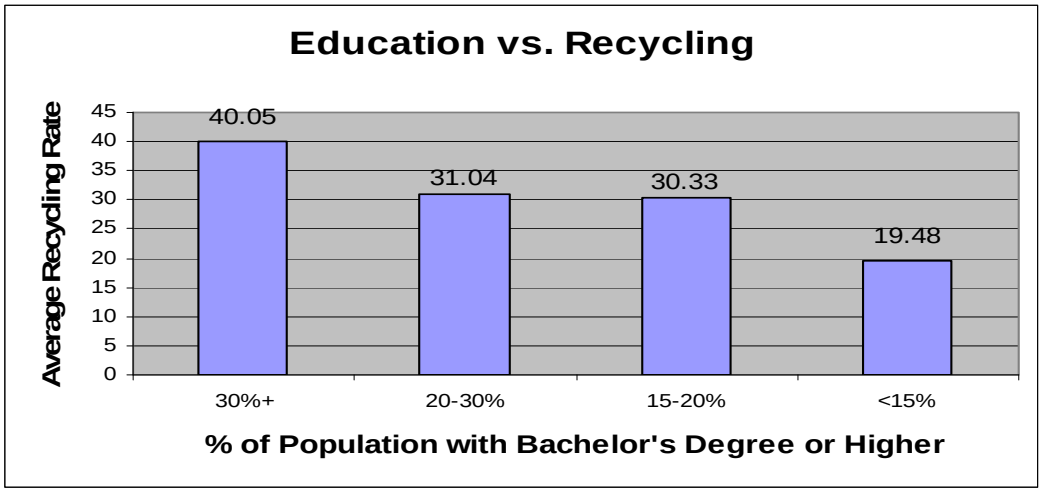
Analysis: As hypothesized, income does indeed correlate positively with recycling rates. There are a number of underlying factors that could contribute to this relationship; for example, wealthier people may have more time or energy to devote to recycling, and wealthier towns may have more money to devote to recycling efforts in the first place. Additionally, the correlation between income and education could mean wealthier people are simply more aware of the benefits of recycling due to their schooling.

** In statistics, the Pearson product-moment correlation coefficient is a common measure of the correlation between two variables X and Y.*

2. Education

Results: Education is also a strong predictor of recycling success according to this study's results, which should not be surprising given the strong correlation between income and education levels—a correlation of .835 in this sample. The correlation between education and recycling rates was .506, and the graphs look quite similar to income graphs featured above.





Again, average recycling rates rise through each bracket of education levels, with the big variations being at the very low levels (less than 15% of the population with a bachelor's degree), and the very high levels (more than 30% of the population with bachelor's degrees). More educated towns tended to produce slightly less waste, and significantly more recyclables per person. Interestingly, education has a substantially higher correlation with municipal rates (.553) than with adjusted rates (.506).

Measure	Pearson Correlation Coefficient
Waste per Person	-.036
Recyclables per Person	.336
Adjusted Recycling Rate	.506
Municipal Recycling Rate	.553

Analysis: Also as predicted, education levels had a strong positive relationship with recycling rates. This makes sense intuitively since more schooling likely leads to more awareness about the benefits of recycling. In addition, the very strong correlation between education and income implies that there is a substantial amount of feedback between the two factors.

3. Age

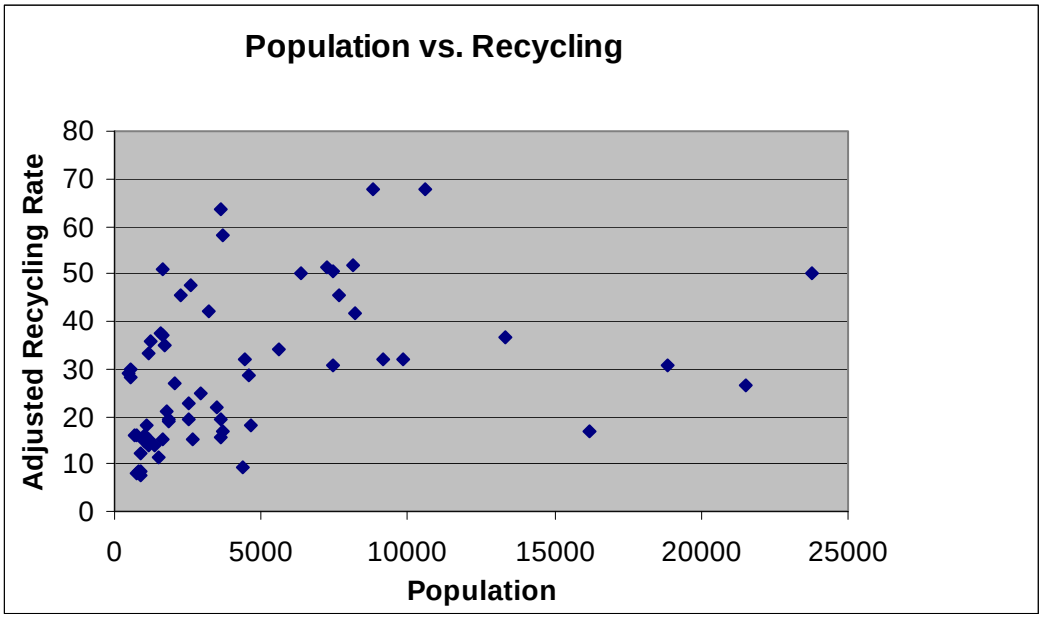
Results: Compared with income and education, age had a very modest correlation with recycling rates at .101. When just municipal rates were considered, the correlation increased to .188—larger, but still relatively weak. Older populations had a very slight negative correlation with waste per person, and a very slight positive correlation with recyclables per person.

Measure	Pearson Correlation Coefficient
Waste per Person	-.080
Recyclables per Person	.076
Adjusted Recycling Rate	.101
Municipal Recycling Rate	.188

Analysis: Contrary to the hypothesis, towns with an older population do not recycle at lower rates. In fact, they have slightly higher rates, although the relationship is very weak. The correlation may be largely due to the fact that median age had a correlation of .412 with education. In other words, the small positive relationship may simply be a result of the correlation between age and education, not age itself.

4. Population

Results: While not as accurate of a predictor as income and education, population did have a moderate positive correlation with recycling rates with a coefficient of .367. As the graph illustrates, however, there is quite a strong positive relationship between the two variables until the very largest towns in the sample are included. In fact, if the data is limited to towns with less than 15,000 residents, the correlation with recycling increases to .508, which is slightly higher than education's correlation with recycling rates. If it is limited to towns with a population of 9,000 or below, the correlation becomes .590—an even stronger relationship with recycling rates than income.



Population density correlated somewhat less with recycling rates, checking in at .286. Similarly to simple population, however, if you limit the sample to all but the most densely populated towns (less than 400 people per square mile), the correlation becomes quite strong, at .534. This is not surprising, since population and population density shared a correlation of .728.

Not surprisingly, larger towns correlate with slightly higher levels of waste per person, but they also correlate with significantly higher levels of recyclables per person. Population correlated significantly less with municipal rates (.269) than with overall adjusted rates (.367).

Measure	Pearson Correlation Coefficient
Waste per Person	.084
Recyclables per Person	.229
Adjusted Recycling Rate	.367
Municipal Recycling Rate	.269

Analysis: In line with the hypothesis, there is a substantial positive correlation between population and recycling rates. This could be the result of better recycling infrastructure and economies of scale, and also could be partially due to the moderate correlation between population and income (.339). Relatively lower recycling rates in the largest towns may be due the fact that cities tend to have lower average income and education levels than their somewhat smaller suburban counterparts, and the fact that recycling is generally more difficult in apartment complexes.

5. Political Party Affiliation

Results: This study found virtually no correlation between party affiliation and recycling, with a coefficient of .042. Party affiliation with Democrats or Greens had very weak negative correlations with both waste per person and recyclables per person.

Measure	Pearson Correlation Coefficient
Waste per Person	-.071
Recyclables per Person	-.022
Adjusted Recycling Rate	.042
Municipal Recycling Rate	-.019

Analysis: Contrary to the hypothesis, towns with more registered Democrats and Greens did not recycle at significantly higher rates than their more conservative counterparts in any discernible fashion. This implies that recycling is not strictly a liberal behavior and why Mainers recycle (or don’t recycle) on the municipal level are for reasons largely unrelated to their political beliefs. This does not prove, however, that political beliefs aren’t a factor on the individual level. In other words, it could be that within a given town, political liberals are more likely to recycle than conservatives.

6. Level of Homeownership

Results: There was also virtually no discernible relationship between recycling rates and homeownership rates, with a very small negative correlation of -.038, and similarly small negative correlations with waste and recyclables per person.

Measure	Pearson Correlation Coefficient
Waste per Person	-.040
Recyclables per Person	-.033
Adjusted Recycling Rate	-.038
Municipal Recycling Rate	-.049

Analysis: Although it is often more difficult to recycle in rented apartments than houses, there does not seem to be an overall relationship between homeownership and recycling. This could be due to the fact that homeownership is very high in many rural Maine towns (rural areas generally recycle at lower rates), and that there is a positive correlation between recycling rates and population (larger towns are likely to have a larger percentage of renters).

7. Seasonal Residents

Results: The ratio of seasonal to year-round households had a relatively weak correlation with recycling rates, compared to income and education, but a relatively strong correlation compared to other factors. The correlation coefficient was .196 with adjusted rates, and .211 with municipal rates. As one would expect, towns with higher proportions of seasonal residents did tend to produce more waste per person. However, because they also produced more recyclables per person on average, their recycling rates remained relatively high.

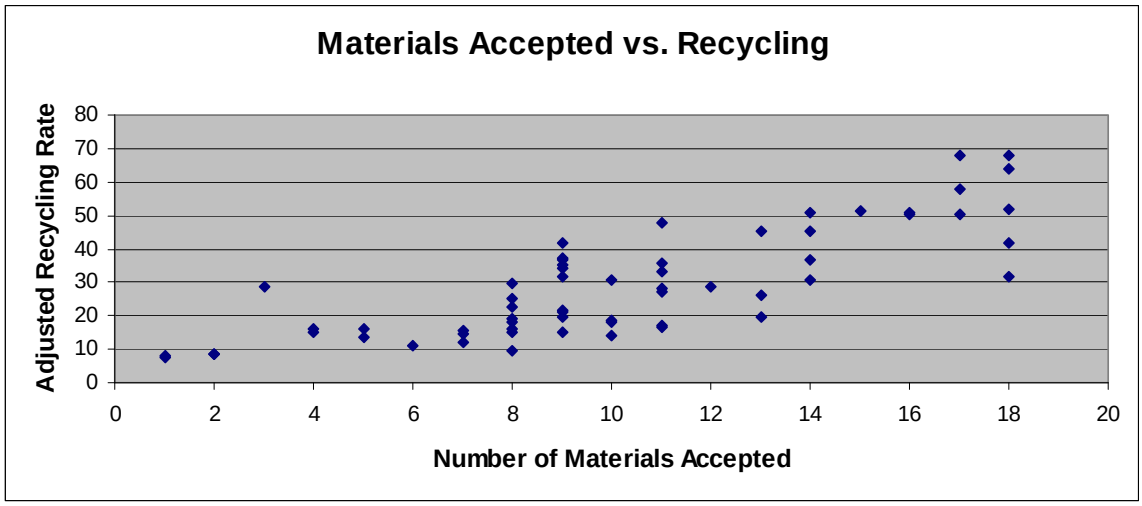
Measure	Pearson Correlation Coefficient
Waste per Person	.333
Recyclables per Person	.317
Adjusted Recycling Rate	.196
Municipal Recycling Rate	.211

Analysis: Surprisingly, towns with higher ratios of seasonal households actually recycled at slightly higher rates overall—contrary to the hypothesis. This is even more surprising since the ratio of seasonal households does not positively correlate with income, education, or population—the three demographic factors discussed above that significantly increase recycling rates. A possible explanation for this limited relationship is that seasonal residents (most of who are not counted in the census) tend to be more educated and wealthy than the town's permanent residents, leading to more recycling in summer communities than the demographics of their year-round residents would predict.

Municipal Policies: Results and Analysis

1. Materials Accepted

Results: Of all the variables examined in this study—both demographic factors and municipal policies—the number of different recyclable materials accepted in a municipality was by far the best predictor of recycling success, with a very high correlation of .805. As the graph below illustrates, the relationship was very strong in the positive direction.



Although the number of materials accepted had significant positive correlations with both income (.480) and education (.438), indicating that wealthier and more educated towns are more likely to accept more materials, the data shows that each set of factors still had effects that are to a large extent independent. As the table below illustrates, the relationship between materials accepted and recycling rates held strong across income levels, from the lowest to the highest.

Income Level	Correlation Between # of Materials and Recycling Rate	# of Municipalities
$50,000 and above	.680	14
$40,000-$50,000	.797	19
$35,000-$40,000	.772	13
$35,000 and below	.695	15

Similarly, as the next table shows, education and income retained positive correlations with recycling rates at various levels of accepted materials, with the one exception being education at communities that accept '0 to 7 materials'. In other words, both sets of factors appear to have discrete effects.

Number of Materials Accepted in Recycling Program	Correlation Between Income and Recycling Rates	Correlation Between Education and Recycling Rates	# of Municipalities
0-7	.306	-.154	13
8-9	.315	.130	18
10-13	.378	.436	15
14-18	.329	.398	15

Perhaps the most dramatic difference amongst towns relating to the variety of materials accepted is the extent to which they recycle bulky materials, which includes wood, construction and demolition debris, metal, and yard/leave waste, among other categories. As the table below indicates, accepting bulky materials as recyclables is a critical component in attaining high recycling rates. In fact, the number of bulky materials accepted had a correlation of .754 with recycling rates—not much lower than the overall correlation between materials accepted and recycling rates. This makes sense for two reasons: one, because more bulky waste is recycled than non-bulky waste; and two, because there is a larger variation in the extent to which bulky wastes are recycled in municipalities—many towns do not recycle bulky waste at all. The fact that the number of bulky materials accepted correlated with the number of non-bulky materials accepted at .524 certainly contributed to the relationship as well.

Number of Bulky Material Categories Accepted	Average Recycling Rate	# of Municipalities
0	15.99	16
1	19.22	10
2	27.93	9
3	30.21	5
4	41.34	10
5	46.29	8
6	49.10	3

Towns that accepted more materials produced more waste per person on average, but they also recovered dramatically more recyclables per person. The correlation between the number of materials accepted (in this case, non-bulky materials) and municipal recycling rates was .692.

Measure	Pearson Correlation Coefficient
Waste per Person	.286
Recyclables per Person	.691
Adjusted Recycling Rate	.805
Municipal Recycling Rate	.692

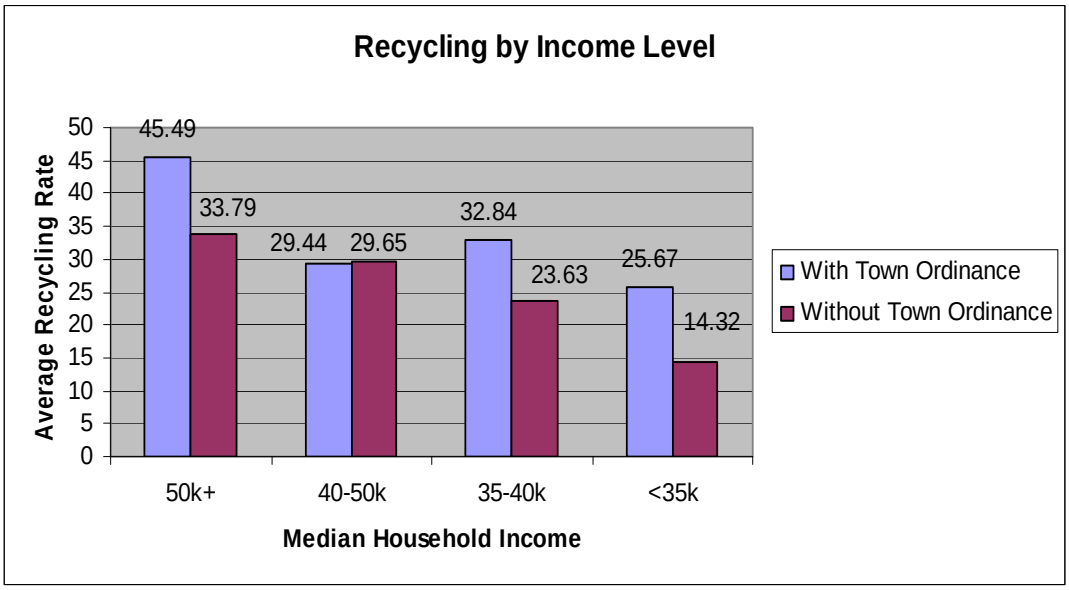
Analysis: The results make it clear that the variety of materials accepted is essential to determining the success of a municipal recycling program. This makes good sense intuitively, since more materials accepted means a higher percentage of the waste stream that can potentially be recycled. And while there is certainly reinforcement between demographic factors like education and income and materials accepted (i.e. wealthier towns are more likely to accept more materials), the results show that the two sets of factors have independent effects as well. In other words, even amongst a group of similarly wealthy towns, much of the variation in recycling rates is attributable to the variation in materials accepted. For example, many of the towns with high recycling rates and relatively low income and education levels were distinguished by very high numbers of accepted materials. At the same time, in a group of towns with similar numbers of materials accepted, income and education seem to play a significant role in affecting recycling success.

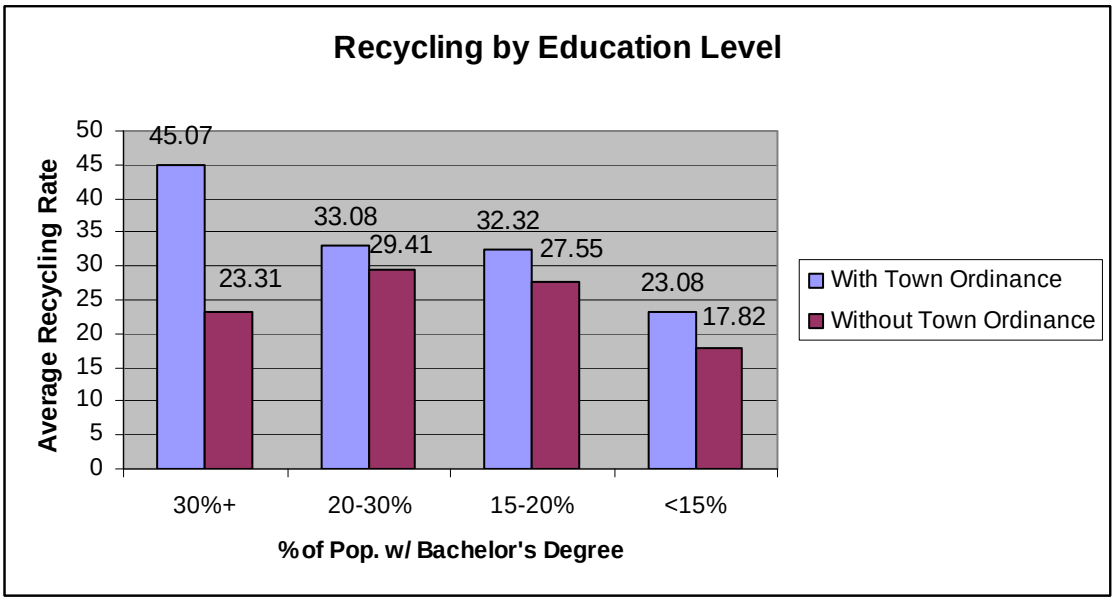
2. Municipal Ordinances

Results: Besides the number of materials accepted, whether a municipality had an ordinance establishing solid waste and recycling guidelines was the best predictor of recycling success amongst municipal policies. Municipalities with town ordinances had an average recycling rate more than ten points higher than towns without ordinances—a 47% higher rate on average. The presence of a town ordinance correlated with recycling rates at a level of .357—not nearly as strong a relationship as materials accepted, but still moderately strong.

	Average Rate	**Median Rate**	**Average Income**	**Average Education**	**Average # of Materials Accepted**	**# of Municipalities**
Town Ordinance	34.93	34.56	$46,615	24.00	11.00	30
No Town Ordinance	23.66	18.82	$38,282	19.21	8.58	31

Although municipalities with town ordinances also had significantly higher incomes and education levels on average, the positive correlation between ordinances and recycling rates generally held across various income and education levels, as the graphs below illustrate.





When the variable of the number of materials accepted was added in, the presence of an ordinance was less predictive of high recycling rates. At low numbers of accepted materials, town ordinances had almost no correlation with recycling rates; at high levels of materials accepted, it actually had a moderate negative correlation. For towns in the middle, ordinances had moderate positive correlations with recycling rates.

Number of Materials Accepted for Recycling	Correlation between Town Ordinances and Recycling Rates	# of Municipalities
0-7	.076	13
8-9	.252	18
10-13	.447	15
14-18	-.320	15

In terms of the mechanism through which ordinances influence recycling rates, the table below indicates that municipalities with ordinances tended to produce slightly more waste per person, but significantly more recyclables per person. Town ordinances correlated somewhat less strongly with municipal recycling rates (.305) than with adjusted recycling rates.

Measure	Pearson Correlation Coefficient
Waste per Person	.067
Recyclables per Person	.208
Adjusted Recycling Rate	.357
Municipal Recycling Rate	.305

Analysis: The results of this study indicate that having a town ordinance on solid waste is associated with higher recycling rates in Maine municipalities. However, once the variable of materials accepted is factored in, the results are far less clear or consistent. Thus, while simply establishing rules for solid waste and recycling may play a role in increasing recycling rates, it is likely that ordinances are often just a reflection of prevailing attitudes toward recycling. In other words, a town that is already committed to recycling may create an ordinance simply to reflect and codify this commitment. From this perspective, rather than an active tool to promote recycling, an ordinance on solid waste and recycling can perhaps be viewed as one sign of a town's commitment to recycling. Furthermore, since ordinances (and their enforcement) differ from town to town, it is difficult to generalize about their potential effects.

3. Mandatory Recycling

Results: Not surprisingly, all towns in this study that had mandatory recycling policies also had town ordinances on solid waste. As a result, mandatory recycling should be viewed as a subset of municipalities with town ordinances for the purposes of this study. With a weak negative correlation of .191, the results of this study yield no evidence that mandatory recycling has any significant impact on recycling rates over and beyond the effect of a town ordinance and the number of accepted materials. When the number of accepted materials was controlled for, there was no consistent or significant positive correlation.

	Average Rate	Median Rate	Average Income	Average Education	Average # of Materials Accepted	# of Municipalities
Mandatory Recycling	34.99	36.61	47289	25.32	11.07	13
No Mandatory Recycling	27.64	23.88	40972	22.03	9.91	48

Interestingly, mandatory recycling had a stronger negative correlation with waste per person than it did a positive correlation with recyclables per person. In other words, the somewhat higher recycling rates on average seem to have been driven more by a subset of towns that produced less rather than recycled significantly more.

Measure	Pearson Correlation Coefficient
Waste per Person	-.146
Recyclables per Person	.049
Adjusted Recycling Rate	.191
Municipal Recycling Rate	.223

Analysis: Contrary to the hypothesis, the numbers for towns with mandatory recycling cast doubt on whether such policies have any independent positive impact on recycling rates. Given that towns with mandatory recycling had very similar demographic characteristics to municipalities with town ordinances and did not have higher recycling rates on average, it may be that mandatory recycling is often more of a symbolic measure than a policy with any tangible impact. This is quite logical since there is very little enforcement of these policies in most Maine towns.

4. Pay as You Throw (PAYT)

Results: The municipalities in this study with pay as you throw programs (a system where residents pay a fee to dispose of their trash) did not have significantly higher recycling rates in 2006 than towns without such programs. Towns with PAYT had an average rate of 30.12, while towns without PAYT had a rate of 29.08—not a significant difference by any means. This is in spite of the fact that towns with PAYT were slightly wealthier and more educated on average than those without PAYT, and accepted slightly more materials on average.

However, if the PAYT towns are divided into those with town ordinances and those without ordinances (as a quick and easy way to separate the towns with greater emphasis on recycling), the differences are stark, with towns that also have an ordinance recycling at rates more than three times higher on average—albeit with much higher incomes, education levels, and numbers of materials accepted.

	Average Rate	Median Rate	Average Income	Average Education	Average # of Materials Accepted	# of Municipalities
With PAYT	30.12	19.1	44327	28.08	11.2	10
Without PAYT	29.08	28.53	41818	21.7	9.96	41
PAYT & Ordinance	50.57	48.52	60163	43.92	14.25	4
PAYT, no Ordinance	16.49	15.56	33769	17.51	9.16	6

Encouragingly, PAYT programs did have a substantial negative correlation with waste per person, implying that they are relatively successful at reducing the amount of waste produced—one of the main goals of such programs. Another encouraging sign is that PAYT correlated positively with municipal recycling rates (.198), indicating that PAYT may have promote the recycling of small, household items if not bulky items.

Measure	Pearson Correlation Coefficient
Waste per Person	-.283
Recyclables per Person	-.092
Adjusted Recycling Rate	.026
Municipal Recycling Rate	.198

Analysis: Given the number of studies that have shown the positive impacts of PAYT on recycling, it could just be that the small number of towns in the sample with PAYT (only 10 municipalities) led to unreliable or skewed results. Also, the adoption of PAYT may have increased recycling rates in individual towns that simply started with very low rates. Nonetheless, the results once towns were split into those with ordinances and those without suggest that PAYT may be effective when combined with other policies. Certainly the large demographic differences between the two subsets and the differences in materials accepted are significant, but PAYT may also be a factor. The fact that PAYT was associated with less waste produced indicates that it is effective in dealing with at least half of the recycling calculation—i.e. the total amount of waste produced. This suggests that combining PAYT with other policies that increase recycling (i.e. more materials accepted, town ordinance) may be very successful.

5. Curbside Trash Collection

Results: Curbside trash collection had a modest negative correlation with recycling rates at -.178. This is in spite of the fact that towns with curbside pickup were in fact slightly wealthier and more educated on average.

However, like with PAYT, the results look different once the variable of whether the municipality had a town ordinance is added into the mix. Those towns with no ordinance but curbside trash collection recycled at a significantly lower average rate than towns with collection and ordinances. This difference is most likely due to the significantly higher numbers of materials accepted by the former group along with higher income and education levels, as the table below illustrates. Interestingly, towns with curbside recycling along with curbside trash collection actually had lower average recycling rates despite very similar demographics to towns with just trash collection. The number of materials accepted again appears to be the driving force behind this; towns without curbside recycling accepted almost twice the number of recyclables on average.

	Average Rate	**Median Rate**	**Average Income**	**Average Education**	**Average # of Accepted Materials**	**# of Municipalities**
CT Collection	27.01	23.88	43390	23.30	9.73	38
No CT Collection	32.82	31.9	40549	21.8	10.86	23
CT Collection & Ordinance	35.59	36.16	47872	27.67	12.05	18
CT Collection, No Ordinance	19.29	17.76	39256	19.36	7.65	20
CT Collection + Curbside Recycling	24.36	20.99	42984	23.41	9.00	21
CT Collection, No Curbside Recycling	30.29	30.54	43892	23.17	10.64	17

Curbside trash collection did not correlate with higher amounts of waste produced per person (in fact, there was a very slight negative correlation), but it did correlate with significantly lower amounts of recyclables per person at -.219, thus driving the negative correlation with recycling rates.

Measure	**Pearson Correlation Coefficient**
Waste per Person	-.075
Recyclables per Person	-.219
Adjusted Recycling Rate	-.178
Municipal Recycling Rate	-.228

Analysis: While curbside trash collection could negatively impact recycling by making throwing away recyclables so temptingly convenient, the weak negative correlation between curbside trash collection and recycling rates appears to be largely due to the fact that towns with curbside trash collection accepted fewer recyclable materials. In other words, once the number of materials accepted is controlled for, curbside trash collection appeared to have no consistent pattern of impacting recycling rates.

6. Curbside Recycling

Results: In this study, every town with curbside recycling also had curbside trash collection. Similar to curbside trash collection, curbside recycling had a weak negative correlation with recycling rates at -.222. As with other municipal policies, however, adding in the town ordinance variable reveals that the key variable at play is the number of materials accepted by the municipality. Those with town ordinances had an average of 11.44 materials accepted and had higher average recycling rates, while those without ordinances had an average of 7.16 accepted materials and correspondingly lower recycling rates. The presence of a town ordinance itself also may be a factor.

	Average Rate	Median Rate	Average Income	Average Education	Average # of Materials Accepted	# of Municipalities
Curbside Recycling	24.36	20.99	42984	23.40	9.00	21
No Curbside Recycling	31.75	31.38	41969	22.38	10.77	40
CR & Ordinance	31.88	29.88	47774	27.51	11.44	9
CR, no Ordinance	18.73	17.49	40682	20.33	7.16	12

As with curbside trash collection, curbside recycling correlated negatively with both waste per person, and more strongly with recyclables per person, thus leading to lower recycling rates.

Measure	Pearson Correlation Coefficient
Waste per Person	-.062
Recyclables per Person	-.224
Adjusted Recycling Rate	-.222
Municipal Recycling Rate	-.241

Analysis: Like with curbside trash collection, the weak negative correlation seems to be due to difference in the numbers of accepted materials and the presence of an ordinance, not the curbside policy itself. Interestingly though, there is no evidence that curbside recycling correlated with

higher rates even when materials accepted are controlled for. There could be an issue of sample size here, or there could be other variables interacting with curbside recycling that this study does not address. For example, it must be kept in mind that this is a cross-sectional study of just 2006 data; thus, it is possible that towns with curbside recycling have increased their recycling rates, but were significantly below average before starting such programs. Also, this study treated curbside recycling as one category, without analyzing variation amongst curbside recycling programs. Thus, it is quite possible that certain types of curbside programs are more effective due to their frequency or mode of collection.

7. Recycling Committee

Results: After the number of materials accepted and a town ordinance, whether or not a town had a recycling committee was the third best predictor of recycling success amongst the municipal policies studied, with a positive correlation of .334. However, recycling committees also correlated significantly with higher incomes, education levels, and materials accepted. When materials accepted were controlled for, there was no consistent pattern of recycling committees correlating with increased recycling rates.

	Average Rate	**Median Rate**	**Average Income**	**Average Education**	**Average # of Accepted Materials**	**# of Municipalities**
Recycling Committee	34.06	30.93	45977	26.24	11.62	33
No Recycling Committee	23.48	19.32	38007	18.60	8.35	28

The presence of recycling committees correlated with slightly lower amounts of waste per person and moderately higher amounts of recyclables per person, contributing to the positive correlation with recycling rates. Recycling committees correlated somewhat stronger with municipal recycling rates than with adjusted rates at .392.

Measure	**Pearson Correlation Coefficient**
Waste per Person	-.080
Recyclables per Person	.185
Adjusted Recycling Rate	.334
Municipal Recycling Rate	.392

Analysis: Much of the observed effect of a recycling committee may be due to correlations with town ordinances, higher income and education levels (the presence of a recycling committee correlated at .41 and .42 with income and education, respectively), and numbers of materials accepted (positive correlation of .322). It is also possible, however, that recycling committees are partially responsible for creating/revising ordinances and expanding the number of materials accepted, which could help explain the positive correlation between the variables.

Statistical Summary of Results: Demographic and Municipal Factors

Demographic Factor/ Municipal Policy	Correlation with Adjusted Rate	Correlation with Municipal Rate
Materials Accepted	.805	.692
Income	.573	.563
Education	.506	.553
Population	.366	.268
Town Ordinance	.357	.305
Recycling Committee	.334	.392
Curbside Recycling	-.222	-.241
Seasonal Residents	.196	.211
Mandatory Recycling	.191	.223
Curbside Trash Collection	-.178	-.228
Age	.101	.188
Party Affiliation	.041	-.019
Homeownership	-.038	-.049
Pay as You Throw	.026	.198

Case Studies of Maine Recycling Programs

1. Standish

2006 population estimate: **9,832**
Median household income: **$50,278**
% of population (25 and older) with bachelor's degree or higher: **22.3**
2006 adjusted recycling rate: **31.90 %**
2006 municipal recycling rate: **14.20 %**

An associate member of *ecomaine*, Standish is a medium-sized town in western Cumberland County that abuts Sebago Lake. Relative to state averages, Standish is quite wealthy and well-educated, and it is also a summer home to many, with 688 housing units specified as seasonal. In 2006, Standish achieved an adjusted recycling rate of 31.9%, or a little more than two points above the average rate of towns in the study. Its municipal recycling rate was slightly above average at 14.2%.

Standish operates a drop-off program for both trash and recycling, although many residents contract with private haulers to deliver their trash to the transfer station. The Standish transfer station accepts as wide a variety of recyclables as any municipality in the state, including many types of bulky waste (for which there are various fees) such as wood, tires, demo debris, and metal. Standish recycles everything that ecomaine accepts, and also additional materials based on available markets and disposal costs. In addition to dropping off recyclables at the transfer station, there are several silver bullets throughout the town in which citizens can deposit recyclables.

Standish has a town ordinance on solid waste, and also an active promotional and educational effort driven by a recycling committee. The committee's duties include reviewing the ordinance, overseeing the finances of the program, and actively promoting recycling throughout the community. Elementary school-age children have been a key target of educational outreach in Standish, with yearly school programs on recycling and a poster contest that culminates in the creation of a calendar that displays a different poster for each month. The transfer station distributes recycling handouts with their stickers, and the Standish town website offers extensive information on the recycling program. Curbside recycling and pay as throw are possibilities in the future, although the obstacles of increased cost may stand in the way.

In terms of reuse, Standish has a bin for donations to the Salvation Army, and periodically leaves re-useable items on the sidewalk for citizens to pick up to prevent them from going to waste. The transfer station lacks the necessary funds and manpower to operate a larger reuse program.

Although outside the scope of this study, Standish made the transition to the 'single sort' recycling system in 2007, along with many other of *ecomaine*'s members. So far, this seems to have produced a modest but not overwhelming increase in recycling rates for the town.

2. Cape Elizabeth

2006 population estimate: **8,826**
Median household income: **$72,359**
% of population (25 and older) with bachelor's degree or higher: **58.7**
2006 adjusted recycling rate: **67.71 %**
2006 municipal recycling rate: **19.17 %**

Cape Elizabeth is a member of *ecomaine*, and also has the distinction of being one of the wealthiest and best educated towns in Maine. Located just south of Portland in Cumberland County, Cape Elizabeth is home to about 9,000 residents and has long had one of the highest recycling rates in the state. In 2006, the town achieved an adjusted rate of 67.71%, with a municipal rate of 19.17% - both significantly higher than average.

With a drop-off program for trash and recyclables, Cape Elizabeth's recycling success is driven by a combination of a motivated citizenry, a strong promotion and education effort, and an extensive and well-run transfer station known as the Recycling Center located a few miles from the center of town. Like Standish, Cape Elizabeth accepts a very wide variety of materials as recyclables, including many types of bulky waste. Apart from the Recycling Center, Cape Elizabeth maintains silver bullets for recyclables behind the town hall and at the middle school.

Cape Elizabeth also operates a busy reuse center at the Recycling Center called the Swap Shop, where citizens can drop off and pick up second-hand items as they please at no charge — preventing a large amount of the waste stream from needing to be recycled or disposed of in the first place. In addition to the Swap Shop, there are bins for donating clothing to Goodwill, and there is also a partnership with Habitat for Humanity to provide reusable building materials such as windows and doors. While their municipal recycling rate is significantly above average, it is primarily the extensive reuse (which counts toward recycling in the rates) and bulky recycling that drives Cape Elizabeth's excellent overall recycling rate.

Cape Elizabeth benefits from a very active education and promotion effort driven by a seven member recycling committee. The committee writes articles for a local newspaper every month promoting recycling, and is involved a wide range of educational efforts at the schools, amongst churches and service groups, and throughout the wider community. In the past, the committee has helped install recycling bins at various locations throughout the town, and is responsible for the addition of silver bullets at the middle school. In addition to its promotional efforts, the committee is responsible for reviewing and helping improve the Recycling Center's policies and procedures.

Cape Elizabeth has a town ordinance on solid waste, but maintains a completely voluntary recycling program that requires citizen initiative. There is no mandatory recycling, no curbside pickup, and no pay as you throw giving citizens an economic incentive to recycle, although pay as you throw has been discussed. Rather, success is driven by a motivated populace and active promotional program. Cape Elizabeth posts large signs tracking the town's monthly recycling rates as a means of further motivating residents to recycle, gives tours of the transfer station and Recycling Center, and allows residents to salvage certain materials at the transfer station for reuse. The town distributes a wide variety of brochures and flyers, and maintains a very active and informative website on recycling in the town.

3. Buxton

2006 population estimate: **8,171**
Median household income: **$48,958**
% of population (25 and older) with bachelor's degree or higher: **17.3**
2006 adjusted recycling rate: **41.71 %**
2006 municipal recycling rate: **12.73 %**

Located about 15 miles southwest of Portland in York County, Buxton is relatively large town both in terms of area and population. Buxton is significantly wealthier than the average town in Maine, although the percent of residents (25 and older) with bachelor's degrees is actually lower than the 2000 state total of 22%. In 2006, Buxton had a significantly higher recycling rate than the average Maine town, with an adjusted rate of 41.71%. Although its municipal rate of 12.73% was not outstanding, the town managed to achieve a high adjusted rate through extensive reuse and bulky recycling.

Buxton has curbside collection of trash and a drop-off program for recyclables. Its transfer station is located near the town limits (a few miles from the town center) and includes a recently renamed Recycling Center. Buxton accepts a wide variety of recyclable materials, including everything the Maine Resource Recovery Association accepts, a variety of bulky recyclables, and also a wide variety of materials for reuse at its Share Shop. In the past, Buxton had silver bullets around town, but these were discontinued after many residents used them for trash rather than recycling.

The Buxton Recycling Center prides itself on its customer service, striving to make recycling as convenient and pleasant as possible for residents. There are at least four workers present when the transfer station is open, and residents often do not even have to get out of their car to recycle—Recycling Center employees will take and deposit the recyclables into their proper receptacles straight from the vehicle. The staff works hard to promote a friendly and helpful atmosphere, even handing out dog biscuits at the gate.

In terms of education and promotion, the main effort is an insert in the local newspaper detailing recycling tips and guidelines. The Recycling Center also sells "Buxton Recycles" t-shirts, and maintains a very informative recycling page on the town website. The Recycling Center gives out tours to students who come on field trips, and also distributes promotional magnets that detail the when and where of recycling in Buxton. Despite a limited educational budget, Buxton benefits from a group of "hardcore" residents who are strongly committed to recycling. .

The Recycling Center staff has also been instrumental to Buxton's recycling success, promoting recycling and reuse through inventive programs that require minimal resources. A key component in this regard is the Share Shop, which promotes a friendly community environment and provides Buxton residents with a convenient venue for reuse. Although it only takes up a small corner of the Recycling Center, the Share Shop has become very popular, encouraging both reuse and recycling and providing free materials such as books, clothes, toys, and doors to Buxton residents.

Another creative effort, one that has achieved both local and national media attention, is the "Keep the Heat On" program, which takes the proceeds from donated returnable bottles and cans to

provide heating oil for the elderly. The program netted $14,000 last year, and has attracted cash donations even from people outside of Maine.

Buxton has an ordinance on solid waste, but the ordinance has very little mention of recycling. There is no recycling committee and no mandatory recycling policy. In order to overcome the obstacle of having of curbside trash collection but no curbside recycling (making it far easier to throw away recyclables than recycle them), the transfer station created a set of policies that limit the amount and type of trash that will be collected, including a ban on yard and leave waste and a cap of 7, 13-gallon or 3, 32-gallon bags. This encourages residents to recycle in order to meet these limits, and to bring their yard trimmings and leaves to the Recycling Center where they are composted for free.

Buxton's Solid Waste Manager is very interested in expanding the recycling program and has pushed for more promotion and outreach, curbside recycling, more active composting, and pay as you throw. However, there has been resistance in allocating additional money to the recycling program, regardless of the potential benefits

4. Mechanic Falls

2006 population estimate: **3,242**
Median household income: **$33,807**
% of population (25 and older) with bachelor's degree or higher: **9.5**
2006 adjusted recycling rate: **41.92 %**
2006 municipal recycling rate: **12.14 %**

A relatively small town in Androscoggin County, Mechanic Falls is home to approximately 3,242 residents. With a significantly lower median household income than the average town in Maine, and a significantly lower proportion of college-educated adults, Mechanic Falls nonetheless achieved an impressive recycling rate of 41.92% in 2006. As the municipal rate of 12.14%, reflecting 'traditional residential recycling' indicates, most of Mechanic Falls' recycling success was attributable to extensive bulky recycling.

Mechanic Falls has a drop-off program for both trash and recyclables, although some residents contract with private haulers. The transfer station is located at the edge of town—about two miles from the town center—and recycles a variety of household and bulky materials based on markets for the materials, although not as many as some other successful recycling programs. For example, in 2006 Mechanic Falls did not report recycling glass, aluminum, yard and leave waste, or construction and demolition debris. Starting in 2007, however, Mechanic Falls began accepting mixed paper, yard and leave waste, and began reusing ground-up glass for inert fill and road base. Mechanic Falls maintains a few reuse sheds, mainly for reusable construction materials like vinyl siding, windows, doors, insulation, and wood.

Rather than focusing on the environmental benefits of recycling, Mechanic Falls has primarily promoted recycling as a means of saving money for the town and taxpayer, both through the avoidance of landfill tipping fees and the creation of revenue through the selling of recyclables.

Mechanic Falls reports saving about $30,000 for the town in 2007 through recycling efforts, and hopes that this number continues to grow through increased participation by Mechanic Falls residents.

Mechanic Falls differs from the large majority of Maine towns in its approach to recycling in that relies on strict enforcement of policies and regulations as a way of promoting recycling. Mechanic Falls has a mandatory recycling policy, and unlike many towns, it actually enforces it—literally requiring residents to recycle. Rather than solely relying on education and promotion about the benefits of recycling, the transfer station enforces mandatory recycling just like any other municipal law or regulation.

In order to use the transfer station, residents must bring their trash in clear bags, which allows the transfer station staff to monitor whether citizens are indeed recycling the materials that Mechanic Falls accepts. If a resident is not recycling, they are informed in a friendly manner by the staff of the town policy and the reasons behind it. If the resident continues to refuse to recycle, however, their transfer station privileges are revoked, and they must find another way to dispose of their trash until they begin to recycle. This enforcement policy began in January 2006, but has only needed to be used rarely since most people have complied when informed of the town policy.

Despite this relatively strict approach, the Mechanic Falls transfer station staff is committed to maintaining a friendly and convenient atmosphere for residents. The transfer station is efficiently run and the staff strives to provide excellent customer service and makes sure that a trip to the station is quick and easy.

Mechanic Falls has a town ordinance on solid waste and recycling, and this serves as the basis for municipal policy and enforcement. The town does not have a recycling committee, and its promotional efforts are basically limited to a transfer station guide and a page on the town website. If residents are not already aware of town policy or of the benefits of recycling, they are informed when they take their waste to the transfer station.

In terms of expanding its program, Mechanic Falls plans to start a voluntary composting program where residents are provided with compost pails that they can fill and bring back to the station free of charge. Policies that provide additional incentives to recycle such as curbside recycling are not being seriously considered at this time because of the potential for significantly increased costs.

5. Scarborough

2006 population estimate: **18,880**
Median household income: **$56,491**
% of population (25 and older) with bachelor's degree or higher: **38.6**
2006 adjusted recycling rate: **30.54 %**
2006 municipal recycling rate: **17.71 %**

One of Maine's fastest growing communities, Scarborough is a member of *ecomaine* and is located in southern Cumberland County approximately eight miles beyond Portland. Scarborough is quite wealthy and well-educated compared to the average Maine town, and achieved an adjusted

recycling rate of 30.54 % in 2006. Although this rate was not significantly above average, Scarborough's municipal recycling rate of 17.71 % was significantly higher than the average town included in this study.

In 2006, Scarborough operated a drop-off program for recyclables combined with curbside collection of trash. Midway through 2007, however, the recycling program was completely revamped, switching to automated curbside recycling, mandatory recycling, and 'single sort' all at once. The results were immediately realized, with Scarborough's 2007 adjusted and municipal rates rising to 45.37 % and 29.30 %, respectively—both well above average. This jump occurred without the addition of many new accepted materials and appears to be largely the result of the increased convenience of household recycling. This is reflected in the numbers, as the biggest jump was in the municipal recycling rate, which encompasses the small household items collected curbside.

Scarborough has a town ordinance on waste and recycling, and accepts a wide variety of materials—essentially everything that *ecomaine* accepts. Bulky recyclables must be taken by residents to one of two transfer stations where these items can be disposed of for a fee: either Riverside Recycling in Portland or Community Recycling in Scarborough. The town has mandatory recycling as of 2007, but it serves mainly as a symbolic measure and is not actively enforced.

Scarborough's curbside program is specifically designed in order to promote recycling and minimize leftover waste. Each resident receives two 64 gallon carts that are emptied curbside once a week by an automated hauler—one for recyclables and one for trash. Residents can obtain extra recycling carts, but extra trash carts are prohibited except in very large families. Since recycling is single sort in Scarborough, all household recyclables can be placed in the one cart, greatly increasing the convenience of the program. If residents produce more trash than can fit in one cart, they have an incentive to recycle more of their waste so that they don't have to pay for disposal of extra trash.

As far as education and promotion goes, three mailings were sent out prior to the shift to 'single sort' and curbside collection, and each cart for use in the curbside recycling collection program was delivered the residents with a brochure inside explaining recycling dos and don'ts. Scarborough does not currently have a recycling committee, but articles in local newspapers have also been utilized as a means of getting out the recycling message in addition to the mailings and brochures. Scarborough has an informative recycling page on the town website, and takes part in an online Swap Shop sponsored by the town of Saco in lieu of a physical reuse center.

Scarborough has tried to expand its curbside program by encouraging condominiums on private roads to pay for the service, but this has not been very successful to date.

6. Sanford

2006 population estimate: **21,534**
Median household income: **$34,668**
% of population (25 and older) with bachelor's degree or higher: **11.7**
2006 adjusted recycling rate: **26.38 %**
2006 municipal recycling rate: **6.23 %**

One of Maine's largest communities, Sanford is located in York County, approximately equidistant between Portland and Portsmouth, New Hampshire. The city is less wealthy and less educated than the average town in Maine, and substantially less wealthy and educated than the average town in this study. In 2006, Sanford's adjusted recycling rate was 26.38 %, which was slightly lower than the average rate for towns in this study. The city's municipal rate, however, was only 6.23 % -less than half the average rate for this study.

Sanford has curbside trash collection and a curbside recycling program for residents who live on public roads and for apartment buildings of three units or less. Residents must take their bulky waste and recyclables to Sanford's transfer station, where they pay for a $20 sticker yearly that allows them to dispose of certain amounts of materials at no extra charge. Sanford sends their household recyclables to ecomaine (although they are not currently a member) and accepts a large variety of materials based on what ecomaine accepts and available markets for bulky materials.

Trash is collected curbside once a week in Sanford, while recycling is picked up every other week. Residents are not limited in the amount of trash they can set out curbside, and they are given an 18 gallon bin for recyclables. Recycling in Sanford is single sort, so all household recyclables can be placed together in the one bin.

Sanford has on ordinance on solid waste, but it has very limited mention of recycling and contains no provisions for enforcing it. There is no recycling committee in Sanford, but there is an educational program in the schools promoting recycling and a recycling page on the municipal website. The town has promoted recycling though pamphlets, flyers, and banners in the past, but these efforts did not appear to have any significant effect.

The main challenge Sanford has faced is the low participation rate amongst its citizenry. Despite accepting a wide range of materials, offering curbside recycling and single sort, the proportion of households that actually participate in curbside recycling is only around 20%--a very low number considering the convenience and ease of the program.

Sanford is home to a large number of apartment buildings that are not served by curbside recycling; but a very large proportion of residents simply do not recycle despite the curbside service, implying an indifferent if not hostile attitude to recycling. According to the transfer station's manager, the middle class neighborhoods recycle best, and the most common justification from those who do not recycle is that they already pay taxes to the town, and should not have any other additional obligation to recycle.

Recently, a task force was created that is currently looking into ways to improve recycling in Sanford. Policies that are being considered include mandatory recycling, pay as you throw, and an automated curbside pickup system that would limit the amount of trash eligible for collection. Increased costs and political opposition are likely barriers to the implementation of new policies.

Conclusion and Implications: What Does this Mean for Maine Towns?

This study finds strong statistical evidence that both nature and nurture are important influences on recycling success in Maine. In terms of individual factors, it appears that the number of materials accepted is most important, followed by income and education. Town ordinances and population also have moderately strong correlations with higher recycling rates, with recycling committees a little lower. The case studies help confirm these findings, while also highlighting the fact that there are many different paths to successful recycling programs, and that each town faces a different set of advantages and disadvantages in implementing a successful program.

In terms of the statistical results, is should be noted that there is substantial overlap between many of the factors explored, and that feedback therefore may be a large factor promoting recycling success. For example, towns with higher incomes and education levels are more likely to accept more materials and to have town ordinances and recycling committees, which in turn impact the success of their recycling programs. Furthermore, many different municipal policies are intimately connected; for example, towns with ordinances and committees are more likely to accept more materials, often making it difficult to isolate the role of individual factors.

Another thing to keep in mind is that this study is not by any means exhaustive. Many factors that likely influence recycling were not examined statistically—either because of a lack of data or because of the qualitative nature of the data. For example, educational outreach or advocacy about recycling was not explored statistically because accurate information on town efforts is hard to come by, and it would also be difficult to translate into a quantitative measure. Other factors not examined statistically that may influence recycling include the accessibility/proximity of transfer stations to residents in towns with drop-off recycling programs, the specific features of curbside programs (frequency, mode of collection, size of recycling bins, etc.), the nature of the solid waste ordinance and the degree to which it is enforced. The case studies were designed to help fill this gap in analysis.

Additionally, since the statistical portion of the study is based solely on 2006 data, it cannot draw any conclusions about whether adopting a certain policy consistently increased recycling in Maine towns. What it can do is determine what features and policies are common amongst towns with successful recycling programs, and thereby provide a set of ideas for towns seeking to increase their recycling rates.

So what lessons can this study provide for Maine towns? First, the results of this study suggest that the simplest and most effective way to establish a successful recycling program is to accept as many different recyclable materials as possible. This is the 'sine qua non' of recycling programs. Quite simply, a town cannot have a truly successful recycling program without accepting a wide variety of materials. An important part of this is recycling bulky waste, which is neglected by many Maine towns. It is also helpful for municipalities to create venues for reuse, which is in fact preferable to recycling on the waste management hierarchy and can make a big difference in recycling rates. The case studies reflect these lessons; in fact, every program studied in depth benefitted from strong bulky recycling, while towns like Cape Elizabeth and Buxton benefitted from substantial reuse operations.

Beyond this simple step, the results of this study indicate that there are many different paths a town can take in order to achieve a successful recycling program. An established ordinance on

solid waste and recycling appears to be common in towns with high recycling rates, but the case studies suggest that in many towns having an ordinance does little to actively promote recycling, either because the ordinance only mentions recycling in passing or because the ordinance is rarely enforced. An exception, of course, would be a town like Mechanic Falls that actually enforces its ordinance in a systematic fashion.

While the statistical relationship between recycling committees and recycling rates is not overwhelming, the anecdotal evidence certainly supports the idea that such committees can have very positive effects. In addition to the education and promotion that these committees usually provide for the recycling program, committees can also be instrumental in establishing new recycling policies and features; for example, the Cape Elizabeth committee helped to install 'silver bullets' and recycling bins around the town.

Policies like curbside recycling, mandatory recycling, and pay as you throw, may help individual towns, but none are by any means required in order to have a successful program. On its own, curbside recycling should not be expected to produce a successful recycling program, although it will likely increase municipal recycling rates (as was seen in Scarborough) and may serve as a good complement in a town with a variety of accepted materials and venues for bulky recycling.

The fact is that many of the best recycling towns in the state do not have curbside recycling (e.g. Cape Elizabeth, Buxton, and Mechanic Falls), and that many towns with curbside recycling have less impressive rates. Many towns simply have committed residents that do not require much encouragement; the statistical data supports the hypothesis that this is partially a function of demographic factors like education, income, and population size. Cape Elizabeth and Buxton are good examples of this, as are towns like Freeport and Gray. A simple drop-off program with a wide variety of accepted materials is often sufficient for high recycling rates, especially in wealthy, educated towns of moderate size.

Conversely, many towns with curbside recycling do not have impressive rates. One reason for this may be that curbside recycling generally does not address bulky waste and its recycling, which can make up a very large portion of the waste stream. Thus, if a town provides curbside pickup for household recyclables but does not recycle bulky materials at all, it may still have a very low rate. Furthermore, curbside may make recycling more convenient, but overall success is still heavily influenced by the variety of materials accepted. If a town has curbside pickup but does not accept a variety of materials, it should not expect to achieve a high rate.

As the Sanford case illustrates, even a town with curbside recycling, 'single sort' recycling, and a high number of accepted materials, is not guaranteed of a high recycling rate; likely because of demographic factors that discourage recycling (large number of apartments, relatively low income and education levels). Thus, while curbside recycling is probably useful in increasing household recycling rates, it is by no means a guarantee of a successful program, nor is it necessary to achieve a successful program in many towns.

As for mandatory recycling, it may be worthwhile as a symbolic measure, but should not be expected to produce substantial results unless seriously enforced, as in Mechanic Falls. Although there was not enough statistical evidence to reach any definite conclusions on PAYT, such programs do appear to be useful in efforts to reduce the amount of waste produced and increase

recycling of small household items, and when combined with other policies are likely to be very effective.

In sum, while it is clear that recycling is influenced by relatively fixed demographic factors like education and income, the main factor appears to be the variety of materials accepted by the municipality. Regardless of demographic factors, increasing the variety of materials accepted tends to have a very positive effect, and establishing an ordinance, curbside recycling, a recycling committee, or adopting PAYT, may have a positive impact as well given on the individual town's circumstances. While it may not be possible for every town to recycle 50 percent of their waste in the next few years, the results of this study indicate that the right mix of policies can go a long way toward reaching this goal.

Appendix #1: Demographic Data

Pop: 2006 population estimate
MHI: Median household income
Educ: Percent of population 25 years and older with a bachelor's degree or higher
Age: Median age
S:YR: Ratio of seasonal to year-round residences
PA: Percent of voters registered as Democrats or Green Independents
HO%: Percent of housing units occupied by the owner

Municipality	Pop.	MHI	Educ.	Age	S:YR	PA	HO%
Acton	2,264	$39,036	19.9	41.1	1.202	23.4	89.2
Alton	831	$35,263	10.1	35.0	.029	30.8	88.9
Arrowsic	513	$53,250	38.9	41.1	.188	44.8	88.7
Athens	854	$24,812	8.7	37.3	.348	32.2	90.8
Belmont	884	$29,013	12.3	39.8	.122	24.5	87.7
Berwick	7,433	$44,629	15.6	35.6	.007	19.6	76.1
Burnham	1,153	$31,071	10.2	37.3	.411	21.4	88.0
Buxton	8,171	$48,958	17.3	37.4	.025	30.4	84.8
Canaan	2,042	$29,397	13.2	35.9	.173	40.5	81.4
Canton	1,163	$32,625	6.8	39.7	.095	32.7	76.5
Cape Elizabeth	8,826	$72,359	58.7	43.1	.040	35.5	87.8
Casco	3,686	$41,629	20.1	37.8	.431	30.2	82.5
Chester	509	$36,250	8.5	38.0	.084	28.8	90.5
Chesterville	1,245	$31,563	19.0	38.1	.408	30.4	88.4
Clifton	761	$36,333	13.3	37.4	.326	29.2	85.1
Cumberland	7,653	$67,556	50.3	37.6	.136	29.0	91.1
Eliot	6,383	$52,606	31.0	39.7	.022	26.8	81.9
Falmouth	10,557	$66,855	53.2	40.7	.031	32.8	83.3
Freeport	8,151	$52,023	38.3	39.8	.044	35.6	77.9
Georgetown	1,136	$47,813	37.8	42.5	1.077	32.9	80.0
Glenburn	4,399	$41,885	12.8	37.1	.093	30.3	88.9
Gray	7,420	$50,107	28.0	37.4	.182	29.5	78.8
Greene	4,463	$48,017	11.2	36.9	.103	31.8	87.8
Hebron	1,100	$45,417	23.1	37.4	.017	27.0	81.4
Hollis	4,656	$48,846	19.5	36.8	.029	30.2	84.6
Lagrange	723	$33,295	9.6	34.6	.083	22.7	77.9
Lamoine	1,682	$39,783	27.9	41.0	.007	28.9	84.9
Lebanon	5,589	$40,021	9.4	36.7	.116	23.0	87.7
Levant	2,498	$41,290	14.0	34.7	.010	24.6	88.6
Limerick	2,580	$40,845	19.9	35.7	.454	29.0	82.5
Limington	3,715	$42,023	15.5	36.6	.148	30.2	85.2
Mechanic Falls	3,242	$33,807	9.5	35.8	.004	31.3	74.2
Mercer	652	$37,500	14.2	41.8	.355	25.4	86.3
Monroe	889	$32,250	24.1	39.6	.126	35.3	90.1

Municipality	Pop.	MHI	Educ.	Age	S:YR	PA	HO%
Mount Vernon	1,662	$39,779	27.8	39.8	.530	31.0	86.0
Naples	3,589	$38,141	16.0	39.5	.761	28.4	83.4
Newburgh	1,487	$39,850	18.2	39.0	.035	25.8	84.0
North Yarmouth	3,506	$60,850	44.7	37.8	.002	30.5	90.9
Orrington	3,622	$44,327	20.5	40.3	.037	28.2	86.4
Otisfield	1,659	$43,304	24.1	39.4	.658	28.0	92.6
Parsonsfield	1,742	$32,214	17.8	38.7	.495	28.1	80.9
Penobscot	1,391	$37,232	25.8	44.6	.290	32.0	86.8
Pownal	1,596	$54,219	33.9	41.0	.005	32.5	88.9
Raymond	4,601	$52,224	33.5	37.8	.531	28.3	86.6
Sanford	21,534	$34,668	11.7	36.6	.027	35.7	63.5
Scarborough	18,880	$56,491	38.6	38.8	.087	29.2	81.4
Searsport	2,664	$31,288	18.6	41.0	.151	29.4	75.2
South Berwick	7,252	$53,201	25.3	36.2	.010	28.6	78.3
South Portland	23,784	$42,770	28.0	37.9	.009	42.0	64.3
Standish	9,832	$50,278	22.3	33.8	.214	28.7	87.7
Stetson	1,036	$30,606	13.0	36.7	.279	27.8	87.9
Stockton Springs	1,651	$37,050	22.5	40.7	.121	28.9	86.4
Swanville	1,451	$31,417	13.6	35.9	.310	25.2	84.8
Van Buren	2,534	$20,038	9.4	45.2	.017	61.3	61.0
Veazie	1,853	$44,519	37.7	40.3	.016	32.1	78.8
Vienna	565	$36,985	26.9	42.8	.677	39.3	88.7
West Bath	1,817	$45,326	26.8	42.0	.276	32.0	80.0
Westbrook	16,201	$37,873	18.5	37.8	.018	43.7	59.9
Winterport	3,629	$40,776	27.5	37.3	.015	32.2	82.6
Woolwich	2,929	$41,741	24.9	39.7	.058	30.4	86.1
York	13,306	$56,171	37.6	43.4	.509	27.9	82.1

Appendix #2: Municipal Policy and Recycling Rate Data

PAYT: Pay as you throw
TO: Town ordinance
MR: Mandatory recycling
CR: Curbside recycling
CT: Curbside trash collection
RC: Recycling committee
MA: Number of materials accepted
MRate: Municipal recycling rate
ARate: Adjusted recycling rate

Municipality	PAYT	TO	MR	CR	CT	RC	MA	MRate	ARate
Acton		X	X			X	14	17.80	45.44
Alton				X	X		2	3.39	8.39
Arrowsic		X	X	X	X	X	8	18.88	29.88
Athens							1	0	7.65
Belmont				X	X		7	6.55	12.06
Berwick					X	X	10	16.23	30.93
Burnham		X					4	10.57	15.30
Buxton		X			X		18	12.73	41.71
Canaan						X	11	10.51	26.99
Canton		X	X			X	5	8.73	13.73
Cape Elizabeth		X				X	18	19.17	67.71
Casco						X	17	31.00	57.98
Chester				X	X		3	3.20	28.87
Chesterville		X			X		11	9.45	35.71
Clifton					X	X	4	5.05	16.05
Cumberland	X	X	X	X	X	X	13	24.88	45.40
Eliot		X	X	X	X	X	17	31.40	50.27
Falmouth	X	X			X	X	17	33.46	67.82
Freeport	X	X	X			X	18	21.43	51.65
Georgetown		X				X	11	24.86	33.41
Glenburn		X		X	X	X	8	5.41	9.34
Gray						X	16	22.51	50.71
Greene		X	X			X	9	9.83	31.84
Hebron		X	X				8	13.12	18.12
Hollis		X	X	X	X	X	10	6.95	17.95
Lagrange					X		1	3.20	8.20
Lamoine						X	9	21.75	35.13
Lebanon					X		9	16.44	34.08
Levant				X	X		8	7.26	22.85
Limerick		X			X		11	15.19	47.55
Limington					X	X	11	4.57	16.70
Mechanic Falls		X	X				9	12.14	41.92

Municipality	PAYT	TO	MR	CR	CT	RC	MA	MRate	ARate
Mercer	X					X	8	11.28	16.06
Monroe							2	3.41	8.41
Mount Vernon		X					14	10.88	36.97
Naples						X	18	30.05	63.76
Newburgh				X	X		6	6.31	11.31
North Yarmouth					X	X	9	10.85	21.85
Orrington				X	X		7	6.58	15.38
Otisfield						X	14	22.04	50.85
Parsonsfield		X	X	X	X	X	9	8.62	20.99
Penobscot					X		10	6.97	13.99
Pownal	X	X			X	X	9	21.02	37.43
Raymond				X	X	X	12	11.28	28.83
Sanford		X		X	X		13	6.23	26.38
Scarborough		X			X		14	17.71	30.54
Searsport	X						9	10.69	15.07
South Berwick		X	X		X		15	24.82	51.19
South Portland		X		X	X	X	16	18.58	50.15
Standish		X				X	18	14.20	31.90
Stetson				X	X		5	5.17	16.17
Stockton Springs	X			X	X	X	7	9.59	14.59
Swanville	X						8	17.06	15.02
Van Buren	X				X		13	10.08	19.38
Veazie				X	X		8	8.53	19.27
Vienna				X	X	X	11	10.97	28.24
West Bath	X			X	X	X	10	8.19	18.82
Westbrook		X			X	X	11	8.47	16.92
Winterport		X					9	15.31	19.43
Woolwich		X			X	X	8	11.91	24.91
York		X	X	X	X		9	17.63	36.61