ecomaine: Scenarios for an Adaptable Future

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Introduction

Operations Overview

ecomaine's waste-to-energy (WTE) plant incinerates municipal solid waste (MSW) to generate electricity. The plant is owned by more than 20 communities taking in approximately 185,000 tons of MSW annually to produce 100,000-110,000 megawatt hours of electricity. The trash is burned in two boilers, which in turn heat water that is used to run a steam turbine. If the temperature is too low, sometimes natural gas is used to augment the combustion process. In 2009, availability of both the A and B boilers was 91% with an average 1.8% natural gas capacity factor. Burning MSW results in bottom ash and flyash which is comprised of 90% BA/10% FA and this collected combined ash is transported for disposal at ecomaine's ashfill. The steam and flue gases enter a series of air pollution control systems to remove pollutants. The lime slurry scrubs acid flue gases such as $SO2$ and HCL; urea injection in the selective non-catalytic reduction (SNCR) system reduces nitrogen oxides (NOx); activated carbon injection eliminates >90% heavy metals (Hg, Cd, Pb) and dioxin/furan; and a five-field electrostatic precipitator (ESP) captures >95% particulate emissions (Hewes 2010).

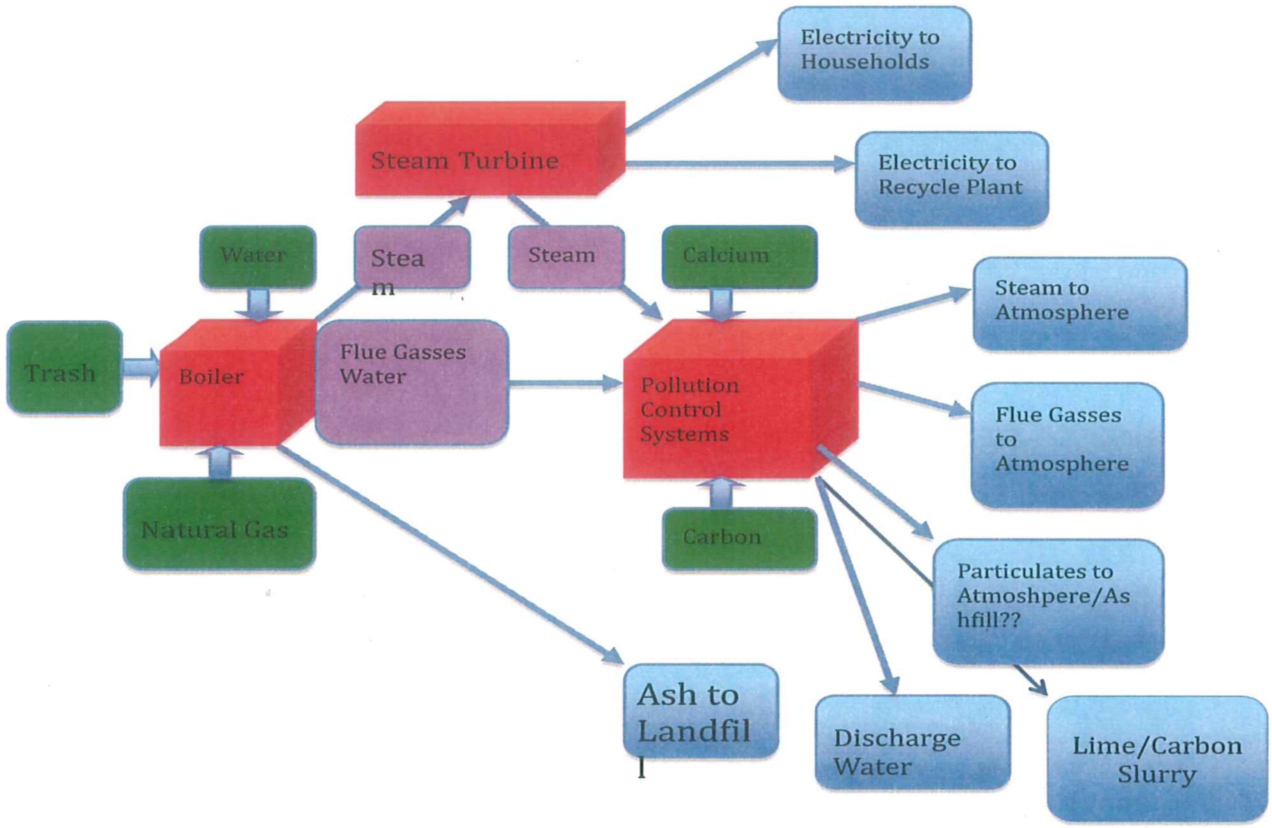
In addition to the WTE plant, ecomaine also operates a single-sort recycling facility. Recycling is free for ecomaine member and associate towns. The recycling rates have increased due to the implementation of ecomaine's single-sort system in conjunction with curb-side collection in its owner communities. The single-sort facility separates glass from plastics, (and the different types of plastic (#1-7)), and types of paper (newsprint, cardboard, office paper), tin, and aluminum into bales, which are then sold to a variety of markets around the Northeast and when the domestic market is unavailable, recyclables are sold overseas, with a percentage going to China. ecomaine also operates a 260 acres landfill/ashfill located 2 miles down the road from the WTE plant. Due to a 90% reduction in volume when a ton of MSW is burned the amount of ash deposited at the ashfill is 90%

less when compared to a ton of MSW. The disposal of ash reduces the 'in-place density' or available air space, such that the longevity of ecomaine's landfill has approximately 30 years of remaining capacity. Furthermore, all three of ecomaine's facilities – WTE, single-stream recycling center and the landfill/ashfill - are ISO 14001 certified with comprehensive Environmental Management Systems (EMS). ISO 14001 is an international standard which ecomaine's Board of Directors support and since 2002 ecomaine has maintained its ISO 14001 registrations.

Industrial Metabolism

Industrial metabolism is an analogy in industrial ecology that likens industry to an organism as a way of looking at how materials, in the form of inputs and outputs, move through industrial systems (Ayres 1998). It can be useful in looking at the large picture metabolic budget of systems to see where opportunities for reuse and/or waste reduction are possible (Anderberg 1998; Graedel 1995). The following diagram shows an industrial metabolism schematic for ecomaine's waste-to-energy plant (see below).

Industrial metabolites are material inputs into the system, industrial enzymes are machinery parts that process the metabolites, and the industrial pathway is the system path the materials flow through (Graedel 2010). In the following diagram, green indicates the industrial metabolites, purple represents the industrial metabolites that are reused within the industrial pathway, red represents industrial enzymes, and blue highlights the final industrial products created by the system. The diagram is followed by the actual amount of inputs and outputs as reported by ecomaine for 2009.



Inputs/Outputs

Some of these quantities were given in daily amounts that were converted to yearly amounts under the assumption that the waste-to-energy plant is in operation 351 days per year with a two-week shutdown for maintenance.

Input	Quantity
Trash	185,000 tons
Natural Gas	60,000,000 cubic feet
Water	87,475,000 gallons
Activated Carbon	370,000 lbs
Calcium Oxide	3,100,000 lbs/yr

Output	Quantity
Electricity	100,000 megawatt hours
Water (Steam/Evaporation)	87,475,000 gallons
Water (Discharge)	385,000 gallons
Fly ash	5,000 tons
Bottom ash	45,000 tons
Particulates to Atmosphere	***
Non H_2O Gases to Atmosphere	***

Compiled from ecomaine's Annual Report FY2009 and an interview with Anne Hewes.

***Data was not available.

Political Context

Waste-to-energy plants assume an interesting role within a political climate where the concept of "Zero Waste" is gaining serious momentum. ecomaine is owned by a number of communities throughout the southern region of Maine (see Appendix, Figure 3, for map) and provides renewable energy to approximately 18,000 households in the area (Hewes 2010). However, some environmentalists criticize WTE plants because they demand garbage to operate and prohibit a move towards "Zero Waste." WTE plants, some environmentalists maintain, provide no incentive to reduce the amount of garbage generated (Rosenthal 2010).

Maine has a legislated waste hierarchy that promotes reducing, reusing, recycling, and composting as its top priorities; sending municipal solid waste to waste-to-energy plants as its second priority; and as a last resort, to landfill the waste. In January of 2009, Maine passed its Solid Waste Management and Recycling Program that includes legislation mandating an increase in the recycling rate to 50% (Maine State Planning Office 2009). The current rate of recycling is approximately 35%, and despite previous legislation, efforts to increase this rate have lagged (Maine State Planning Office 2009). The State Planning Office attributes the lack of growth in the recycling rate to the following factors: Missed opportunities for a recycling market into growing fractions of the waste stream such as organic waste and construction and demolition debris; despite the growth in the market for recycling commodities, municipalities have budget constraints that prevent taking advantage of a growing market; the lack of inclusion of small business within recycling programs constitutes a missed opportunity to increase the recycling rate (Maine State Planning Office 2009). The 2009 legislation is a renewed effort that hopes to address these factors and increase the recycling rate.

The push for this legislation comes from an ever-decreasing amount of landfill space in Maine. The Maine State Planning Office found that, assuming a growth rate of 4% in MSW generation over the next twenty years, Maine will need approximately 25 million cubic yards of landfill capacity. ecomaine has 1,013,111 cubic yards total remaining disposal capacity for its owner community use based on data through 12-31-09 as part of the Public Benefit Determination analysis. The state currently has about 16 million cubic yards of licensed landfills (Maine State Planning Office 2008). With these figures in mind, the legislation to increase recycling rates to 50% is seen as the best strategy to deal with this shortage: "Maine could decrease its landfill capacity needs by 25% over the next 20 years by recycling 50% of its municipal solid waste each year "(Maine State Planning Office 2009).

ecomaine itself has enough landfill capacity to take care of the ash from its WTE plant, assuming it operates at capacity, for the next 20-25 years (Maine State Planning Office 2008). Burning trash for energy decreases the amount of waste sent to the landfill by approximately 90%. Despite four WTE plants in the state, however, Maine, finding itself with a shortage of landfill space, has reaffirmed its commitment to increasing the recycling rate.

In addition to Maine's legislative efforts, the greater national agenda focusing on climate change has implications for ecomaine's operations as well. As of December 29, 2009, the EPA has mandated greenhouse gas inventories for large emitters in the United States (EPA 2010). ecomaine has also been mandated to install two carbon dioxide monitors in addition to quarterly sample analyses for biogenic CO2 (Hewes 2010). First quarter results for affected WTEs in Maine include: ecomaine 64% biogenic CO2; MERC 60%; PERC 58%. The MERC and PERC facilities are refuse derived fuel (RDF) plants which pre-process their waste, while ecomaine's WTE is a mass burn design with no presorting yet ecomaine's fuel had higher organic content (CO2 from renewable source) which may be due to the higher recycling activity of its owner communities with its adjacent single-stream recycling center. Dr Eileen Brettler Berenyi's (2008) research support this premise that WTE facilities operate in concert with recycling activities where many materials have been identified and diverted from the waste stream to be recycled. The EPA ghg reporting rule may use power plant information to shape the regulatory framework of EPA's emission reduction policies.

The EPA's pyramid of waste management, like that of Maine, puts waste-to-energy above landfills, which is to say that it is a more desirable waste management system (EPA 2010). The pyramid of best management practices is not based solely on carbon emissions but encompasses a broad range of environmental concerns and standards. The EPA, however, establishes the following carbon considerations for waste-to-energy plants:

1. For every megawatt of electricity generated through the combustion of solid waste, a megawatt of electricity from conventional, e.g., coal or oil-fired, power plants is avoided, creating a net savings of emissions of greenhouse gases, i.e., carbon dioxide.

2. A modern municipal waste-to-energy facility separates ferrous and/or nonferrous metals for recycling. This is more energy efficient than mining virgin materials for the production of new metals such as steel. As a result, there is a significant energy savings and additional avoidance of greenhouse gas emissions.

3. When a ton of solid waste is delivered to a waste-to-energy facility, the methane that would have been generated if it were sent to a landfill is avoided. While some of this methane could be collected and used to generate electricity, some would not be captured and would be emitted to the atmosphere. Methane is a potent greenhouse gas twenty-three times more potent than carbon dioxide (EPA 2010).

Proposed climate change in the House under the Waxman-Markey American Clean Energy and Security Act passed by the House of Representatives, considers waste-to-energy plants as an "other qualifying energy resource" and only the portion of waste burned that is renewable (biogenic) can be considered for renewable energy credits (HR 2454). This means that the burning of plastics or other fossil-fuel-based waste would be deducted from the renewable energy accounting. However, in the Senate, the Bingaman-Dorgan (S.1462) energy legislation approved last Spring viewed WTEs eligible for 100% renewable energy credits (biogenic/non-biogenic fuel). In fact, ecomaine currently receives Class II Connecticut RECs in NEPOOL (New England Power Pool). These RECs represent environmental attributes of ecomaine's electrical energy source and amount to $0.25/kwh or approximately $24,000 annually.

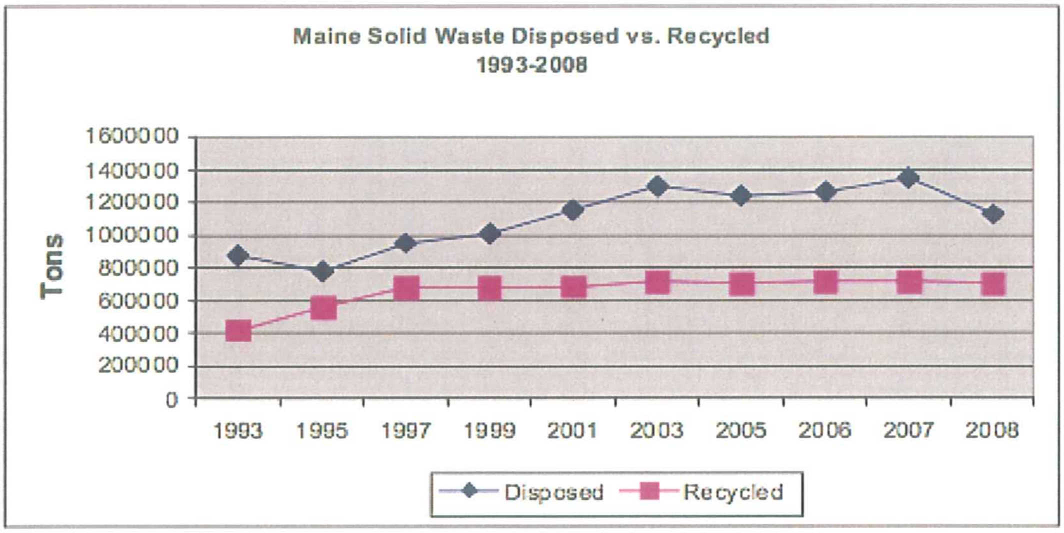
These legislative efforts pose interesting questions for ecomaine as a system that can readily adapt to fluxes in the political climate around environmental regulation as well as trends occurring in the realm of MSW generation and recycling.

Recent Trends

Recent records of MSW generation and recycling highlighted some interesting trends: MSW generation rates have decreased in the past two years while recycling rates have increased. These trends are consistent between both Maine and ecomaine. MSW generation has declined since 2008 mainly due to the economic downturn: People are consuming less and therefore generating less waste (Maine State Planning Office 2009). Maine's definition of MSW can include Construction and Demolition Debris (CDD), however, ecomaine is not licensed to accept CDD and so it is not a portion of its waste stream. The amount of CDD is a clear indicator of economic activity, and with the economic downturn, this portion of MSW has declined dramatically (Maine State Planning Office 2009).

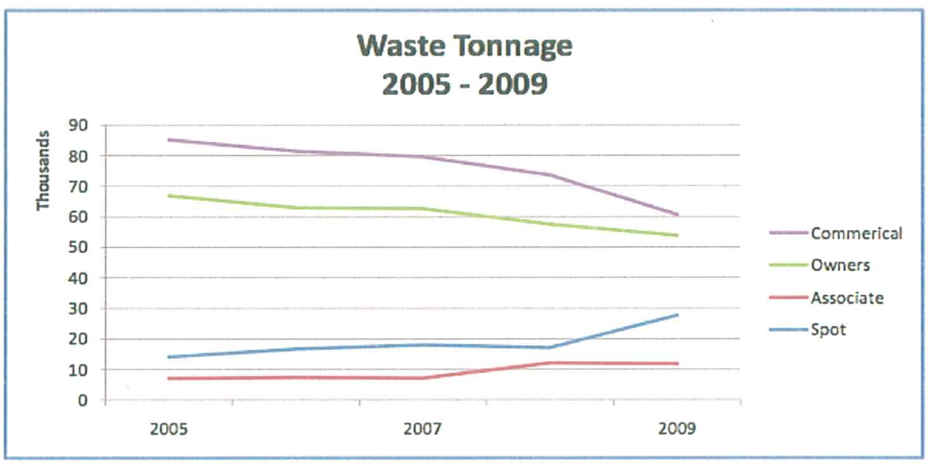
To account for this drop in MSW generation, ecomaine has had to increasingly rely on a "Spot Market." The spot market represents independent waste haulers (from both within and outside of the state) to whom ecomaine offers reduced rates in an effort to keep their WTE at capacity. In 2008, 98% of ecomaine's waste fuel came from the State of Maine and only 2% came from out-of-state Spot Market (Hewes 2010).

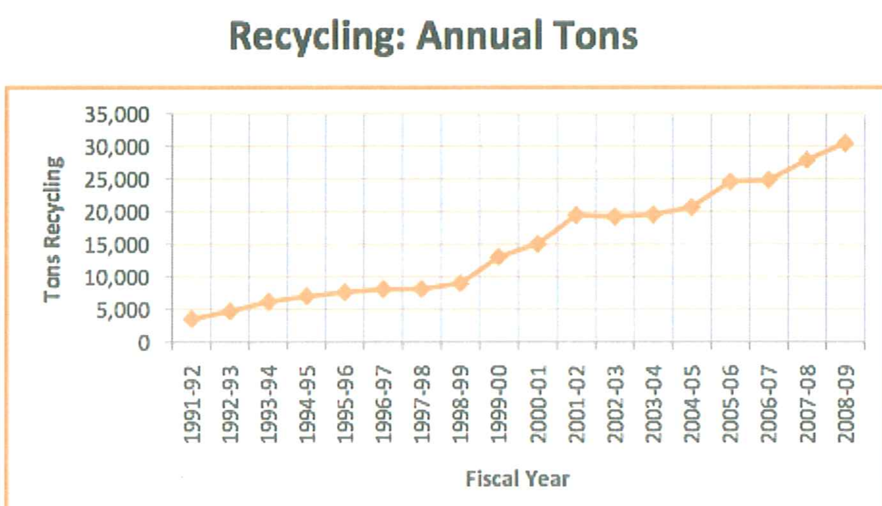
State of Maine Trends in MSW Generation and Recycling:



Graphs generated by Maine State Planning Office, "Waste or Resource? Rethinking Solid Waste Policy," 2009

ecomaine Trends in MSW Generation and Recycling:





Graphs courtesy of ecomaine's Annual Report, 2009

These trends, coupled with recent and proposed legislation, lead to some interesting questions: Are recycling and waste-to-energy compatible? Is ecomaine a system that can adapt to Maine's recycling priorities? How will the system adapt to potential climate change legislation?

We sought to address these questions through the creation of scenarios to look at ecomaine as a system within the current political climate. Scenarios are used in industrial ecology to describe possible future outcomes of systems based on their behavior and the "laws" that govern them (Graedel 1995). The following scenarios look at how ecomaine can effectively reach Maine's initiative to achieve a 50% recycling rate coupled with how carbon emission regulations might affect ecomaine's waste-to-energy program. These scenarios necessitate that ecomaine's WTE plant continue to operate at capacity in order to provide electricity and fulfill its contract to supply ISO-NE (independent system operator of the New England bulk power system) or electric "grid."

Methods

We looked at MSW composition (Appendix 1) and BTU value (Appendix 2) to predict what would happen if ecomaine invested in sorting technologies that enabled the power facility to burn different compositions of waste in an effort to keep its waste-to-energy plant at capacity while also increasing the recycling rate to 50%. We present three scenarios, which affect methods of sorting, amount of waste collection, and the possibility of receiving renewable energy credits under proposed climate change legislation.

Methods used to analyze ecomaine relied upon annual reports and data that characterize the type and amount of waste coming into the system, the capacity of the WTE and Recycling Plants, the amount of BTUs generated per ton of MSW, and the characterization of renewable energy credits.

Results and Discussion

Landfill space, waste legislation, recycling rates, and electricity generation are the constraints that bound the scenarios constructed for future ecomaine prospects and permutations. Before illustrating future scenarios for ecomaine, a short discussion of the state of these specific constraints will be undertaken. Adapting to the changing waste environment in Maine will be essential in each presented ecomaine scenario.

With approved municipal and commercial landfill space expected to reach capacity by 2020, no approved commercial or municipal landfill space coming online, and no new waste-to-energy plants planned or approved, the state of Maine is projecting that its single state-run landfill will take in almost 2 million tons of MSW per year by 2020 (Maine State Planning Office 2008). Post 2020, Maine will handle two thirds of all generated MSW, which represents all waste in Maine not headed for a waste-to-energy plant (Maine State Planning Office 2008). Today, the state of Maine processes less than 500,000 tons of MSW per year, meaning that there will be a significant change in waste handling in the next decade (Maine State Planning Office 2008). Under the state plan, Juniper Ridge Landfill will shoulder all of the increased volume of waste (Maine State Planning Office 2008). However, the Maine Department of Environmental Protection recently put on hold plans to expand the landfill to a size that would enable it to deal with the increased volume of waste that is expected (Maine Public Broadcasting Network Website). These projections prepared by the state illustrate that waste handlers will have significant room for expansion because of the constraints of space in working landfills and the uncertainty of the process surrounding the expansion of Juniper Ridge (State owned landfill in Northern Maine which is operated by a private firm, Casella of Rutland, VT).

Understanding the future of ecomaine means understanding Maine's landfill projections in juxtaposition with Maine's waste initiatives. The frontline of Maine's waste management is a waste hierarchy. The waste hierarchy of Maine considers landfilling to be the least desirable option, while endorsing reduction, reuse, recycling, and composting as the most desirable options (Solid Waste Management Hierarchy of 1989). Sandwiched between recycling and landfilling is the waste-to-energy option (Solid Waste Management Hierarchy of 1989). Currently, Maine processes 32% of its solid waste through its four waste-to-energy plants (Maine State Planning Office 2009). The capacity of these plants is projected to hold steady over the next two decades, while MSW generation is projected to rise 4% annually over the next two decades (Maine State Planning Office 2008).

The Maine waste hierarchy dovetails with a 2009 law that urged, but did not mandate, Maine to reach a recycling rate of 50%. Maine's definition of recycling incorporates composting as a method of recycling in realizing the 50% mark (Solid Waste Management Hierarchy of 1989). The Maine-wide recycling rate has held mostly steady around 35% since 2003 (Maine State Planning Office 2008). Interestingly, the recycling rate has decreased when comparing the 1990's to the 2000's. Tonnage of recycling in Maine has increased since the 1990's, but MSW generation has typically grown at a faster rate than recycling (Maine State Planning Office 2008). Maine's landfilling projections, coupled with the state's waste hierarchy and a legislative-backed drive to realize a recycling rate of 50%, color the future scenarios of ecomaine.

In presenting three distinct scenarios for ecomaine, each permutation will take into account the drive to reach higher recycling rates, while limiting the amount of material going to overtaxed landfills and keeping ecomaine's electricity generation stable at 102,400 MW of electricity per year.

In 2009, the ecomaine waste-to-energy plant incinerated 183,282 tons of MSW, and the recycling facility processed 30,814 tons of material (ecomaine 2008-2009 Annual Report). ecomaine communities in Southern Maine realized a recycling rate of 17% in 2009 (ecomaine 2008-2009 Annual Report). The 17% recycling rate falls well short of the level urged by Maine's legislation. Realizing recycling rates at ecomaine will force the industrial organism that is ecomaine to adapt to a changed environment.

Currently at ecomaine, routing for recyclables and MSW is determined by the waste generator and not by ecomaine. Therefore, any recycling routed to the waste-to-energy plant will be incinerated, while all recyclables routed to the recycling facility will be processed there. There is little to no MSW sorting currently occurring at the ecomaine waste-to-energy plant in keeping with the Mass Burn design. The only sorting that is currently occurring happens on the waste-to-energy tipping floor when a tipping floor attendant spots E-waste, appliances used for refrigeration, or very large pieces of metal in the deposited material (Hewes 2010). The process for finding and removing the undesirable waste is solely dependent on casually seeing the material, then using manual labor to remove these unwanted materials. Furthermore, although ecomaine possesses a permit to compost biogenic material, it does not currently have the capacity to compost (Hewes 2010). Considering that a significant portion, about 16%, of Maine's recycling is biogenic waste, this puts ecomaine at a significant disadvantage when trying to achieve a 50% recycling rate (Maine State Planning Office 2008).

To determine prudent scenarios, it was necessary to examine the waste stream at ecomaine. ecomaine does not keep detailed statistics on the types of waste coming into the plant (since it is bagged MSW), therefore, the data used has been derived from EPA data. As a check on this extrapolation, ecomaine provided readings on biogenic (64%) and non-biogenic (36%) CO_2 being released into the atmosphere, and it was determined that ecomaine's operation resembled the national norm (Hewes 2010). Based on EPA data, biogenic sources (organic wastes) make up 61% of the total MSW, amounting to about 107,000 tons incinerated per year at ecomaine (Appendix 4). Incinerating this material does not significantly add to the amount of CO_2 in the atmosphere because it was only very recently sequestered in the biogenic material. Even though biogenic waste makes up 61% of the incinerated waste, due to its low BTU value it only accounts for 51% of the electricity generated (Appendices 4 & 5). Therefore, burning biogenic waste is not as efficient as burning non-biogenic wastes.

Non-biogenic sources, mostly compromised of different forms of plastic, are much more efficient in generating electricity by incineration. However, combustion of non-biogenic materials increases the concentration of atmospheric CO_2. According to EPA values, non-biogenic material makes up 39% of the waste and accounts for 49% of electricity generated at ecomaine (Appendices 4 & 5). When breaking down the non-biogenic component further, it is evident that plastics are the most efficient, widely abundant fuel source in the waste stream. At ecomaine, about 30,000 tons of plastics are burned annually (Appendix 4). By weight, plastics make up 17% of the waste stream, but generate 33% of the power (Appendix 4 & 5). Rubber is also a very efficient fuel source. Rubber helps to generate 7% of the power produced, but accounts for less than 4% of the MSW by weight (Appendices 4 & 5).

For each scenario, the goal is to keep electricity generation stable, while greatly increasing the recycling rate as mandated by Maine legislation.

SCENARIO 1

In the first scenario, ecomaine will invest in MSW sorting equipment and person-power to sort out biogenic and non-biogenic material deposited on the waste-to-energy plant's tipping floor. This sorting technology is currently being mandated in California. Employees of ecomaine also discussed the rapid improvements in sorting technology related to recycling, and the head of ecomaine's recycling facility believed that the technology would soon be used in MSW sorting (Morin 2010). Once all non-biogenic and biogenic material is sorted in this scenario, the non-biogenic material would be sent to the recycling facility for further sorting, baling, and eventual sales. The biogenic materials would be incinerated in the waste-to-energy operation. Given that biogenic materials currently account for half of the electricity generated, ecomaine would need to double the volume of biogenic waste that they receive to keep electricity generation stable (Appendix 6).

In this scenario, the recycling facility would also more than double the amount of material coming directly to the recycling tipping floor, not including the material coming from the waste-to-energy plant. The total capacity of the ecomaine recycling facility, including material coming from the waste-to-energy plant, would need to expand to 210,000 processed tons of material per year. In 2009, the recycling plant processed about 30,000 tons, while the total capacity of the plant is estimated at 80,000 tons per year (ecomaine 2009 Annual Report).

The total material flow for both the recycling plant and the waste-to-energy facility in this first scenario would need to double to 420,000 tons per year to realize a 50% recycling rate and keep electricity generation stable. The additional 105,000 tons of biogenic waste needed for electricity would increase the total volume of incinerated waste by 35,000 tons annually.

To generate this material flow, an expansion of the number of member communities and an increase in spot market buying would have to occur. Of the three tracked varieties of waste collection, residential, commercial, and spot market, ecomaine would need to maintain a balance of collection where the spot market accounts for 1/3 of waste acquired, while residential and commercial accounts for 2/3 of all waste acquired (ecomaine 2009 Daily Tonnage Report).

Financing for the expansion would be covered by annual tipping revenues of about $25 million. Using 2009 as a model for revenue generated from tipping fees, the scenario extrapolates future tipping fees from 2009 data. In this scenario, ecomaine would generate $20,328,000 from commercial and residential tipping sources, while also generating $4,620,000 from spot market sources. These fees assume that each category of waste contributes about 33% of the total tonnage collected. Under the current ecomaine fee structure, both municipal and commercial sources would be charged $88 per ton to deposit waste, while the spot market charge was estimated by calculating an average 2009 spot market figure and using that figure for future spot market prices (ecomaine 2009 Statement of Revenue and Expenses). It was only prudent to use the 2009 spot market data because ecomaine's use of the spot market grew substantially in 2009. Before 2009, ecomaine rarely used the spot market to obtain material (ecomaine 2003-2009 Annual Reports). As landfill space becomes scarce, the spot market price may rise significantly, thus bringing in more revenue for ecomaine. Augmented by the longevity of ecomaine's ashfill and ecomaine's innovative strategy to 'cache' MSW fuel at the landfill and back-haul it to use at the WTE (Hewes 2010). The spot market price will be unpredictable and will be lower than $88 per ton over the short-run. Therefore, if ecomaine expanded its operations solely through spot marketing buying, the revenue accumulated would be far less. Any expansion at ecomaine should be backed by an expansion in member communities that guarantee a predictable tipping price and also contribute municipal assessments. Municipal assessments currently bring in around $4.6 million annually, but a large expansion of member communities could significantly increase these fees (ecomaine 2009 Statement of Revenue and Expenses).

Not only will tipping fees increase, recycling sales should rise substantially. In 2008, ecomaine realized a profit of about $1.5 million from recycling sales (ecomaine 2008 Annual Report), while in 2009, ecomaine only generated $500,000 from recycling sales (ecomaine 2009 Annual Report). The 2009 figures are colored by a total collapse in prices for recycled material because of the economic crisis that occurred in late 2008 and 2009

(Morin 2010). Scenario one calls for a seven-fold increase in material processed and sold by the recycling facility. The revenue generated from these sales will be dependent on world markets, which are unpredictable. For the sake of scenario one, it is assumed that revenues will rise to between $3.5 and $10.5 million per year from recycling sales alone.

Scenario one presents an interesting opportunity in which ecomaine realizes revenues from tipping and recycling of non-biogenic material. Currently, if an item is recycled, there are zero tipping fees charged (Morin 2010). Allowing member communities to bring recyclable material to the plant at no charge is an attempt to encourage recycling in those communities. A new sorting system, envisioned in scenario one, would mean that ecomaine could capture most non-biogenic recycled material no matter where the waste generator placed the material. If ecomaine keeps its current policy of not charging for items taken directly to the recycling facility, there would still be an incentive for municipalities to separate their recyclables from the biogenic waste stream. If ecomaine finds that purchasing and implementing MSW sorting to be cost prohibitive, there may be a way to force recycling by significantly raising the tipping fees for MSW on member communities.

Under scenario one, there may be a possibility to obtain renewable energy credits under the Bingaman-Dorgan, Waxman-Markey Bills or even Kerry-Graham-Lieberman. Under the Bingaman-Dorgan 100% of WTE renewable energy would be available for RECs while in the Waxman-Markey legislation that has yet to be ratified by both chambers of the United States Congress, waste-to-energy plants would receive renewable energy credits only from biogenic sources (Waxman-Markey Bill). Considering that scenario one mandates that 100% of ecomaine's emissions be biogenic, it is possible that a significant amount of funds could flow from the national legislation. Even discounting scenario one, the Waxman-Markey legislation, if enacted, could have a significant effect on waste-to-energy operations because there would be an incentive to burn a higher percentage of biogenic sources. This would favor recycling of plastics and other fossil-fuel waste, but could de-incentivize composting and the recycling of paper goods. The legislation could help ecomaine because they possess a facility to recycle plastics and other non-biogenic sources. ecomaine will be constrained by its current inability to sort MSW on the waste-to-energy tipping floor, and therefore, efforts to increase recycling will rely on the community at-large and consumer awareness to sort out the non-biogenic wastes and recycle that waste. It is possible that the Waxman-Markey incentives could spur ecomaine to sort MSW and even transport some biogenic material (paper products) from the recycling facility to the waste-to-energy plant. Waxman-Markey could act as a catalyst in encouraging ecomaine to carry out scenario one.

SECOND SCENARIO

In the second scenario, the reverse of scenario one will occur. The scenario envisions that on the WTE tipping hall floor, all biogenic sources are recycled by composting and all non-biogenic sources are incinerated in the waste-to-energy plant. To realize this scenario, ecomaine will need to invest in MSW sorting that separates biogenic and non-biogenic materials for burning and composting. This sorting technology would be a significant investment in dollars and person-power. Also, a composting program is not currently in place at ecomaine, although ecomaine possesses a composting permit for leaf litter and yard waste developed as a service for owner communities for Spring and Fall clean-up (Hewes 2010).

Material flows in scenario two would need to double to keep electricity generation stable (Appendix 7). Intuitively, one would surmise that less material would need to be collected if less material was used for electricity generation, but the intuitive conclusion does not take into account the proportionality of the waste stream coming into the waste-to-energy plant. Non-biogenic sources are a smaller portion of the waste stream, therefore, the amount delivered to the waste-to-energy plant will mirror Scenario one because electricity generation is almost evenly split between biogenic and non-biogenic sources (Appendices 1, 6, 7). However, because non-biogenic materials are more efficient at generating electricity due to high BTU value of plastics, a smaller proportion of the total tonnage would need to be used for electricity generation. Only 137,000 tons of non-biogenic waste would need to be incinerated under scenario two. Scenario two would burn 73,000 tons less than scenario one and 38,000 tons less than business-as-usual projections.

Total material flows in scenario two would exceed 380,000 tons. This would be a decrease of 30,000 tons from Scenario one, but a substantial increase of 205,000 tons over business as usual. This increase in total tonnage will ensure that ecomaine achieves a significant increase in recycling from the business-as-usual track.

Recycling rates in scenario two would rise above 60% due to the inclusion of composting as recycling. With biogenic recycling representing 213,000 tons of material, or 56% of the total waste stream, and the established recycling program representing 7%, or 30,000 tons, of the material. This increase under scenario two will exceed Maine's recycling standard. Interestingly, if ecomaine succeeded in recycling this large amount of biogenic material (for composting), it would exceed the amount of biogenic material currently recycled in the state by 96,000 tons (Maine State Planning Office 2008).

Recycling of the biogenic material will be done on land near the ecomaine ashfill. This amount of biogenic materials will be substantially more than the material ecomaine currently takes to the ashfill. ecomaine currently takes about 42,000 tons of ash-material to the ashfill every year (ecomaine's Landfill/Ashfill Facility Website). The total amount being trucked from ecomaine's waste-to-energy plant to the ashfill/composting facility would increase to 255,000 tons of material if scenario two was enacted. Scenario two's use of the ashfill and adjacent composting facility would be a stark change from scenario one and business-as-usual, being that both business-as-usual and scenario one only envision depositing a minimal amount of material at the ashfill/landfill after incineration occurs.

To procure the amount of material needed to realize scenario two, ecomaine would need to expand its member communities, while also expanding the amount of material taken in by the spot market. Expansion would need to be based on the expansion of member communities and only supported through the spot market.

All new investments in sorting and establishing the biogenic recycling facility would come primarily from tipping fees and, secondarily, through municipal assessments. Scenario two would also generate $25 million in tipping fees mirroring scenario one. These tipping fees, coupled with an expanded portfolio of municipal assessments, would be the only new financing in this scenario. It is possible that composting material could generate some revenue in the future, but calculating the revenue lost or gained from the operation is currently outside the scope of this scenario because of the untried nature of large scale municipal composting in Maine and the multiple unknown variables involved in making a realistic calculation.

Recycling of non-biogenic material in scenario two will mirror the business-as-usual track, therefore revenues will hold steady in this scenario, as well as tonnage going to the recycling facility. The tonnage going to the recycling plant in scenario two is estimated to be around 30,000 tons of material per year (Appendix 7). This business-as-usual approach to non-biogenic recycling illustrates a major difference between scenario one and scenario two because the recycling facility is greatly expanded in scenario one, while the facility is mostly ignored in scenario two. No investment in the single-sort recycling facility will be needed in scenario two, while substantial investment would be needed in scenario one. The difference in tonnage between scenario two and scenario one is that 180,000 fewer tons would enter the recycling facility in the second scenario.

Under scenario two, ecomaine would not receive 100% renewable energy credits under the proposed Waxman-Markey bill but would under Bingaman-Dorgan legislation. Other forms of State and Federal climate and energy legislation have bestowed renewable energy credits on all power generated by waste-to-energy plants, not just the biogenic portions of the power generated. In the State of Maine during the 124th Legislative Session, proposed language to LD1682 "An Act to Amend the Electric Utility Industry Laws as they Relate to Renewable Resources" was proposed to authorize WTEs as 'renewable capacity resource' (Hewes 2010). WTEs are currently 'renewable resources' in Sec 4. 35-A MRSA Sec 3210, sub-Sec 2, Par C and thus eligible for Class II RECs (Hewes 2010). However, if WTEs were categorized as a 'renewable capacity resources' and upgraded control efficiencies to its operations (installed after 2005) then ecomaine could qualify for Class I RECs and under CT NEPOOL yield eligibility for $17.00/kwh. Under these changed provisions, scenario two could realize a substantial amount of funding for ecomaine.

Enactment of new federal laws or even adjustment to language in current Maine statute are highly unlikely, but if Legislators grant credits for all power generation for WTEs, this legislation could push ecomaine toward the second scenario. By making the burning of all forms of MSW more of an economic activity, there could be an incentive that would economically favor waste-to-energy over recycling or composting but would maintain preference for WTEs over landfilling MSW. This type of legislation could threaten the enactment of programs that carry out Maine's waste hierarchy and the State's attempt to reach a 50% recycling rate. The unlikely legislation could incentivize ecomaine to expand its energy production to realize substantially more credits bestowing financial benefits to the communities that own and invested in ecomaine. Any expansion of energy production could cause the recycling rate to fall, something that scenario two tries to avoid. However, scenario two does create an excess amount of recycling above the 50% goal. The tonnage above and beyond 50% could be easily used to push up electricity generation, in an effort to realize credits under a law that rewards all forms of energy generation at a waste-to-energy plant.

In scenario two, the efficiency of ecomaine's air pollution control technology (APCT) would continue to mitigate for mercury, SO2, NOx, and non-biogenic CO_2 emissions. ecomaine's APCT currently has >90% removal efficiency of emissions emanating from incinerated non-biogenic sources and there is no reason to assume that an increase in the waste stream would greatly enhance the pollutants in the waste-to-energy facility. ecomaine continues to operate well within the regulatory limits and it may benefit from having less plastic in the waste stream at the waste-to-energy plant due to increased recycling of ecomaine's member communities.

SCENARIO THREE

In scenario three, the single-sort recycling facility would meet and exceed its full capacity of 80,000 tons, while no changes would be made to the waste-to-energy operation. The total material coming to both the waste-to-energy plant and the recycling facility at ecomaine in this scenario could reach or exceed 255,000 tons. This scenario would see the smallest increase in tonnage of the three options. Scenario three would also see little to no new investment occurring at ecomaine. The other two scenarios were predicated on substantial investment in new technology. Scenario three maximizes the potential of all facilities at ecomaine without a drastic realignment.

Increasing the recycling rate at ecomaine can be done in a few different ways. By simply increasing the recycling plant's hours of operations and the number of member and associate municipalities, ecomaine can operate to accommodate Maine's legislation. ecomaine finds itself in an interesting position within the waste hierarchy and Maine's recent legislation. Equipped with a recycling plant, ecomaine is more adaptable to embrace Maine's policy of increasing recycling than the other WTEs in the State. The other three

State WTEs are: Maine Energy Recovery Company (MERC) in Biddeford, Mid-Maine Waste Action Corp (M-WAC) in Auburn and Penobscot Energy Recovery Company (PERC) in Orrington. ecomaine operates the only single-sort recycling facility in the State of Maine. Casella Waste, which also operates Juniper Ridge landfill and the MERC WTE own two single-sort recycling facilities in Massachusetts. Casella has contracts with several Maine communities and transports their recyclables to Massachusetts (Labbe 2010). The distinction between the location of the single-sort recycling facilities has been part of a strategy to market potential clients to join ecomaine.

ecomaine is already working to increase the number of its member communities. Currently, ecomaine provides services for twenty-one municipalities within the greater Portland area. The Business Development Manager has 15 towns she is actively working to bring into the ecomaine network. Additionally, she has 25 towns on her priority list that she contacts about monthly as these communities will be making a decision about their waste disposal in the next year. And finally, there are 50 towns in the pipeline that she checks in with every 6 months to nurture a working relationship.

ecomaine can also increase its recycling rate by promoting recycling to commercial businesses. ecomaine receives 85% of its recyclable materials from the residential pick-up and only receives 15% from commercial sources (ecomaine 2009 Recycling Production Worksheet). In 2009, ecomaine received 33% of its MSW from each of three sources: commercial, residential, and the spot market (ecomaine 2009 Daily Tonnage Report). Spot market practices do not generally occur in the recycling side of ecomaine because there are no tipping fees to drop off recyclables. Thus, one would conclude that the residential and commercial market would deliver similar percentages of recycling, but they do not deliver these amounts. Therefore, a push to receive more recycling from established commercial sources should be undertaken.

Stonecraft's "Maine EcoStone"

An increase in recycling rates, coupled with technological advances, has resulted in advantages for ecomaine in the past. These advantages and a drive to innovate could help push ecomaine into the future. For instance, advances in recycling technology of glass chipping has produced a product of mixed glass chips that ecomaine has brought to market (Morin 2010). These glass chips were created be modifying the single-sort recycling machinery, glass trommel, to produce polished pieces of glass in two different sizes. ecomaine now sells its glass chips to a local counter-top maker who uses recycled chips as "Maine's EcoStone" and includes it in designer countertops.

Some may speculate that the increase in recycling rates of plastics, have had the benefit of lower acid flue gas emissions; however, ecomaine's emissions for SO2 have deviated very little over the years but less non-biogenic inputs may contribute to lower HCl emissions.

When the idea of an independent compost operation that could potentially divert a large portion of the organic waste stream from ecomaine's WTE facility was suggested, the response was one of optimism: Diverting wet waste from the MSW stream would allow the plant to burn at greater efficiency (Labbe 2010).

Conclusion

Adaptive Strategies

In achieving increased resiliency and adaptability, ecomaine has its eye on several initiatives that can decrease dependence on external inputs and increase its initiatives in providing cleaner renewable regional energy.

For instance, ecomaine is currently evaluating a relationship with a local insurance company that is interested in using hot water from ecomaine to use for heat at its facility and offset its cost of natural gas. The insurance company employs three thousand people and has a demand for heating and cooling in its large facility. It is also located adjacent from ecomaine's facilities although I-95 divide the two properties (Hewes 2010). Cost-benefit analyses are under scrutiny and also CO2 offsets from reducing the Insurance company's dependence on natural gas. Two thousand tons of CO2 could be averted each year for the Insurance company by using ecomaine's district heat. It is a multi-million dollar project and both parties are weighing the costs and benefits.

Additionally, the idea of diverting ecomaine's leachate, collected at its ashfill, from release to Portland's sewer treatment facility for use at its power plant has been discussed as a way to eliminate treatment costs imposed by the Portland Water District and to achieve greater efficiency in resource reuse (Hewes 2010). A prohibitive factor right now includes the necessary infrastructure for the project, which would include building a diversion pipe underneath the Rt 22 to connect the force main line conveying the leachate to ecomaine's WTE plant.

These developments would increase the adaptability of ecomaine in creating further avenues for revenue, minimizing external inputs, and achieving greater environmental benefits by diverting waste products to be used in power creation.

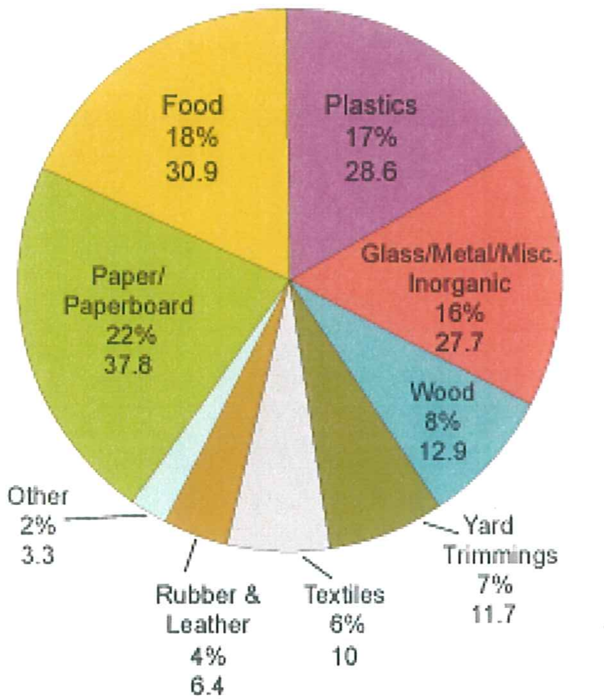
Further Research

Waste-to-energy plants often bear the brunt of criticism by environmentalists who exclaim that with WTE plants in place, it will be difficult to achieve a reduction in waste; however, people at ecomaine disagree. ecomaine endorses WTE technology to handle solid waste and as long as there will continue be consumers , "there will always be garbage" was a phrase we heard over and over again.

This leads to some interesting ideas for further research. ecomaine is creating renewable energy from regional garbage. The plant has extensive air pollution controls in place and has achieved ISO 14001 Certification at all three of its facilities (WTE, Recycling Center, Landfill/Ashfill). Is it more environmentally friendly to burn waste and send less trash to the landfill than to collect recyclables and send them off to China for processing in a country where the environmental standards are not as strict? In industrial ecological terms, a comparison of the emissions and environmental impacts of both processes might result in some interesting findings.

Appendices

Content of MSW Landfilled or Burned, 2007
(Millions of tons, total: 169.2)



Source: U.S. Environmental Protection Agency, Municipal Solid Waste in the United States: Facts and Figures (2007). http://www.epa.gov/waste/nonhaz/municipal/msw99.htm#links

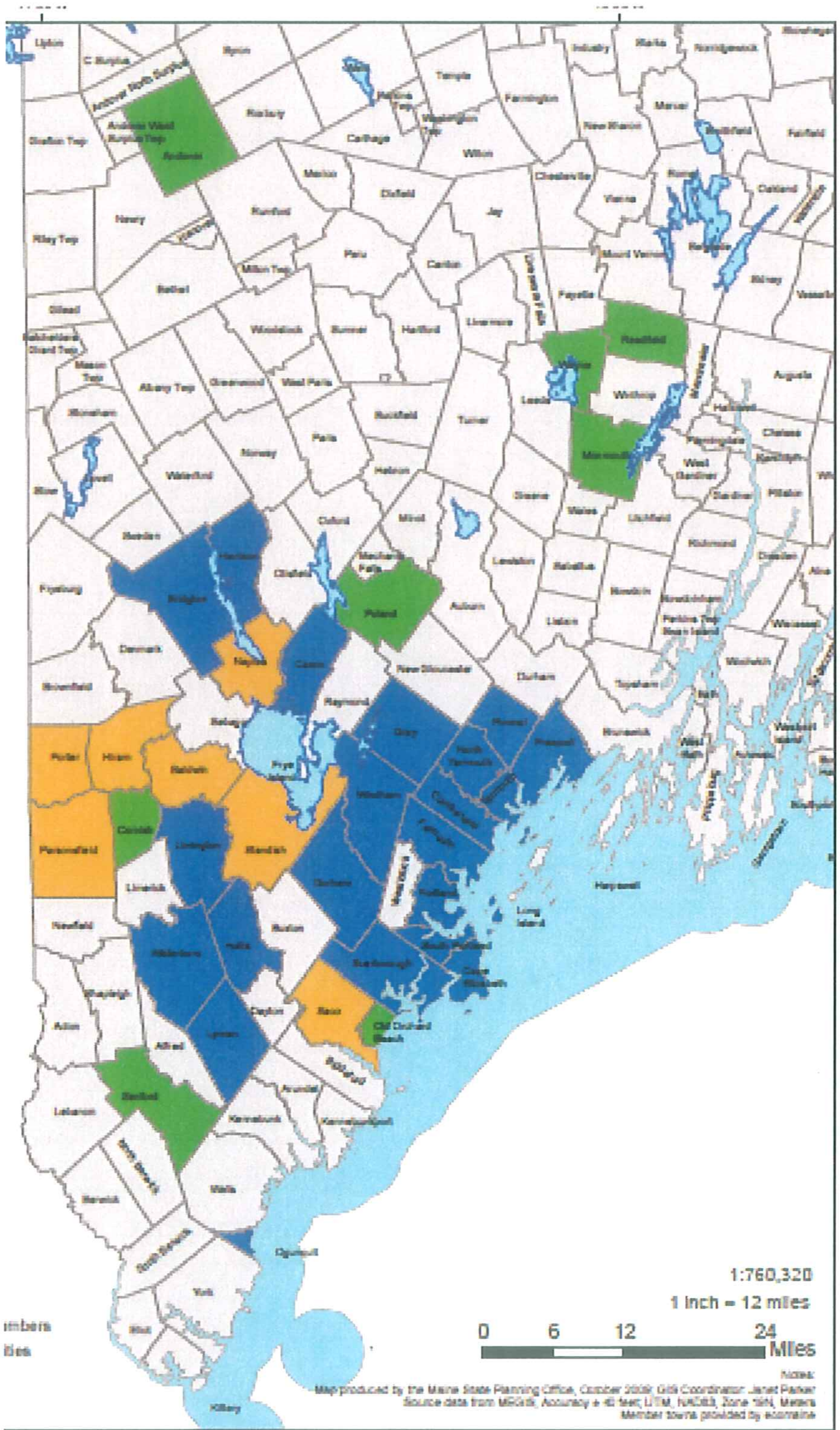
Appendex 1: EPA figure used to calculate the amount and breakdown of ecomaine's waste stream

Table 4. Typical Heat Content of Materials in Municipal Solid Waste (MSW) (Million Btu Per Ton)

Materials	Million Btu Per Ton
Plastics	
Polyethylene terephthalate[c, e] (PET)	20.5
High density polyethylene[e] (HDPE)	19
Polyvinyl chloride[c] (PVC)	16.5
Low density polyethylene/ Linear low density polyethylene[e] (LDPE/LLDPE)	24.1
Polypropylene[c] (PP)	38
Polystyrene[c] (PS)	35.6
Other[e]	20.5
Rubber[b]	26.9
Leather[d]	14.4
Textiles[c]	13.8
Wood[b]	10
Food[a, c]	5.2
Yard trimmings[b]	6
Newspaper[c]	16
Corrugated Cardboard[c, d]	16.5
Mixed paper[e]	6.7

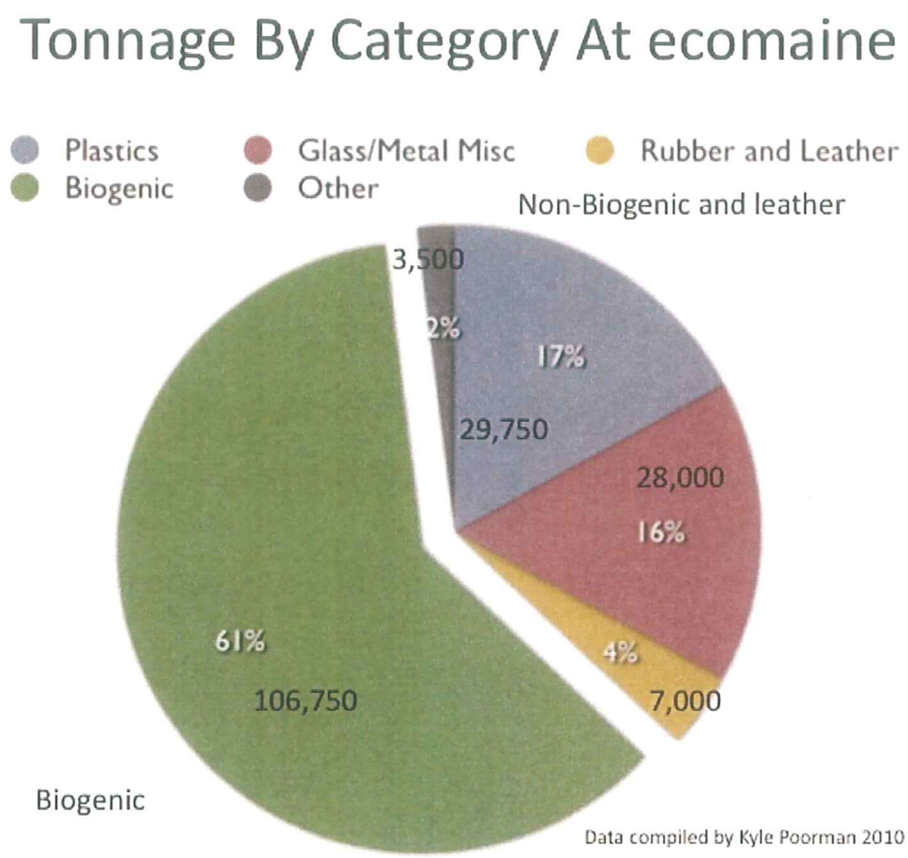
a Includes recovery of other MSW organics for composting.
b Energy Information Administration, Renewable Energy Annual 2004, "Average Heat Content of Selected Biomass Fuels," (Washington, DC, 2005).
c Penn State Agricultural College Agricultural and Biological Engineering and Council for Solid Waste Solutions, Garth, J. and Kowal, P. Resource Recovery, Turning Waste into Energy, University Park, PA, 1993.
d Bahillo, A. et al. Journal of Energy Resources Technology, "NOx and N2O Emissions During Fluidized Bed Combustion of Leather Wastes," Volume 128, Issue 2, June 2006. pp. 99-103.
e Utah State University Recycling Center Frequently Asked Questions http://www.usu.edu/recycle/faq.htm

Appendix 2: BTU values of MSW waste, Energy Information Association. Source: EPA

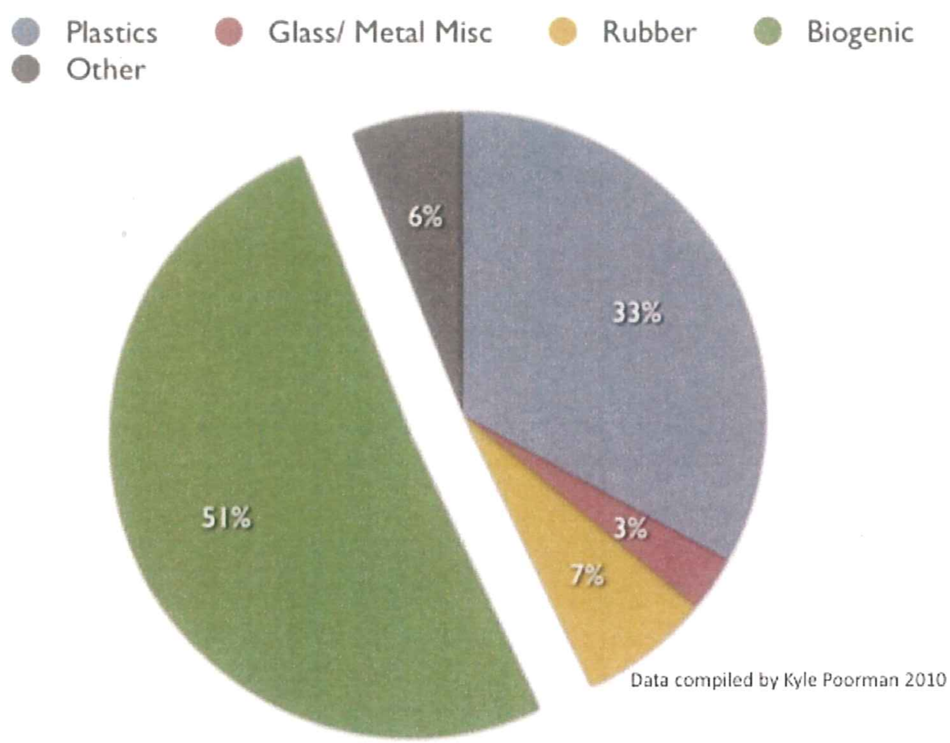


Appendix 3: ecomaine member communities
Blue = Corporate Members
Yellow = Associate Members
Green = Recycling Members
Gray = Nonmembers

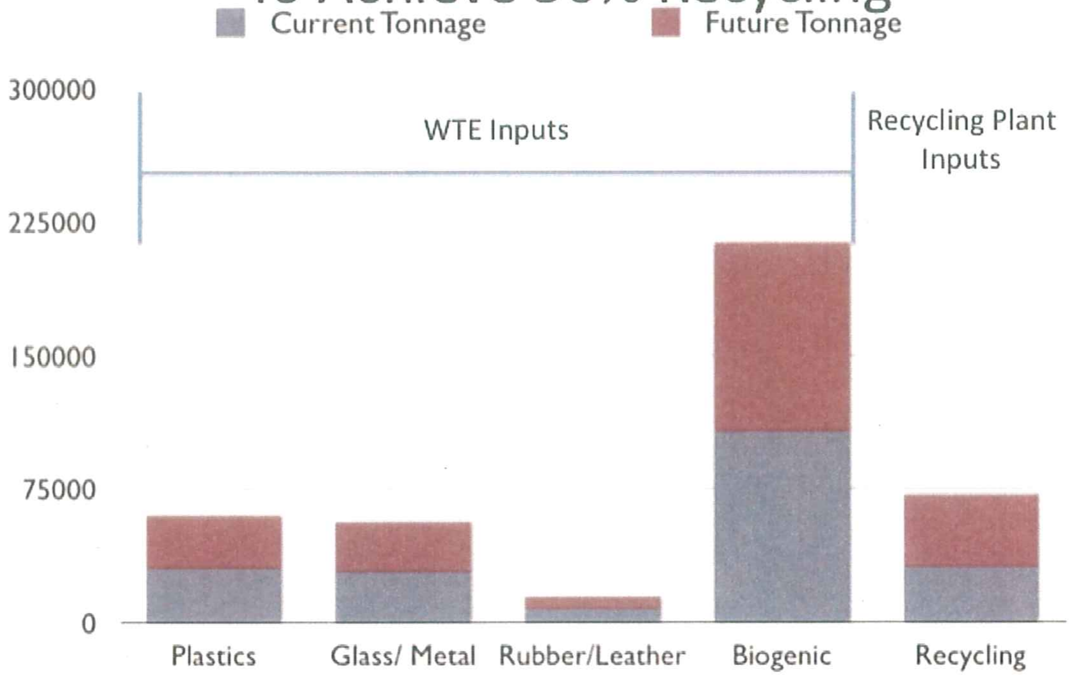
Courtesy of ecomaine


Tonnage By Category At ecomaine
Plastics
Glass/Metal Misc
Rubber and Leather
Biogenic
Other
Non-Biogenic and leather
3,500
2%
17%
29,750
28,000
16%
4%
7,000
61%
106,750
Biogenic
Data compiled by Kyle Poorman 2010

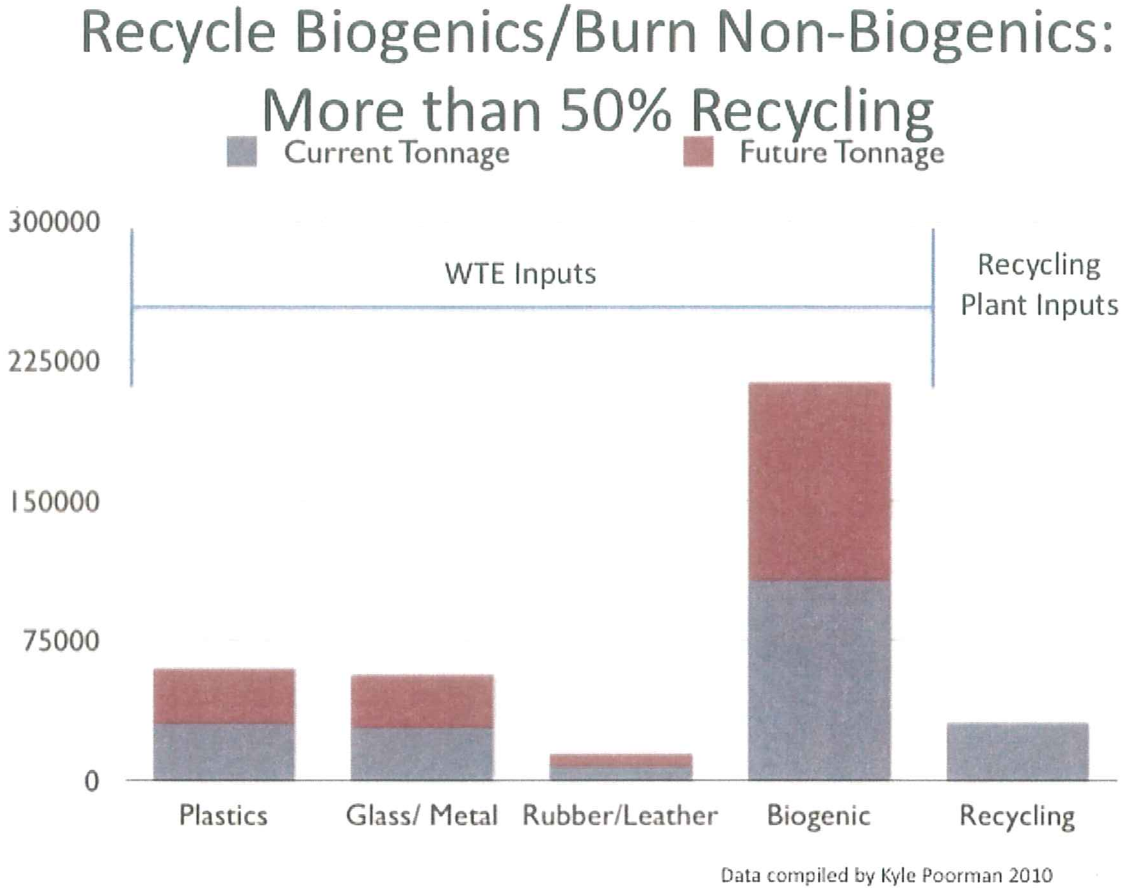
Percentage of Electricity Generated By Category



Recycle Non-Biogenics/Burn Biogenics: To Achieve 50% Recycling



Data compiled by Kyle Poorman 2010



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