

Sustainability Strategy
for Biddeford, Maine's

WASTE MANAGEMENT SYSTEM

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HUID 50781909

Environmental Studies E-105:
Strategies for Sustainability Management

Harvard University Extension School
Spring 2009-2010

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INTRODUCTION

Many sustainability efforts are focused around waste reduction. The elimination of waste reduces pollution and other related impacts. This paper focuses on the handling of waste itself– what happens at the end of the value chain and how waste management can have significant ramifications for the sustainability of a community. This will be an examination of the waste management system of Biddeford, Maine, a small, real city located in the southern coastal area of the state referred to by some as "Trash Town USA."¹

Waste is a particularly relevant topic for this city as it is a host community for a waste-to-energy plant, which has generated a considerable amount of debate since its construction in the 1990s. Outside those debates, this paper will examine Biddeford's own waste management system with information drawn from the city's Department of Public Works, public records, as well as related industry organizations, in an attempt to provide suggestion on strategies for improving the city's waste management's level of sustainability through a systems approach.

The boundaries are set to the waste management system's direct sphere of influence. The sphere of influence of an organization usually includes external parts of the value chain for which it should exercise due diligence when determining that sphere (International Organization for Standardization, 2010). Therefore, discussion will extend beyond the activities undertaken by Biddeford's Department of Public Works to include subsequent steps in the value chain. Discussion begins from the point of waste generation and follows through to final processing, either the landfilling of residual ash that is a product of waste combustion, or through to the recycling of commodities. The use of the term "waste management system" refers to the handling of both waste and recyclables.

Discussion is limited to the handling of household waste and does not include commercial, oversized, hazardous or universal waste. Additionally, it does not include scrap steel that is hauled to the transfer station by both household and commercial users and would most likely be minimally affected by the efforts discussed in this paper.

CREATING A FRAMEWORK FOR A SUSTAINABILITY MANAGEMENT SYSTEM

When embarking along the path to sustainability, it is important to build a framework that will drive efforts. The framework determines the context, establishes the approach, and identifies the organization's processes and impacts.

Figure 1: The Sustainability Nexus



Defining the Sustainability Nexus

The waste handling system exists at a nexus between the municipal government, Biddeford citizens, and waste-to-energy and recycling companies. The municipal government's Department of Public Works and city council are the decision makers and operators

¹ Reference drawn from a *Portland Press Herald* article (Wack, 2004, Nov 8).

for the waste management system. The municipal government holds legal, financial and operational responsibility to the city's citizens, who are the direct beneficiaries of the waste management system. The structure can be likened to a company where the city council represents the executive level, Public Works is the management team, and the citizens are the shareholders. Waste-to-energy and recycling companies are contractors and the end processors for the waste management system and are positioned to have significant influence on the system's overall sustainability.

Establishing a Positive View

As the operators of the city's waste management system, the Department of Public Works is in the position to lead a sustainability effort. A sustainability strategy is defined by its Vision, Mission and Core Values.

Public Works has the following Mission Statement posted on its website:

To provide outstanding Public Services in a timely and fiscally responsible manner while maintaining an excellent infrastructure, assuring a clean and safe environment as well as sustaining a high quality of life. □

We will act with pride, vision and accountability and will react in readiness.

We will listen ... Furthermore ... □ We will respond. We are committed to serving all the people every day. (Department of Public Works)

Should the department establish a sustainability system, it would be an opportunity to re-examine the above statement in light of new goals and the express it in the form of vision, mission, and core values statements. A **vision** statement communicates what the department wants to become, providing a positive view of its sustainable future and helping guide strategic planning and decision making. A **mission** statement may outline operational priorities. **Core values** provide guiding principles. Some of the content for a new set of statements may be extracted from the existing mission statement and restated with a sustainability focus.

For example, the **vision**, **mission**, and **values** may be established along the lines of:

Vision—Providing public services that contribute to a sustainable, thriving community and support a high quality of life.

Mission—Provide service in a timely, fiscally and environmentally responsible manner; maintain an excellent infrastructure; and assure a healthy and safe environment for our citizens and municipal staff.

Values—We will engage our stakeholders and will consider the broader economic, social, and environmental impacts of our services, striving to achieve a sustainable balance.

Incorporating Leading Indicators in Planning for Sustainability

Incorporating principles outlined in business performance frameworks such as the *Baldrige Criteria for Performance Excellence* (Baldrige National Quality Program, 2010) can assist in establishing leading indicators that drive sustainable performance. Mapping of existing principles against a selection of comprehensive criteria formulated to promote business success will facilitate building a framework the sustainability efforts for the waste management system.

A discussion of criteria drawn from Baldrige in relation to the waste management system follows.

Quality leadership is critical to the success of the sustainability effort. In the case of Biddeford's waste management system, the leaders consists of the city government officials and the director of the Department of Public Works. Leaders must be committed to achieving sustainability and guide efforts toward the realization of sustainability goals. Leadership should be demonstrated through the considered definition of and commitment to the vision, mission, and values of the waste management system. Leaders are key to the internal and external communication of goals, progress and results. They communicate what is done well and what could be improved and introduce future goals. Their communication of sustainability efforts to stakeholders will create a focus on action that will help drive performance. They are integral to assuring continuous improvement and are accountable for progress. Accountability within an organization acknowledges that it is part of larger social, environmental, and economic systems and supports the performance through management of risks and opportunities (The Sigma Project, 2003).

Strategic planning defines the approach taken to prepare for the future, establishing strategic objectives and goals to be met by the waste management system. Planning should be derived from the system's strength and weaknesses, stakeholder input, and include timetables for achieving objectives. Strategies for addressing economic, environmental, and social improvements should consider current technologies, commodities markets, customer preferences, service providers' impacts, and the regulatory environment.

A customer (citizen) focus achieved through planned engagement with the city's citizens will ensure services are geared to meet their needs. Engagement efforts will allow the Department of Public Works, as the operators of the waste management system, to listen and respond to needs as well as provide support in helping citizens best utilize services.

Performance measurement, analysis, and review will drive sustainability efforts by providing data and information for tracking the progress of programs. Currently, financial performance has a well-established system; however, to make meaningful progress in sustainability, measures for environmental and social performance must also be created to enable comprehensive performance analysis and review.

As an example, environmental performance measures could include the tracking of greenhouse gas emissions associated with the waste management system through the use of an established protocol such as that produced by Entreprises pour l'Environment (2008).

The value in these measurements is providing the capability to report to city council, taxpayers, and citizens not only on financial performance, but also on environmental and social returns on tax dollar investments, potentially generating increased support for waste management activities.

A workforce focus encourages high performance. Compensation, reward, recognition, and incentives are part of this focus, as are learning and development systems that access the capabilities and capacity of the workforce, including leaders. The policies of the waste management system should maximize health, safety, and security. Leaders must consider how they provide effective formal and informal communication of goals and how they actively engage with the workforce as a primary stakeholder in sustainability efforts.

Process management through the design, operation, and improvement of work processes maximises resource use and minimizes waste. The use of process maps that describe core and

supporting processes promotes a broader understanding of the organization and facilitates the identification of opportunities for improvement (Pojasek, Characterizing a Process, 2010).

Identifying the Sustainability Footprint

The "sustainability footprint" of the waste management system is an inventory of associated services, facilities, equipment, and human resources, framed to identify each item's economic, social, and environmental impacts upon the system. Due to direct and immediate correlation of impacts, the footprint for Biddeford's waste management system has been extended beyond Biddeford's own work processes to include subsequent stages. An initial investigation into the footprint is illustrated in the Table 1. The comprehensive view of services, facilities, equipment, human resources, and related value chain impacts promotes understanding of the organization from a sustainability standpoint and is useful in the identification of opportunities for improvement.

Table 1: Sustainability Footprint

SUSTAINABILITY FOOTPRINT				
		Environmental	Social	Economic
Services	Curbside residential waste collection and transport	Diesel consumption and emissions, dust	Necessary social service, maintenance of a tidy city, truck noise, odor, community relations	Taxpayer investment
	Recyclable commodity collection, processing, storage, marketing	Resource recovery, reduced pollution associated with recycling, fuel consumption and emissions	Worker safety, community relations	Recyclable commodity revenues
	Hazardous and universal waste collection	Hazardous material recovery and rendering to harmless state, reduced pollution	Promoting responsible handling, worker and community safety	Reduced cost of hazardous material cleanup
	Scrap metal, compost item collection	Resource recovery, reduced pollution		Revenue from metal sales
	Large item, demo debris collection and processing	Diesel consumption and emissions, electricity consumption	Meeting social need	
Facilities & Equipment	Transfer station	Electricity consumption, heating fuel emissions, water runoff, physical footprint		Capital investment, maintenance
	2 roll off trucks	Diesel emissions, oil consumption		Capital investment, maintenance
	3 packer trucks	Diesel emissions, oil consumption		Capital investment, maintenance
	4 vertical balers 1 horizontal baler	Diesel emissions, electricity consumption, oil consumption		Capital investment, maintenance
	Forklift			
	High density compactor			
Human Resources	1 Director			Salary and benefits
	2 Drivers		employment	Wages and benefits
	4 Packers		employment	Wages and benefits
Directly related Impacts	Waste combustion	Recovered energy, air emissions, reduced reliance on fossil fuels	Meeting society's need for energy	

Process mapping

Process mapping is a proven analytical and communication tool that helps teams understand processes, identify opportunity and risk, and communicate with others (Pojasek, 2010). The creation of a process map enables the exploration of the process by a team, creating a platform for communication. Verification of the associated work steps, resources, and risk inventories serves as the assessment. Figure 2 provides a map of the key processes of Biddeford's current waste management system.

The perspective of the process map is taken from the waste object from the point of disposal. Dependant upon the personal decision of the owner of that object and the waste management system services, objects embark along one of two paths– to be combusted, or to be recycled. The main process steps are identified along the value chain from user disposal through landfilling or recycling. Blue represents steps which the municipal waste management system has indirect impacts; red represent direct control and impacts.

The importance of viewing these two paths simultaneously is to understand that waste input increases for one path is directly correlated to a decrease in the other. In addition to mapping process steps, each step is accompanied by identified resource inputs and outputs, making it possible to identify areas of overlap where resource conservation may be achieved. Furthermore, below each line on the process map is a table of risks associated with each step. Understanding risk is key to informed decision making. A further investigation of risk could be accomplished through the use of a risk register that assists in weighing the significance of a risk and developing an action plan to address it.

IMPLEMENTING A SUSTAINABILITY PROGRAM

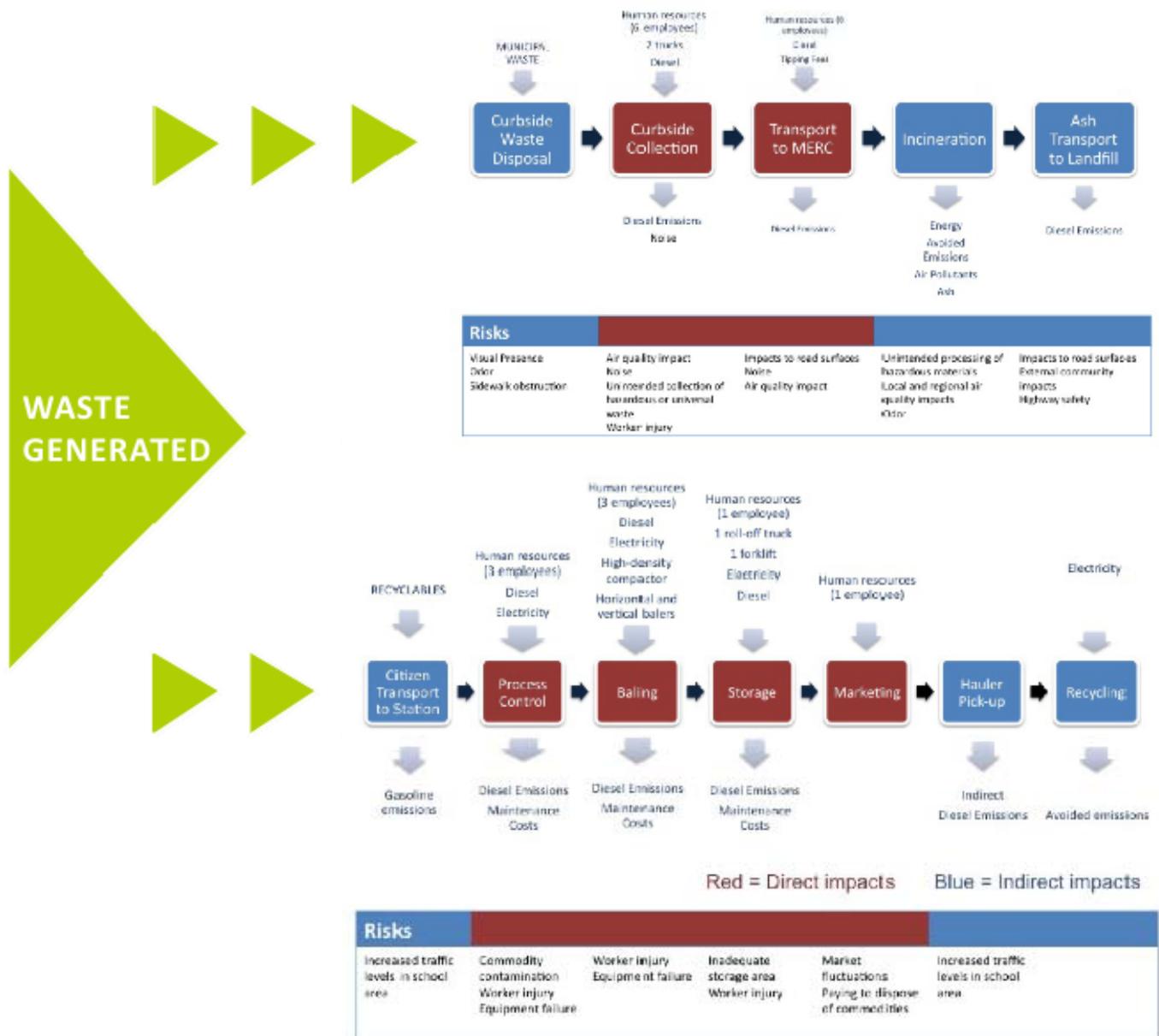
The discussion above has provided guidance for establishing the framework of a sustainability management system by identifying context, establishing the approach that will support success, and identifying the waste management systems main processes. With a framework in place, a push forward with the sustainability effort can begin.

Identifying Opportunity for Improvement

In light of growing concern regarding global climate change, a growing number of industries are required by regulators to report on their greenhouse gas (GHG) emissions. The EPA issued a ruling at the end of 2009 requiring facilities that emit a certain amount of greenhouse gases to submit annual reports to the agency (U.S. Environmental Protection Agency, 2009). Although emissions associated with Biddeford's waste management practices are well below the reporting threshold, such requirements are indicative of the growing importance being placed on public and private organizations taking responsibility for their contribution to climate change. In fact, voluntary reporting is being undertaken by many organizations, including those within the waste management industry. An example is the establishment of a Carbon Footprint Team by the company Waste Management, the "leading provider of comprehensive waste and environmental services in North America," that is producing an inventory of direct and indirect emissions to be publicly reported annually beginning in 2010 (Waste Management, 2010). Municipalities are also committing to greenhouse gas reduction targets through such organizations as the U.S. Conference of Mayors, whose members agree to "strive to meet or exceed Kyoto Protocol targets

for reducing global warming pollution by taking actions in our own operations and communities" (United Conference of Mayors, 2008) . Biddeford's former mayor signed *The U.S. Mayors Climate Protection Agreement*, committing the city to reducing global warming pollution. Waste management provides a key role in supporting the implementation of that agreement; therefore, the *opportunity for improvement* is identified as: "Reduce green house gas emissions related to waste management."

Figure 2: Process Map for Waste Management Services



Root Cause Analysis

The EpE greenhouse gas inventory protocol identifies fuel consumption from transport associated with waste collection as the source of direct greenhouse gas emissions. Examining the sustainability footprint chart, along with the red colored steps on the process map, it is apparent that diesel consumption is the most significant contributor to direct emissions. Utilizing standard figures established by the U.S Energy Information Association², a calculation based on FY2008 diesel fuel consumption of 10,130 gallons (Biddeford Department of Public Works, 2009) reveals that the equivalent of 103 metric tons of CO₂ equivalent emissions were released to the atmosphere from the operation of waste management vehicles and equipment.

Numerous methods for decreasing diesel emissions could be posed, such as switching fuels to biodiesel or natural gas, using GIS mapping software to map out the shortest and most efficient waste pickup routes, or to minimize truck idling times. However, further examination of the process map also indicates that avoided emissions are a benefit of both waste combustion and recycling.

According to the EPA, the net greenhouse gas emissions associated with waste combustion from a waste generation standpoint is -0.12 metric tons CO₂ equivalent per ton (MTCO₂E/ton) of municipal solid waste as disposed, meaning, from a waste generation standpoint, combustion for energy production actually reduces greenhouse gas emissions³. Recycling provides even greater benefits, with mixed recyclables accounting for -2.91 MTCO₂E/ton (U.S. Environmental Protection Agency, 2006)⁴. Using Biddeford's FY2009 figures, 7598 tons of waste combusted resulted in 911 tons of avoided CO₂ equivalent emissions. Recycling of 596 tons of mixed recyclables resulted in 1734 tons of avoided emissions. A look at the life cycle of waste beyond the boundaries of Biddeford's own waste management system makes clear that the greatest benefits in greenhouse gas reduction are to be achieved through increased recycling.

Priority of Solutions

In *The U.S. Mayors Climate Protection Agreement*, Biddeford committed to actions including: "Increase recycling rates in City operations and in the community." Biddeford currently has a very low recycling rate. In FY2009, Biddeford recycled only 10.6% of its total waste, including scrap steel. Mixed recyclables accounted for 6.8% (Department of Public Works). The State of Maine's average recycling rate was 38.7% in 2008 and its state-wide goal is to reach 50% (Maine State Planning Office, 2010). It is apparent that an increase in recycling in Biddeford will contribute to the achievement of not only municipal goals, but also state and national goals aimed at providing benefits to the broader population.

Suggestions to increase the recycling rate have included:

- Raise awareness of environmental benefits and promote recycling through mailings and/or TV spots

² CO₂ emissions are calculated based on methods found on the EPA's website <http://www.epa.gov/oms/climate/420f05001.htm> and converted to metric tons

³ The EPA figures are calculated from the waste generation standpoint, meaning virgin material inputs are not considered. Additionally, this figure is calculated for mass burn facilities; MERC is a refuse derived fuel (RDF) facility, for which emissions may be differ, though not significantly enough to affect the argument of this paper.

⁴ These numbers do not account for source reduction. If waste is not generated, much greater avoided emissions are realized.

- Hold educational community and school presentations and field trips to waste and recycling facilities to raise awareness
- Switch to single stream recycling so residents would not have to spend time sorting
- Provide more recycling drop off stations
- Institute a pay-as-you-throw program that charges for waste disposal, encouraging citizens to recycle more

Currently, recycling only happens when residents choose to transport their recyclables to the municipal recycling station located on the outer reaches of the city. Therefore, the system is entirely reliant on the motivation, capacity, and time of residents to store, transport, and sort recyclables into designated bins. Although numerous factors could be contributing to Biddeford's low recycling rate, the main factor contributing to low recycling rates can be determined with relative certainty to be the inconvenience of recycling.

Although the implementation of some of the measures above could be prioritized according effectiveness, ease of implementation, and financial costs, implementing them may only result in modest increases in recycling rates. The "crown jewel" of solutions is to provide curbside recycling service to residents. It is widely accepted in the waste management industry that curbside recycling increases recyclable material recovery, and with a goal of reducing greenhouse gas emissions, curbside recycling will provide the most benefits.

Choosing a Recycling System

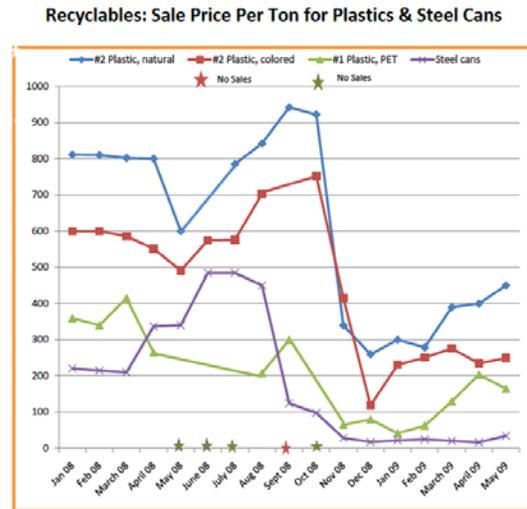
Curbside recycling offers numerous options and Biddeford, should it decide to offer curbside recycling, will be presented with the task of selecting the system strategy that best meets its needs. The decision-making process should incorporate a systems approach that considers economic, environmental, and social implications for each strategy.

Single Stream versus Dual Stream—The first decision relates to whether Biddeford would choose to implement a single stream or dual stream system. A single stream system allows residents to place all types of recyclables—cardboard, paper, plastic, cans, etc.—in one bin. Recyclables are sent to a processing facility, sorted, baled, and marketed. A dual stream system requires residents to place plastics, glass, and metal cans in one bin, fiber (cardboard and papers) in a second bin. The two material streams are picked up and placed in separate compartments on the recycling truck, and taken to a processing center. The fiber is sent to market with little or no processing, and the containers go through a variety of automated sorting equipment and hand-picking before being baled and sent to market. A report prepared by the American Forest & Paper Association states that single-stream systems save from \$10 to \$20 per ton during collection, but processing the material results in additional costs of from \$5 to \$15 per ton. In particular, paper mills incur increased costs of from \$5 to \$13 per ton due to contamination of material. Additionally, AFPA states that single stream results in only a 1 to 3 percent increase in recycling with single-stream (The American Forest & Paper Association, 2004). However, much debate exists around the topic with industry persons claiming far greater recycling increases and noting that the general trend is towards single-stream (Fickes, 2005). A study in Miami showed that the switch from dual stream to single stream recycling nearly doubled the annual collection (Waste Management, 2010). Considering the uncertainties surrounding the increase in recycling rates (and related

greenhouse gas emission reductions) as well as any potential revenue gains from dual stream, Biddeford may choose to align itself with the waste industry trend toward single stream.

Revenue neutral versus revenue sharing– Biddeford currently bales its recyclables, producing income, which in 2009, excluding mixed metals, amounted to \$36,828.19 (Biddeford Department of Public Works, 2009). However, selling single stream recyclables would not generate the same amount of revenue as separated and baled commodities. If Biddeford went to single stream curbside recycling collection, two options exist for dealing with collected commodities: revenue neutral or revenue sharing (Casavant [personal email], 2010). Revenue neutral would imply that the city would not pay to dispose of materials. This system would generate no revenue but would also carry no risk for costs resulting from market fluctuations. On the other hand, revenue sharing is a system that has potential to create profits but also the potential for costs if markets are down. Such fluctuations in commodities markets are illustrated in Figure 3 drawn from the annual report of a large Maine recycler (EcoMaine, 2009). The decision between the two systems will ultimately depend on the city's tolerance for risk.

Figure 3: Recyclable Commodity Market Prices



On the other hand, revenue sharing is a system that has potential to create profits but also the potential for costs if markets are down. Such fluctuations in commodities markets are illustrated in Figure 3 drawn from the annual report of a large Maine recycler (EcoMaine, 2009). The decision between the two systems will ultimately depend on the city's tolerance for risk.

In order to determine the system that would best meet the needs of Biddeford, a draft action plan should be constructed that compares and contrasts the benefits and risks of each option, taking into consideration the costs, environmental, and social impacts discussed below.

Addressing the Three Responsibilities

Economic

Assuming that Biddeford will keep all curbside pickup operations in-house, introducing a single stream curbside recycling program requires capital investment into trucks and cans. Additionally, the added number of trucks to the fleet that travel the same routes as the waste pickup trucks will result in added related costs for fuel and maintenance.

The Department of Public Works has proposed that savings generated from the simultaneous upgrade to an automated curbside waste pickup system will help fund the recycling program (Department of Public Works, 2008). Biddeford's current waste pickup system requires resource inputs related to 2 drivers, 4 packers, and 3 packer trucks (one backup truck). An automated system would reduce the inputs to 1 driver and 2 trucks.

Further examination of a pay-as-you-throw program could also reveal potential benefits. Additional positive economic benefits will likely be realized from increased recycling rates in the form of lowered expenditures in tipping fees. Tipping fees are levied by MERC per ton of waste transported to the company by the city for combustion. The waste management system

will help fulfil its economic responsibilities by striving to maximize recycling rates and increase savings.

Prior to rolling out a new automated waste and recyclables collection system, it is possible to estimate the increase in recycling rates through the examination of similar communities with an automated system. Saco, the city immediately adjacent with a similar population recently switched to single stream automated pickup system and for FY2009 averaged a 26% recycling rate. Portland, Maine's largest city, has achieved a recycling rate of more than 30% since 2004 (EcoMaine, 2009).

An increase in recycling rates would have direct economic benefits for Biddeford. According to Public Works, in 2009, Biddeford sent 7598 tons of waste to MERC for combustion, and expended \$373,767.89 in tipping fees (excluding hazardous waste) (Biddeford Department of Public Works, 2009). If Biddeford were to produce the same amount of waste, yet achieve a 26.5% recycling rate, at the current tipping fee of \$42.93/ton, total tipping fees would amount to \$258,610.32, a savings of \$115,157.57. Further increases in recycling would add to those savings.

Figure 4: Potential Tipping Fee Savings

	Total Waste Produced (ton)	Waste Combusted (ton)	Tipping Fees
2009 6.8% recycling rate	8194	7598	\$373,767.89
Achieving 26.5% recycling rate	8194	6024	\$258,610.32
		Total Savings	\$115,157.57

Negative economic impacts would include added financial liabilities for the purchase of new equipment as well as a highly likely decrease in revenues from the sale of commodities. Added costs may include those associated with educating the public about the new recycling system. In the decision-making process, both positive and negative impacts must be weighed against the overarching goals of the organization.

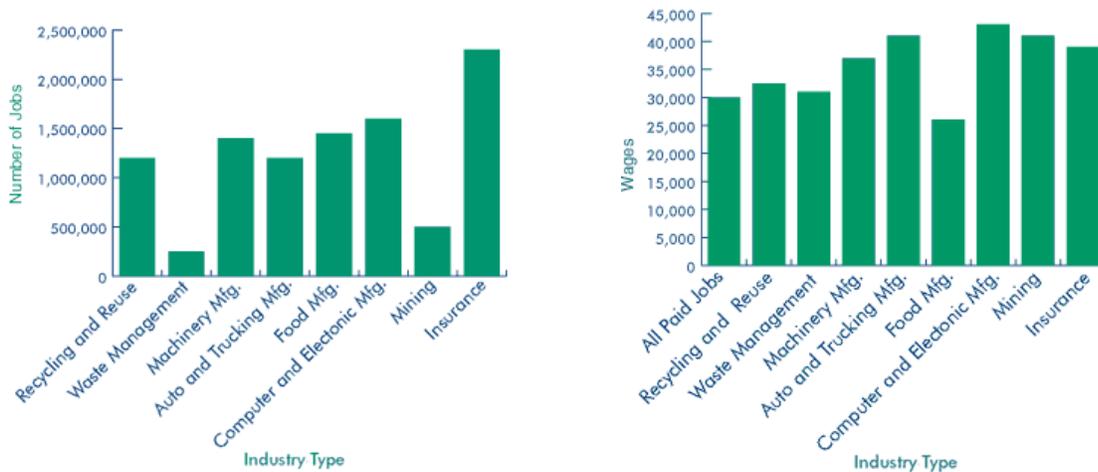
Social

At the local level, an automated curbside waste management system can provide numerous social benefits. Firstly, by implementing a system that increases the city's recycling rate and reduces greenhouse gas emissions, Biddeford is honoring the *U.S. Mayors Climate Protection Agreement* that it signed, demonstrating accountability for its commitments. In addition to pledging to inventory emissions and create an action plan aimed at reducing pollution, signing the agreement specifically obliges the city to "[i]ncrease recycling rates in City operations and in the community." Furthermore, local social benefits may include providing greater value for the taxpayer, helping meet the needs of residents who believe in the positive environmental impacts of recycling, and improving the city's image against the "Trash Town USA" stigma. Automated pickup would also improve the aesthetics of trash day, confining waste and recyclables to bins,

rather than the freely discarded trash bags of the current system, helping provide an impression of orderliness and tidiness.

Although many potential positive impacts exist, a negative social impact of establishing automated waste management would be the loss of several jobs. However, potential for redistribution of employment is possible. The recycling and reuse industry as a whole employs more people than the waste management industry, and offers higher average higher wages, as illustrated in Figure 4 (R. W. Beck, Inc, 2001). Biddeford could work to alleviate negative social impacts through assistance in job placement.

Figure 4: Sourced from <http://www.epa.gov/osw/conservation/rrr/rmd/rei-rw/result.htm>



At the state level, increased recycling in Biddeford will help push the state closer to meeting its 50% recycling rate goal and preserve valuable landfill space. The state of Maine has banned the development of new commercial landfills and currently only has enough landfill capacity to meet projected needs until the year 2018 (Maine State Planning Office, 2010). Although the volume of waste is significantly reduced through the incineration process, approximately 20% of the original weight remains and is landfilled. Although it is impossible to predict whether or not reduced waste delivered to the incineration facility would be replaced by other waste sources, it may be reasonable to assume that, at the least, the volume of ash avoided is the net savings; in a best case scenario, recycling has provided the opportunity for the incineration of waste that would otherwise be landfilled at greater volumes. Therefore, increased recycling has the social benefit of assuring the continued availability of space in landfills to meet society's future waste disposal needs.

Environmental

The environmental benefits of recycling include energy and resource conservation. For instance, the recycling of one aluminium can saves enough energy to power a television or computer for three hours, and recycling one ton of paper saves the equivalent of 17 trees and 7000 gallons of

water. Recycling reduces volume added to landfills, emissions related to replacement of materials, and virgin material inputs. Energy conservation through recycling is not only an environmental issue, but also a social issue, contributing to greater energy security (U.S. Environmental Protection Agency, 2010b).

Another means of calculating the positive environmental impacts of recycling is through greenhouse gas emissions. Protocols for the quantification of emissions from waste management activities exist, such as that published by EpE, that assist waste managers in understanding their systems' impacts and offers possible solutions to improve performance. A study calculated that in Fiscal Year 2009, Biddeford waste disposal (not including recyclables) was responsible for 890 metric tons of CO₂ equivalent emissions, accounting for curbside pickup, delivery to Maine Energy Recovery Company (MERC), combustion, and ash transport to a remote landfill. In the same year, *avoided emissions* from recycling accounted for a decrease of 1,686 metric tons of CO₂ (Roseberry, 2010).

Biddeford may consider reducing greenhouse gases through the purchase of natural gas trucks, the use of biofuels, or the maximization of route efficiency, but, clearly, recycling offers the greatest opportunity for the reduction of emissions, and should be the primary focus of efforts to provide positive environmental impacts.

Engaging Stakeholders

Understanding the waste management system's stakeholders and their interests is important for successful operations. The process of engaging with stakeholders will allow the Department of Public Works to gain a fresh view of its services through the eyes of the community, which is an important step toward an appreciation and understanding of external viewpoints (Savitz, 2006). With the identification of interests, it becomes possible to predict how a change to operations, such as introducing curbside recycling, will have impact across the various interests of the stakeholders. This allows the department to address potential issues before they arise.

The first step is the identification of stakeholders and their interests. Table 2 provides an initial summary, which should be revised with further input from the department. Effective stakeholder engagement requires planning, and the following steps should be considered:

Enable effective engagement—In order to achieve effective stakeholder engagement, capacities for engagement should be strengthened through consideration of interests (AccountAbility, 2005). It is important to understand how a choice may affect stakeholders in a positive or negative manner to enable more effective communication (Pojasek, 2010m). Preliminary identification and consideration of key issues, overlaps in objectives, potential information to be gained, and potential opportunities to strengthen the effort will increase engagement capacity.

Engage—Public Works could engage with the various stakeholder groups through various methods such as surveys, focus groups, informational sessions, or public presentations. What is important is that the tool used be appropriate for the waste management system and stakeholders.

Prioritize interests and act—The risk of stakeholder engagement is that it will likely be difficult to satisfy all interests of all groups because each group of stakeholders may have differing priorities (AccountAbility, 2005). For example, some stakeholders may fully support recycling, but others may be concerned about the capital investment required. As a public service entity, it is important that the city considers all interests, which are prioritized to develop an informed

strategy that is in alignment with their own path to sustainability, but also meets the needs of the community.

Stakeholder engagement should not be a one-time effort, but should be incorporated into a continuous cycle of Plan, Do, Check, Act (PDCA) that will ensure changing interests are acknowledged and addressed. Proactive, rather than reactive engagement will keep the community involved in recycling efforts and present further opportunities for improvement. Sustainability is built on continuous improvement, and, therefore, the waste management system should continue to set new goals.

The initial introduction of curbside recycling may initially push recycling rates above what is currently the case, reaching, for example, 25%. The city will have successfully planned and implemented a new system that pushes the city further down its path to sustainability. Reporting on the performance of the new system will help gauge progress and allow the identification of further improvements to be made. Following initial success, the city, for instance, may decide to use the State of Maine's target of reaching a 50% recycling rate as its own objective. If so, it would become important to understand the barriers to reaching that goal. Through continued stakeholder engagement, several new strategies may be introduced.

STAKEHOLDER	INTEREST
Citizen	<ul style="list-style-type: none"> •Meeting basic waste disposal needs •Availability and convenience of recycling •Clean streets and sidewalks
Municipal Government	<ul style="list-style-type: none"> •Providing waste and recycling services to citizens •Economic responsibility to taxpayers •Ability to supply required demonstration of progress towards meeting state goal of achieving 50% recycling rate
Public Works Employees	<ul style="list-style-type: none"> •Employment and benefits •Safety •Pleasant work environment
Citizen Groups	<ul style="list-style-type: none"> •Creating and maintaining a positive image of the city that promotes sustainable development •Represent citizen and business owner waste handling interests to government or private entities
Downtown Business Owners	<ul style="list-style-type: none"> •Maintaining a tidy downtown without visual, malodorous, or physical deterrents to customers and/or clients
Waste-to-Energy Company	<ul style="list-style-type: none"> •Assurance of a reliable fuel source
Recycling Hauler	<ul style="list-style-type: none"> •Recycling commodity availability and quality
Surrounding Communities	<ul style="list-style-type: none"> •Safety, noise, odor, pollution, road maintenance impacts due to hauling and incineration
Regulators	<ul style="list-style-type: none"> •Regulation compliance
Maine State Planning Office	<ul style="list-style-type: none"> •Meeting statewide goal of achieving 50% recycling rate as an environmental move and to extend life of landfills
Future Generations	<ul style="list-style-type: none"> •Availability of natural resources •Ability to meet waste disposal needs

Table 2: Stakeholders and Interests

An important stakeholder group is the employees of the waste management system. Employees involved in the collection of recyclables are well positioned to identify methods to improve the system as they put the system into action, are in contact with the citizens they serve, and observe how the system is utilized. A key aspect of a sustainability management system is employee involvement in the understanding of processes, generation of improvement strategies, and implementation of the sustainability system. Additionally, employee involvement and empowerment can increase satisfaction, motivation, commitment to the organization, and productivity (APA Practice Organization, 2010).

License to Operate

A "license to operate" is not a formal license, but one embedded within public perceptions of an organization and its operations. It is earned from the community of stakeholders and is comprised of social legitimacy, credibility, and trust (On Common Ground). As a municipal department, Public Works is in the position of serving the citizens that fund their operations. Although waste management is a public service, the community as the primary stakeholder has a vote in the continuity of Public Works as the provider. Should the community feel unsatisfied with the service or its value, a risk is posed to the department that could result in a city vote to contract to external companies.

A primary goal for any sustainable organization is to strive to minimize harm and maximize benefits to a broader set of stakeholders. By actively engaging with the community, Public Works will be better equipped to understand the community's interests, stay in touch with evolving perceptions and opinions, and begin to build upon the requisites that produce the "license to operate." Every week, citizens see their dollars at work with the pickup of their household waste. Through active, informative, engagement that communicates the department's goals, it is possible that citizens will begin to view waste management beyond a basic service, understanding the benefits and impacts it has on the vitality of the community.

OPERATIONALIZING SUSTAINABILITY

The following section provides suggestions on how Biddeford's Department of Public Works could begin to put a sustainability system into practice. A Plan, Do Check, Act cycle is presented with the intention of providing a means to assure continual improvement for the department's sustainability system.

Planning

A significant portion of the sustainability effort will fall under the planning stage as this stage builds the foundation for subsequent phases.

Defining responsibilities—This stage begins with the definition and acceptance of responsibilities. The city should appoint a sustainability management representative who will be responsible for establishing, implementing, and maintaining the sustainability system. This representative will also be responsible for reporting to the city on the progress and performance of the system and seeking input for improvements from the city council. Additionally, as a department of the municipal government, this person must ensure that the department's efforts are supporting the

larger goals of the city. Employees should be aware of their role in sustainability efforts, understand how their jobs affect the overall system, and provide feedback on problems or opportunities for improvement.

Identify training requirements—The introduction of a sustainability management system will require training to establish new and improved competencies. For example, the introduction of a new recycling system and related equipment may require training for equipment operation, communication with residents, and actions to be taken to minimize disruptions during the transition to the new system.

Establish and maintain documents and records—Documents related to the system include descriptions of the scope, policy, goals, and structure, as well as related documents necessary to the planning, operation, or control of processes. Records of ongoing activities assist in the evaluation of the performance of the system. Both documents and records are necessary to ensure the effective operation of the sustainability system and should be complete, organized and available to those with a responsibility or stake in its operation.

Communication Processes—Effective internal communication will ensure information flows from the top of an organization to the bottom, and across all levels. External communication should be meaningful and directed to reach stakeholders. The Department of Public Works may wish to establish a regular schedule of meetings that will include all employees, providing the opportunity for the introduction of new policies or programs, feedback and reports, and discussion. The most effective means of external communication should be determined, and may include direct mailings that report on progress, notices in local papers, or website postings.

Define operational controls—In order to ensure performance along the steps of the processes within the sustainability management system, it is important that controls, procedures and instructions are in place along with corrective measures.

Do (Implementation)

Maintain performance principles—With a defined responsibilities and authorities, competence and training, defined processes and controls, and communication methods, the Department of Public Works is set to begin the implementation of its sustainability system and programs. During implementation, it is important that principles that lead to performance, such as those outlined in the Baldrige criteria, are used to guide efforts. The department must ensure that it abides by system policies, implements the strategy, maintains a customer focus, and strives for improvement.

Record outcomes—Records created during the implementation of the system will serve as valuable tools in the subsequent "check" stage. Through the documentation of progress and feedback, a team enables the tracking of progress. Example records that may be kept by the department when implementing a new recycling program may include tonnage of material collected, number of incidents of households placing trash in recycling bins, time required for each route, fuel consumed, and formal and informal community feedback.

Social value measurements are often seen as difficult; however value creation can also be measured through the quantification of inputs, outputs, outcomes, and impacts. *Inputs* are the resources needed to make something happen. *Outputs* are the direct result of a program. The

outcome is a change that occurs over time and the *impacts* are outcomes less an estimate of what would happen without the additional inputs (New Economics Foundation, 2004).

For example, the social impacts of a new direct-mail advertising campaign for a hazardous waste collection day may be measured through 1) financial and time inputs of producing and mailing postcards, 2) outputs expressed in the number of participants and amount of waste collected, 3) outcomes of reduced environmental impacts, money saved from potential cleanups of improperly disposed waste, and increased awareness that leads to growing participation, and 4) impacts calculated by subtracting an estimate of what participation would have been without the direct-mail campaign, possibly from outcomes based on previous events.

Check

Monitor progress—Monitoring the achievement of sustainability goals, training and corrective/preventive actions is critical to understanding the progress of the sustainability system. Records created during the implementation stage can be analyzed and interpreted to determine whether activities have had the anticipated outcomes, potentially generating new action plans.

As an example, environmental performance measures could include the tracking of greenhouse gas emissions associated with the waste management system through the use of an established protocol such as that produced by Entreprises pour l'Environnement (2008).

Undertake management(city) review—As city council members act as the upper level management for the Department of Public Works, they should be involved in the review of the performance of the system. As key decision-makers, they are in a position to judge the value of progress and make decisions influencing the future of operations. For example, after achieving an initial increase in recycling through the introduction of curbside recycling, a management review may establish a new target that would initiate new efforts to increase resident participation.

Act

Undertake nonconformance and corrective actions—Following review of progress, any element of the system that is not in conformance with established policies, procedures, or goals should undergo corrective action to realign the element with the sustainability system. Utilizing root cause analysis to determine the factor that lead to nonconformance, a process may be established to prevent the reoccurrence of nonconformance. This process helps support the continual improvement of the sustainability system.

PROJECTED RESULTS

Improved efficiency

Through the definition of clear goals and policies defined in the *vision*, *mission*, and *values* statements, the Department of Public Works' efforts will be provided a framework that enables an effective decision-making process and keeps operations focused on sustainability.

Process mapping will increase the understanding of operations among a broad audience, and allow for the effective identification of opportunities for improvement. The creation of a map by the waste management system's operators with associated resource inputs, outputs, and risks, will

enable systems thinking among those involved in the operations, improving the level of consideration that can be undertaken when making changes.

The implementation of a sustainability program would likely strengthen the structure of the organization, providing more opportunity for leadership and participation among employees. As actively engaged stakeholders, employees may feel more empowered, which could lead to improved personal performance levels that affect the system as a whole. With increased levels of communication, fewer errors may be made due to misunderstanding goals or objectives. A workforce focus that strives to ensure the health and safety of employees will help limit the number of injuries and lost work time. All of these factors contribute to departmental increases in performance and decreases in costs.

The municipal government may begin to view the Department of Public Works as a valuable asset to achieving city-wide sustainability goals, such as those identified in the *U.S. Mayors Climate Change Agreement*. Actions outlined in the agreement extend well beyond the scope of Public Works; however, experience the department would gain from implementing its own sustainability management system could be applied to develop a broader system for the city as a whole. This potential outcome could help break down some of the silos within the municipal government, and improve performance across departments.

Stronger community relations

A truly sustainable institution identifies areas of common interest with the community and, through its daily operations, enriches it (Savitz, 2006). Stakeholder engagement is an integral component of the sustainability management system that will likely improve community relations between the city and its citizens. Through the proactive creation of engagement opportunities with residents, the Department of Public Works positions itself to listen and react to the needs, perceptions, and opinions of the public, ensuring that its services remain in alignment with the interests of the community. Knowing that they are listened to and their requests are considered, residents may feel that they are an active part in determining how their tax dollars are spent, and may attribute greater value to services.

Publicizing sustainability efforts and reporting to the community on progress will further build upon the department's "license to operate," which is built upon social legitimacy, credibility, and trust. The department can increase the credibility of their operations through communications introducing the sustainability management system that enables them to best balance a number of interests with economic, social, and environmental goals. When results are reported, the department displays the accountability for its performance and helps build trust.

Improved external presence

Should a curbside recycling program be implemented, the community stands to benefit from the improved image the city may obtain. Biddeford has long endured a stigma as a "trash town;" a successful recycling program would directly counteract that perception and potentially spur other actions to improve the city's level of sustainability and image. Additionally, the department's operations impact the achievement of state-wide goals; therefore, successful improvements that lead to improved recycling rates will likely draw positive recognition from the state, placing the city in a favorable position to obtain support for future efforts that require state-level support.

A positive contribution to the environment

A sustainability management system helps place focus on and provides tools for improving the environmental performance of processes. This paper has identified real opportunities for the Department of Public Works and the City of Biddeford to improve its environmental performance and help mitigate climate change. Recycling can help conserve materials and resources, reduce energy consumption, and avoid greenhouse gas emissions. By establishing a sustainability management system, the shift can be made from unfulfilled intentions to realized progress.

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