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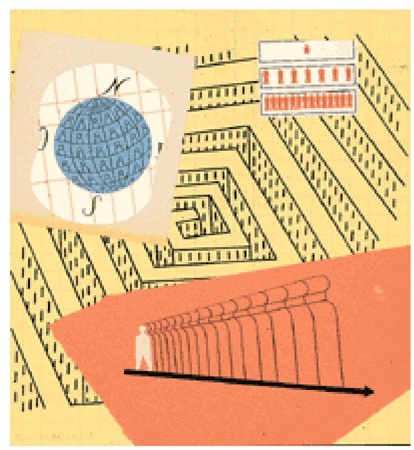

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Solid Waste Management Alternatives for The City of New York

Prepared for
New York City Economic Development Corporation

By

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EXECUTIVE SUMMARY

New York City collects approximately 13,000 tons of municipal solid waste every day. With the closure of Freshkills landfill and no other local facility, New York City began to export its waste out of state. Waste export is not environmentally sustainable and will incur rising costs as demand for landfilling remains constant or increases and supply decreases. Alternative technologies are used in environmentally progressive cities around the world to process solid waste in a more sustainable way.

The *Solid Waste Management Alternatives Report* provides a detailed investigation of five case studies of alternative waste management facilities. Each case study includes comprehensive information about siting, financing, and technology and a range of lessons for New York City. The report offers five primary lessons for New York City, should it attempt to implement an alternative waste management facility.
The five cases reviewed in this report are:

<u>Pencor-Masada OxyNol™ Orange Recycling and Ethanol Production Facility, Middletown, New York</u>

- This proposed facility will be located in Middletown, New York, about 70 miles driving distance from Manhattan.
- The city of Middletown will receive one million dollars a year as a host fee from the private corporation Masada.
- This proposed facility will use acid-hydrolysis technology to convert organic waste and sewage sludge into ethanol.
- The facility capacity is 275,000 tons per year.
- Orange Environment, a local environmental organization, has taken an active role in the siting process for this facility. A citizen's advisory board established by Masada also helped address community concerns.
- The facility cost per ton is $65.

<u>Hawaii Medical Vitrification and H-POWER Facilities, Honolulu, Hawaii</u>

- Both facilities are situated on industrial zoned land.
- The technology used in the H-POWER waste-to-energy facility involves incineration and produces electricity which is sold.
- The Hawaii Medical Vitrification facility only treats medical waste. It produces slag and synthesis gas.
- The Hawaii Medical Vitrification facility treats up to one ton per day and the H-POWER facility treats two thousand tons per day.
- Honolulu has opted to expand its H-POWER facility rather than construct a larger-scale plasma-arc gasification facility.
- The cost per ton at the H-POWER waste-to-energy facility is $50.
- The cost per ton at the HMV gasification plant is $150.

Newmarket Organic Waste Processing Facility, Newmarket, Ontario, Canada

- This anaerobic digestion facility is sited in an industrial zone alongside a highway, thirty-three miles north of Toronto, Canada.
- The feedstock is the organic component of source-separated waste.
- Biogas is produced and converted to electricity at this facility.
- Citizens embraced the environmentally friendly technology but are currently dissatisfied with it because of odor.
- The facility can treat 150,000 tons of waste per year, but is not running at full capacity.
- The cost per ton is $39.

Ecopark 2 Valorga Anaerobic Digestion Facility, Barcelona, Spain

- The site for this facility is on an industrial zone in the north of Barcelona.
- A high profile architect designed Ecopark 2 in order to maximize aesthetic appeal.
- Ecopark 2 treats 130,000 tons of municipal solid waste per year.
- The cost per ton is $48.

Nippon Steel Shaft-Type Gasification Facility, Akita City, Japan

- The facility is sited at a previously used incinerator site and is wholly owned by Akita City.
- Biannual community meetings occur with the town appointees and the city.
- The facility has a maximum capacity of 160,600 tons per year and treated 125,075 tons in 2003.
- Twenty-six such facilities are in use or under construction in Japan and South Korea.
- The cost per ton is approximately $145.

Based on the cases reviewed, it is evident that significant amounts of waste are processed in alternative facilities in major cities around the world. Much like New York City, Barcelona and Toronto are urban environments. Akita and Honolulu are both on islands with limited space for landfills.

These cases have demonstrated that successful siting of an alternative waste facility occurs on industrial zones that had similar existing uses; a new facility can represent a renovation of an industrial area. It is important to have community involvement in order to gain support for the facility. Community participation prepares the public in advance which will allows for issues to be address and trust to be earned.

It is possible to finance an alternative waste management facility with traditional mechanisms. Many of the cases were privatively financed by investors and costs are similar to traditional technologies. There is also potential for generating modest, but reliable revenues through the sale of the byproducts from the facility. In addition, siting an alternative waste facility is more environmentally sound due to lower emissions, dual functioning as a cleaner power source, and fewer environmental hazards than landfilling waste.

The details of the case studies present viable options for New York City's future waste management plan. By examining the successes and failures of other cities, New York City can implement appropriate tactics to ensure a more cost-effective, environmentally sound waste management plan.

CHAPTER 1: INTRODUCTION

Statement of the Problem

The New York City Sanitation Department collects approximately 13,000 tons of mixed municipal solid waste, including household waste, every day (Recyclables such as paper, plastics, metals and glass compose 45 to 50 percent of the collected waste; the remaining waste includes non-recyclable plastics, bulk items, food, yard trimmings, textiles and other waste (New York City Economic Development Corporation and New York City Department of Sanitation, 2004a).

Since the 1970s, New York City has attempted to find sustainable disposal methods for the large quantity of garbage generated by the city's 8 million inhabitants. The mandated closure of the Freshkills Landfill in 2001 paired with the fact that no other local facility was available led New York to begin exporting its waste out of state. The ongoing export of garbage to out-of-state landfills and incinerators is a concern due to the risk of increasing costs, the environmental damage caused by landfilling, incineration and transportation, and the environmental justice issues related to the exporting of the City's waste to other jurisdictions. The siting of waste management facilities within New York City is impeded by a range of financial, technical, environmental justice and political concerns.

The Evaluation of New and Emerging Technologies recently prepared for the Economic Development Corporation and the Department of Sanitation (New York City Economic Development Corporation and New York City Department of Sanitation, 2004b) has identified thermal and anaerobic digestion technologies as the most plausible alternatives to overcome the financial, technical, and political constraints discussed above. This report includes a detailed review of five cities, domestic and international, that have pursued alternative strategies for solid waste management, and concludes that siting an alternative facility to process New York City's garbage is feasible and advantageous. The case studies address some of the questions that have proved problematic for New York, which include:

- How expensive will it be to develop a plant in comparison to current waste disposal costs?
- Can the technology provide for the disposal of waste with a composition and volume comparable to that which is generated in New York?
- Will potential external impacts, such as pollution, odor, noise and increased traffic, lead to significant public opposition?
- Would the new technology reduce the environmental impacts of waste disposal?

Costs of Emerging Technologies

The implementation of an emerging technology requires expenditures to secure a site, acquire the technology, and construct and operate the facility. It is critical to this assessment that the costs of the proposed disposal method be compared to the existing costs of landfilling or incineration. This report compares expenditures in five cities, including the costs of financing and of facility construction and operation.

Technological Constraints of Present Technologies

Landfills have several environmental impacts including: emission of odors and greenhouse gases, including methane, potential release of toxics into groundwater, and the destruction of large tracts of land. Waste-to-energy incineration, one of the few mainstream alternatives to landfills, can emit carcinogenic dioxins and create an ash that still must be landfilled; although the volume of ash is only 10 percent of the original waste load.

Siting and Environmental Justice

A public hearing on the Draft Solid Waste Management Plan highlighted the public concerns faced by the Department of Sanitation in siting a waste management facility in New York City. The city has a recent tradition of vocal opposition to many types of construction. No neighborhood wants a waste facility. Mayor Bloomberg's policy on facility siting is to ensure equity by siting a waste transfer facility in each borough. In implementing these technologies, other municipalities have faced similar siting concerns and have successfully addressed these concerns.

Our Project

The purpose of this study is to identify, through a series of practical case studies, lessons for New York City in siting an alternative waste management facility. This report is a product of the thorough investigation and findings of 5 case studies. The cases represent both attempted and successful siting of alternative solid waste treatment facilities around the world.

Project Methodology

The project was organized around a Project Control Plan, which includes a definition of the research problem, a project overview, specific assignment of responsibilities, and a schedule of tasks.

To identify potential facilities and select the 5 cases that we would investigate, we conducted a literature review, including basic cost, demographic, and capacity information on 11 alternative waste management facilities around the world. Additionally, we developed facility selection criteria based on applicability and potential lessons for New York City. The criteria included political and siting issues (noise, odor, traffic, community opposition, stakeholder acceptance), project economics (cost of facility operation and construction, revenue stream, financing mechanisms), and technology and planning (environmental impacts, operations management, volume of waste, demand for usable byproduct). Our goal was to select cases that provided as much variety as possible among the criteria we developed.

During this stage of research, the team also developed an interview guide with standard questions to allow the conduct of parallel studies. The interview guide includes both general and specific sets of questions intended for different types of contacts, such as government officials, private contractors, and community group members.

During data collection, two people were responsible for each case study. These case teams conducted thorough literature reviews of their facilities, including available print and internet published materials. While researching, we formed lists of key contacts who might be able to provide further information.

With a solid understanding of respective facilities, case teams conducted interviews with key contacts to more fully understand political challenges, facility financing, and technological processes. With each interview, we requested names and contact information from others who would be able to assist us in our research.

We collected as much information as possible on political opposition to siting, traffic, noise, operations management, technological processes and volume of waste, environmental impacts, demand for a useable byproduct, costs and financing mechanisms. Because some financial data was proprietary, after exhausting all other resources, we estimated missing figures, and recorded our methods and basis for estimates.

Practical Challenges

New York City has exhausted its own landfilling capabilities and public sentiment prohibits the city from opening new landfills or waste incinerators. In the absence of new waste disposal facilities, the City will continue to rely on out-of-state or possibly upstate New York waste management, an expensive temporary option that distracts attention from long term solutions. The case studies in this report represent how other major cities have addressed the issue of growing waste and limited disposal options.

Political & Social

Solid waste management is laden with political challenges. Elected officials and public managers are sensitive to the financial cost, environmental impact, and community opposition to the siting of any type of waste management facility. Government representatives are hesitant to even discuss municipal waste disposal due to the sensitivity of garbage siting concerns. The complications of facility siting and “not in my backyard” concerns make it difficult to analyze and discuss waste management.

Economic

Facilities employing alternative technologies use various disposal methods and environmental controls, which result in different facility cost configurations. Alternative technology projects, especially in the absence of comparable facilities with several years of proven operation, may require high financial contributions or government funding, due to high capital costs and possible risk factors (Beck, 2003). Companies selling these technologies are reluctant to provide financial details. The waste stream of the selected facilities was critical in addressing the issue of scale and meeting New York City’s waste disposal requirements. An increase in scale would necessitate increased capital and operating costs. These factors contributed to the difficulties experienced when attempting to obtain financial data to complete our research; information associated with risk allocation and municipal costs presented significant project challenges.

CHAPTER 2: TECHNOLOGY

New York City is currently exploring technologies capable of handling the large quantity of garbage that the city generates. Landfilling and incineration are the two waste disposal technologies that New York City currently relies on. This report reviews cases of alternative technologies as well as one case of an incineration facility. New York City is now analyzing the suitability of the following alternative technologies to reduce landfill dependency. The alternative described below include gasification, anaerobic digestion, and hydrolysis.

Gasification

Gasification and plasma-arc are categorized as thermal processes due to the use of high temperatures to treat mixed waste. The thermal process occurs in a chamber where mixed waste is heated to temperatures in excess of 750 degrees Fahrenheit. Unlike incineration, both gasification and plasma-arc processes occur in an oxygen deprived environment and result in a different chemical reaction. (United Kingdom Department of Trade and Industry, 2002.)

The byproducts of the gasification process are:

- Fuel gas, a clean combustible gas, often used to generate electricity, which may be filtered to remove impurities. Part of this gas can also be used to fuel the thermal process itself.
- Solid slag, a byproduct which may also include a liquid stream, with potential use in construction and road-building. To date, there are no examples of its ongoing use.

In these processes, mixed waste is fed into the gasification or plasma chamber where the reaction takes place. The feedstock may be mixed with combustible materials such as coke or oil to increase the temperature of the gasification chamber.

Anaerobic Digestion

Anaerobic digestion is a process through which biodegradable material is converted into methane and carbon dioxide by bacteria in the absence of oxygen. This process can only treat organic waste, which must be separated from other mixed waste either at the source (in homes and restaurants) or at the treatment site.

Following separation, three types of bacteria act upon the organic waste (Area Metropolitana de Barcelona, 2004). The first group of bacteria breaks down large organic molecules into small units like sugar; this step is referred to as hydrolysis. Another group of bacteria converts the resulting smaller molecules into volatile fatty acids, mainly acetate, as well as hydrogen and carbon dioxide; through a process called acidification. The third group of bacteria produces biogas (methane and carbon dioxide). This biogas contains 50 to 70 percent methane.

On average, municipal solid waste feed is introduced once a day into a plant; the waste stays in the plant for approximately 30 days before it is converted to compost.

The byproducts of an anaerobic digestion process are:

- Biogas (65 percent methane and 35 percent CO_2), which is used to create electricity.
- Compost, which is processed further and then marketed for agricultural use.

Waste-to-Ethanol

The Orange Recycling and Ethanol Production Facility, reviewed in Chapter 3, combines a hydrolysis process with an ethanol conversion process.

The organic component of the municipal solid waste is dried to control for odor and shredded and is mixed with a sterilized sewage sludge. Concentrated sulfuric acid is mixed with the feedstock to break down the cellulose into sugar (Zhang, 2005). The sulfuric acid column recaptures the acid, separates it from the sugar, and re-concentrates it using patented technology (DiPardo, 2002). Lignin is precipitated from the mixture and is burned to recover energy used in the process. The other precipitate is gypsum which is removed and can be processed as wallboard. Additional sugar is added to the sugar and water mixture to normalize the pH at 7.4. In the Ethanol Production process, a fermentation and distillation process converts the sugary mix to ethanol. Ethanol is the potable form of alcohol so it is denatured with two percent unleaded gasoline and can then be used as a fuel additive. (T. Judge, Personal Communication, February 17, 2005). Figure 2-1 depicts the Masada-OxyNol™ process.

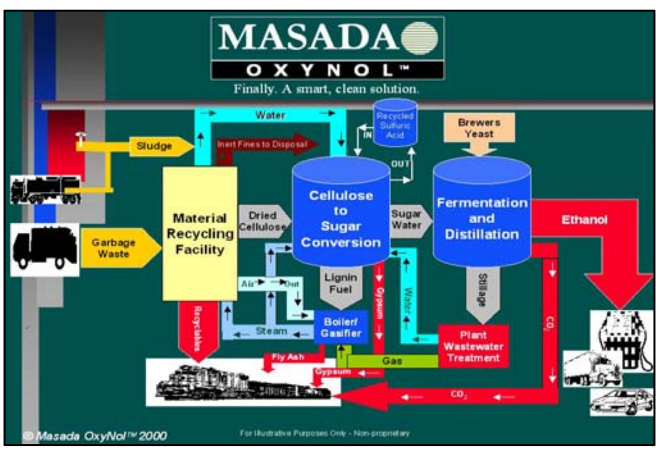


Figure 2-1. Illustration of the hydrolysis process. *Source*: 2000 Masada OxyNol™. http://www.masada.com/thetechnology.htm

The products of the hydrolysis process are:

- Ethanol, which is a marketable gasoline additive (DiPardo, 2002).
- Compounds such as gypsum, which can be sold to companies for conversion to wallboard, or sheetrock, when blended with crushed limestone.

Pre-treatment

It is important to note that pretreatment processes are part of most facility designs. Materials recovery facilities can recover recyclable and reusable materials. Shredders can be incorporated to treat bulk waste. The variability of waste streams can also be accommodated with separation, of organics from non-organics for example, or combination of waste streams such as mixing sewerage sludge with municipal solid waste.

This report discusses two anaerobic digestion facilities, one which relies on source separation, and one that uses on-site separation. The latter facility separates all recyclable materials and source-separated biowaste within the mixed municipal solid waste stream on site. It uses screening and sorting devices, such as magnetic separators and air suction devices, to remove film plastics in a falling material stream; this is followed by several manual picking lines and trammels operating in parallel to further sort the waste (Area Metropolitana de Barcelona, 2004).

CHAPTER 3: THE PENCOR-MASADA OXYNOL™ ORANGE RECYCLING & ETHANOL PRODUCTION FACILITY

Middletown, NY, a small town of about 25,000 residents located about 70 miles outside of New York City, has a history of waste disposal problems (Idcide, 2005). Historically, the town thrived as a major manufacturer of fragrances and perfumes. The productions of these fragrances led to the unregulated disposal of toxic byproducts through a "burn and bury technique" into county landfills. One city landfill, located in Middletown, was defined as a Class 3 Hazardous Waste Site on DEC's Registry of Inactive Hazardous Waste Disposal Sites (Stapleton, 2001). Over time these landfills closed, while other landfills that received the county's Municipal Solid Waste sought permits for expansion. Both public and private landfills generate revenue for the county. However, Middletown, working with local environmental and citizens groups, specifically Orange Environment, Inc., sought an alternative to landfills (T. Judge, personal communication, February 17, 2005).

The Problem

The City of Middletown faced serious problems with municipal waste management when Orange County lost several lawsuits, initiated by Orange Environment Inc., over landfill expansion in the county and began to export its wastes out-of-state. In 1994, the city of Middletown, working with Orange Environment, Inc., drafted a request for proposal for an integrated waste management facility with ninety percent recovery (Edelstein, 2004).

Pencor Environmental Ventures Inc., a Baltimore-based company, first approached the city with a plan to install a materials recovery facility with a compost producing unit. The compost unit was not a viable option for the city due to the volume of waste that needed to be processed. Masada OxyNol, L.L.C. met with officials in Orange County and the City of Middletown with a design to incorporate a material recovery facility with an ethanol, or OxyNol™, production facility, rather than a composting unit (T. Judge, personal communication, February 17, 2005; Masada Timeline, 2003).

In January of 1995, Pencor and Masada OxyNol, L.L.C. merged to form Pencor-Masada OxyNol L.L.C. (PMO), which is commonly referred to as Masada. Pencor, would perform the management duties and oversight of Masada OxyNol™, while Masada would perform the engineering, technical duties, and patented technology side of the partnership. By 1995, Masada provided a draft of the facility design to Middletown. In 1996, Middletown officials, accompanied by local environmental and community stakeholders, visited a model facility in Muscle Shoals, Alabama, a small-scale version of the materials recovery facility and Ethanol Production Facility that was developed by The Tennessee Valley Authority (TVA). The TVA facility has the capability to treat up to 50 tons per day of municipal waste, but does not incorporate dewatered sludge, as would be processed at the Middletown facility (Times Herald-Record, 2002). David Pettijohn, a local engineer, gave a positive review for the project, despite the fact that many industrial reviews and local newspapers reported that problems could be expected (M. Edelstein, personal communication, February 17, 2005).

After visiting the facility in late 1996, Middletown chose Masada to construct the town's new alternative waste management facility. In order to secure a long-term contract it was necessary for Masada to compete in a competitive bidding process. Without any major competition, Masada was the top bidder for a twenty-year contract. (T. Judge, personal communication, February 17, 2005).

The technology proposed by Masada will incorporate a materials recovery facility in the front end with an Ethanol, or Masada's patented OxyNol™ Production Facility at the back end. Only organic material and sewage sludge enter into the ethanol production process. Masada owns the OxyNol™ technology (T. Judge, personal communication, February 17, 2005). This process reuses as much material as possible and creates useable byproducts, such as gypsum and ethanol, while minimizing material requiring landfilling. Ninety percent of incoming waste will be reused, reprocessed or redistributed, meeting the desired recovery as proposed by Middletown and Orange Environment Inc. Therefore, less than ten percent residual municipal solid waste, which would primarily come in the form of sand, dirt gravel, and other non-recyclables will require landfill disposal (T. Judge, personal communication, February 17, 2005).

Community Relations

Throughout the development and siting process, Masada worked to gain the support of the environmental community, specifically Orange Environment Inc. and the Institute for Local Self Reliance. Masada worked with local environmental, community, and business stakeholders to create a Citizens Advisory Board, which recognizes and resolves issues concerning the Masada Project. Masada will pay the $15,000 operating costs for the Citizens Advisory Board, "an independent body for residents and businesses to obtain information about the plant, voice concerns and get answers" (Stapleton, September 2001). Working with Middletown, Masada agreed to the following conditions, as outlined by the Citizens Advisory Board, required for support:

> An open and honest application effort, funding of a parties of interest process for public oversight for the facility during construction and operation, funding for an independent onsite monitor, preference for in-county wastes over imported garbage, maximized recovery including acceptance of source separated materials, setting of all permit parameters to provide the utmost precaution in avoiding hazards, and a three-strikes-you're-out policy threatening permit revocation if violations were not addressed. (Edelstein, 2004)

Aside from communicating and addressing concerns of local stakeholders, Masada needed to ensure that the facility could be built to manage the county's waste. To make the plant viable, Middletown's Common Council gave the Public Works Commissioner the authority to solicit trash from outside municipalities. This would increase the plant's municipal solid waste inflow to about 750 tons per day, a large increase over the 50 tons per day solely generated by Middletown (Masada Timeline, 2003). In addition, the facility would be able to process 194 tons per day of dewatered sludge from a local wastewater treatment plant (T. Judge, personal communication, February 17, 2005).

Throughout the planning process, Masada visited all of the forty-one Orange County municipalities and numerous towns in surrounding counties including Rockland, Sullivan, and

Ulster Counties. Masada delivered over 200 presentations to address all parties that would be involved or affected by this facility. Between 1997 and 1999, Masada secured waste contracts with 24 of 41 Orange County municipalities. Municipalities that signed contracts with Masada realized the lack of waste management alternatives existing in Orange County and recognized the cost savings that the Masada facility would provide to their communities.

In 1999, the Middletown Planning Board approved the proposed site for the Masada facility, which will be constructed on a closed city landfill site. This land was donated to Masada by Middletown, provided that Masada would pay the cleanup costs for the Class III Hazardous Waste Site. Tests at the landfill conducted between 1987 to 1999 uncovered buried metal parts, visibly contaminated soil and refuse. Various 55-gallon drums with residue from gasoline products, were also found buried at the site. (Stapleton, April 2001). The landfill is approximately twenty-two acres, with sixteen acres to be developed for the facility and nine acres will be under roof. This site is ideal because it is adjacent to a wastewater treatment facility, and siting the facility there will allow for the removal, reprocess, and integration of sludge into the Masada Plant (T. Judge, personal communication, February 17, 2005).

Initially, there was public support for the Masada plan and the proposed location for the facility. Toward the end of the permitting process, Kathleen House, who owned a local shopping center called Campbell Plaza, began an opposition movement. This opposition was primarily attributed to the fear that the facility would create odor and deter shoppers from visiting the Campbell Plaza. In addition, project opponents warned that “using sludge in the process would create a hazard to the environment by emitting heavy metals such as cadmium, lead and mercury” (Stapleton, May 2001). House’s opposition gained support and led to a public hearing in December 1999 regarding the impacts of Masada’s proposed facility. The opposition was backed with hundreds of thousands of dollars of advertisements, apparently financed by traditional non-local waste disposal companies and haulers. These companies also may have used funds to hire expert testimony criticizing the project at the public hearing. The testimony and advertisements created a public opinion shift and generated doubt in the community. In the long run, this opposition had little impact but did delay the project (M. Edelstein, personal communication, February 17, 2005).

In July 2000 the Middletown Planning Board issued a construction permit to Masada. Excluding legal proceedings, the Masada-OxyNol™ facility will take six to eight months to complete the engineering phase and an additional eighteen months to construct the plant. Training for employees will occur four to six months before the facility will open and planners expect an additional three to six months of shake down time to work out possible unforeseen glitches before the facility is fully operational. The construction of the facility will create 300 to 500 jobs and the day-to-day operation of the facility will create an additional 100 to 110 jobs. Masada estimates that this plant alone will generate $100 million of positive economic gain to the area annually. The construction of the facility, as estimated by Masada, will cost between $150 and $285 million with an operational life of 20 to 30 years (T. Judge, personal communication, February. 17, 2005).

Financing

The Middletown Masada-OxyNol™ Facility will not require any taxpayer funding. Pencor-Masada uses a private equity model and a tax-free municipal revenue bond issue, benefiting Middletown by bringing revenue into the municipality. Masada's Financial Advisor is Ewing Bemiss & Company and the Municipal Bond Underwriters are Merrill Lynch Securities and J.P. Morgan. The interest paid to the investor will be tax-free, benefiting Masada. Once the bond is issued, the revenue stream will allow for payments to back the facility's construction. Middletown will receive a host fee, a guaranteed payment of $1 million per year. In addition, Masada will engage in a revenue share with Middletown for the sale of the facility's ethanol, gypsum, and biogas. Currently, Middletown and all other Orange County municipalities pay $75 per ton to dispose of municipal solid waste in county landfills. The Masada-OxyNol™ Facility will charge sixty-five dollars per ton to process Municipal Solid Waste—a $10 per ton savings for municipalities using this facility. Masada presently holds a 20-year contract for constructing and operating the facility. After 30 years of operation, the facility's ownership will revert to the city (T. Judge, personal communication, February. 17, 2005).

Masada underwent seven separate adjudicatory procedures to obtain the Federal Title V[1] air permits for the solid waste, which is valid for five years. Masada obtained its first permit in July 2000 and this permit expires in 2005 (T. Judge, Personal Communication, February 17, 2005). In March 2005, the New York Department of Environmental Conservation issued a draft permit for Masada's facility. A public hearing will be held before the Title V permit is officially renewed. These permits set limits for mercury, lead, nitrous oxide, sulfur oxide, and carbon dioxide. Carbon dioxide is used in the fermentation process to make yeast, which is captured, conditioned and sold as industrial grade yeast. The emissions of the facility occur when lignin is added to the biosolids then gasified to produce steam. This energy is used for cellulose drying, distillation, and heating the sludge and acid. Additionally, all acid used in the acid-hydrolysis process is recaptured, recycled and reused. No combustion occurs during any part of this process (T. Judge, personal communication, February 17, 2005; ENB Region 3 Completed Applications, 2005).

In July 2001, Middletown hired Kroll Associates, Inc. for $100,000 to conduct a risk assessment of the Pencor-Masada OxyNol™ L.L.C's (Masada) waste-to-ethanol production facility (Cahn, 2004; Masada Project, n.d.). The risk assessment was conducted on Masada's "proposal to design, build and operate a facility for the disposal of municipal solid waste and sewage sludge by recycling" in order to "analyze all material and information associated with the facility, to identify all risks related therewith, and then to provide the city with recommendations that would mitigate any risks identified" (Masada Report, 2002). By December 2001, Kroll was asked to narrow the scope of their review include only issues that impacted the city's liabilities and revenues specifically related to legal, financial, construction and operations, and environmental subject matter (Masada Report, 2002). Concerned primarily with the city's liabilities and protection of expected revenues, Middletown Common Council hired a lawyer for $50,000, who specializes in complex contracts and limiting risk (Masada Timeline, 2003). After much debate and public outcry, the Kroll Associates Report was made public in a November 2002 story printed in Times- Herald Record (Masada Project, n.d.).

[1] Title V Air permits are granted by the Environmental Protection Agency.

Current Status

Middletown's Due Diligence Review and subsequent community member challenges concluded in early 2003. The final resolution of the Masada-Middletown Project occurred in December 2003. Pencor-Masada OxyNol™ did not receive the contract for the next phase of engineering until April 2004. Two months later, doctors diagnosed Masada's CEO and chief financial backer, Daryl Harms, with a terminal illness (Cahn, 2004). By July, Harms was incapacitated and the project was placed on hold. Masada is a privately owned company, now seeking a strategic manager to replace the former CEO. In the meantime, a former partner is filling this position, and seeks a financial partner. In an effort to raise equity, Masada's Financial Advisor, Ewing Bemiss & Company, indicated that Masada was selling partial ownership in the project in June 2004 (Cahn, 2004).

MIDDLETOWN ON TRIAL

On May 6, 2004 Middletown's City Hall was raided and Middletown's Mayor, Joe DeStefano, and other city officials were later indicted on 55 counts of municipal corruption (Cahn, 2004). The mayor and city officials were on trial regarding corruption and misuse of United States Department of Housing and Urban Development (HUD) loan distributions (Cahn and Mackson, 2005). The city officials were acquitted, but Mayor DeStafano was charged with two misdemeanors. The Mayor resigned his position on April 11, 2005. Marlinda Duncanson has taken over as the interim mayor until the next election (Cahn, 2005). These events, unrelated to the Masada venture, are likely to extend delays.

Table 4.1 Timeline: Middletown/Pencor-Masada

(*Source*: T. Judge, personal communication, February 17, 2005 and Times Herald-Record, November 16, 2002)

Year	***Month***	***Event***
1994	January	Middletown drafts an RFP for an alternative waste management facility
1994	February	Pencor answers RFP to build a recycling/manufacturing plant in Middletown
1994	December	Pencor Orange Corp. proposes designing and operating a waste-to-ethanol facility
1995	January	Pencor becomes Middletown's vendor and merges with Masada OxyNol™ Inc., a subsidiary of Masada Resource Group to form Pencor-Masada OxyNol™ LLC
1996	January	Middletown's Common Council gives Public Works Commissioner authority to solicit trash from outside municipalities to make the plant viable (750 tons/day)
1996	March	City officials and environmental stakeholders visit Masada's small scale Muscle Shoals, AL plant
1997	September	Middletown, and five other municipalities, sign contacts for Masada to process their waste
1998	August	Orange County lawmakers reject Masada's offer to process county garbage
1999	March	25 Municipalities sign contracts with Masada and Middletown's Planning Board approves Masada's plant to build the facility on a former city landfill
1999	December	Middletown holds a public hearing where 500 residents express concerns
2000	Summer	Masada abandons a similar venture in Birmingham, AL
2001	July	Middletown hires Kroll Associates, an international risk management firm, to review Masada
2002	October	The Common Council hires a lawyer ($50,000) specializing in complex contracts and limiting risk
2002	November	Kroll Associates Report make public in a Times Herald-Record story
2003	Summer	SUNY Orange economists release a report projecting the venture to pump $20 billion into the local economy over 20 years
2003	November	Common Council receives a final draft of the contract between Masada and Middletown
2003	December	Common Council votes to authorize Middletown Mayor DeStefano to sign Masada contract

Conclusion

The Masada case study indicates some of the potential obstacles and benefits the City of New York may experience upon implementing an alternative technology. Factors worthy of analysis include community involvement, a practical technology, and a successful permitting process. Although the proposed Masada facility at Middletown would have the capacity to process only seven percent of New York City's daily municipal solid waste, Masada executives believe the OxyNol™ ethanol technology to be scalable, and a viable option for New York City. Masada believes each site, municipality, and waste stream to be unique, and as such, each materials recovery facility and/or OxyNol™ facility could be engineered to accommodate these differences (T. Judge, personal communication, February 17, 2005).

In general, the community has supported Masada and the alternative waste management technology it will provide to these 41 municipalities. Masada has addressed public concerns and taken measures to include the public and advocacy groups whenever possible. Opposition to the construction of the facility occurred by groups and individuals associated with traditional waste management and were resolved both by court rulings and Citizens Advisory Board decisions. If a similar facility is planned for handling New York City's municipal solid waste, the city must expect public opposition. The Masada case identifies some of the opposition groups New York could expect, including traditional waste managers, environmental groups, landfill operators, local citizens, and government agencies. City planners must also identify and correct false sources of information, especially before they are incorporated into newspaper advertisements. Advertisements with false or incomplete information were effectively used to sway public opinion in Middletown.

The technology Masada proposes to use is capable of handling all of Orange County's waste and sludge. This technology is adaptable and could be a part of New York City's waste solution. Ideally, a facility located in New York could be located near a wastewater treatment facility so that it could process a similar waste stream to the Middletown Plant. Masada also completed the New York Department of Environmental Conservation (DEC) and US Environmental Protection Agency (EPA) permitting processes. It is relevant that the DEC and EPA have already approved this type of facility for construction and operation in New York State. The technology is scalable to local needs. The Materials Recovery Facility (MRF) can be separate from the OxyNol™ facility. This means a MRF facility can be located in one part of the city, while separate OxyNol™ facilities could be located in several places or near waste treatment plants.

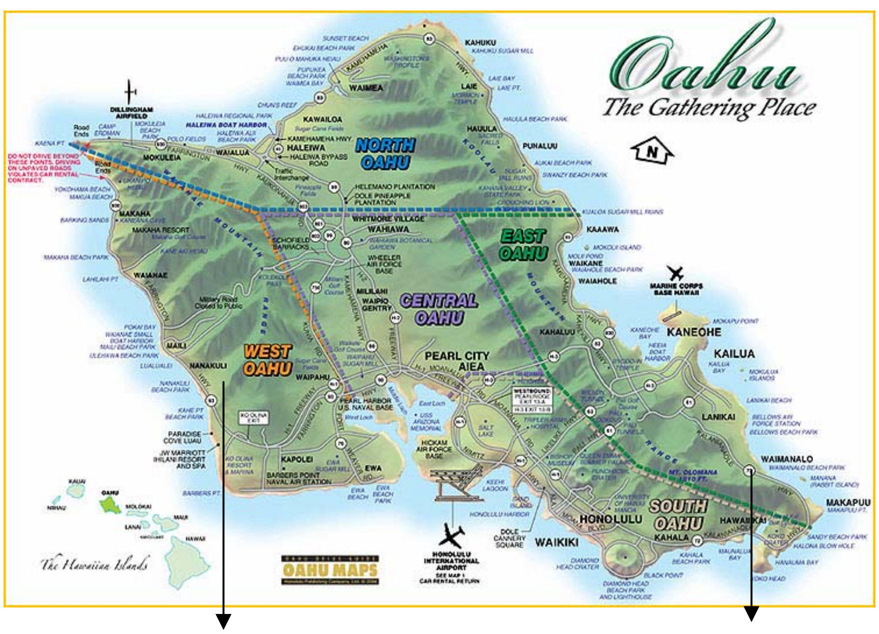
It would be helpful to further investigate either historical or existing partnerships between municipalities and environmental stakeholder groups to identify and address concerns and solutions for New York City's specific challenges. Michael Edelstein identifies a parallel case study within New York City involving The Natural Resource Defense Council, which collaborated with Banana Kelly, a South Bronx economic development agency, and paper companies from the US and Sweden to turn the abandoned Bronx rail yards into a $440 million Bronx Community Paper Mill (BCPM). The BCPM intends to recycle a quarter of New York City's paper wastes (Edelstein, 2004). This case study illustrates the importance of engaging the local community early on to create active, aggressive, and meaningful participation. The community should be involved in shaping the design of the facility to foster a sense of community, ownership, and participation. Siting can also be mitigated by locating the facility in an existing industrial area, so that it does not detract from future real estate development.

CHAPTER 4:

THE HAWAII MEDICAL VITRIFICATION FACILITY & THE H-POWER FACILITY

The city and county of Honolulu produce 4,383 tons of municipal solid waste per day, equivalent to about 33 percent of New York City's waste (Pacific Waste Consulting Group, 2004). The local Waimanalo Gulch Landfill, the only existing municipal solid waste landfill on the island of Oahu, is nearing capacity. Honolulu's preferred method of waste disposal is waste-to-energy incineration using the existing H-POWER plant. The landfill currently accepts refuse exceeding H-POWER's capacity, as well as non-combustible, non-recyclable waste separated from H-POWER's refuse stream, and H-POWER's residual ash (Turn, et.al., 2002). Disposal alternatives are critical for this location because of space constraints and high cost to export waste. The State Land Use Commission ordered the closing of the Waimanalo landfill by March 2008 (Pacific Waste Consulting Group, 2004). With this, the city has been actively researching municipal solid waste management options.

According to Joe Ryan, Vice Chair of Waimanalo Neighborhood Board, there was little public outcry during the planning stages of the Waimanalo Gulch Landfill, which may be attributed to a lack of adequate public communication and the landfill's misleading name. The name Waimanalo Gulch Landfill implies that the landfill would be located in Waimanalo, a community with a population of 10,000 predominantly native Hawaiians on the east side of the island. However, it was actually created in West Oahu, a much larger and more populated area; see Figure 4-1 below (J. Ryan, personal communication, March 12, 2005). Local residents requested that Waimanalo Gulch be closed as soon as an alternative is identified.



Waimanalo Gulch The Community of Waimanalo

Figure 4-1. Oahu Map & Waimanalo Gulch Landfill location (Source: J. Ryan, personal communication, March 12, 2005)

In 2002, the City of Honolulu issued a request for proposal (RFP) for a plasma arc gasification facility to identify costs and allocation of risks of municipal solid waste (MSW) disposal. Included in the disposal specifications were 25,580 tons of auto fluff, 13,440 tons of recycling residuals, and 60, 995 tons of municipal solid waste per year (Turn, et.al., 2002).

The City's Findings

The Honolulu City Department of Environmental Services (ENV) concluded, following proposal reviews, that plasma arc technology would significantly increase Oahu's waste disposal costs without offering environmental advantages to justify such increased costs. The City Department of Environmental Services briefed the City Council with recommendations for landfill reduction, which included increased recycling opportunities, expansion of the existing H-POWER waste-to-energy facility and utilization of best available alternative disposal technologies (City and County of Honolulu, 2005).

Honolulu may petition the State Land Use Board to extend the existing Waimanalo Gulch Landfill permit, in order to keep the landfill open. At the current disposal rate, the landfill has the capacity to remain open for 20 more years. With expansion of the H-POWER waste-to energy plant and proposed recycling initiatives, the disposal rate would decrease and thereby extend landfill life to more than twenty years (Pacific Waste Consulting Group, 2004). The local Neighborhood Board recommended that city officials keep the Waimanalo Gulch Landfill open for a few more years until a new site is identified. According to Board chairman George Yamamoto, the Board also expressed concern that landfill expansion would affect the planned development of a new resort, which would subsequently affect jobs and the local economy (Ishikawa, 2002).

Concerns associated with the expansion of the H-POWER waste to energy plant include the dollar costs of expansion and the inevitable increase of ash residue produced from H-POWER incineration. The cost to the city of expanding the H-POWER waste-to-energy facility will total approximately $66 million. To date, the city has budgeted six million for the planning and design phase. Additionally, expanding the facility will generate increases to the 200 tons of ash which are currently brought to the Waimanalo Gulch landfill each day (Ishikawa, 2002).

The Hawaii Medical Vitrification (HMV) Facility

Hawaii Medical Vitrification (HMV) is a plasma arc gasification facility located in Campbell Industrial Park, Honolulu. The facility processes medical and hazardous waste and has been in operation since 1998. Medical waste, which is mostly homogenous and well regulated, is defined by the EPA as "any solid waste generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals" (Beck, 2003). It can include organism tissue, organs, bandages, needles, etc.

Currently, the Hawaii Medical Vitrification Facility has a permitted throughput of 1 ton per day, which is below the State of Hawaii's air emission regulatory threshold and the facility is therefore exempt from air emissions testing. The process results in a reduction of the waste by 99.5 percent by volume or 95 percent by weight. The facility does not produce a net output of electricity. The facility can process up to one ton per day, but does not always meet its capacity, which is less than 0.01 percent of New York City's 13,000 ton per day requirements (Beck, 2003).

Medical and hazardous waste, stored in 8-gallon buckets, is fed into an enclosed plasma reactor/chamber. Graphite electrode-type transfer torches are positioned in the process chamber and remain in the glass melt keeping the melt in a liquid state. Additional torches are positioned above the melt to provide heat for processing the organic/hydrocarbon material (Beck, 2003).

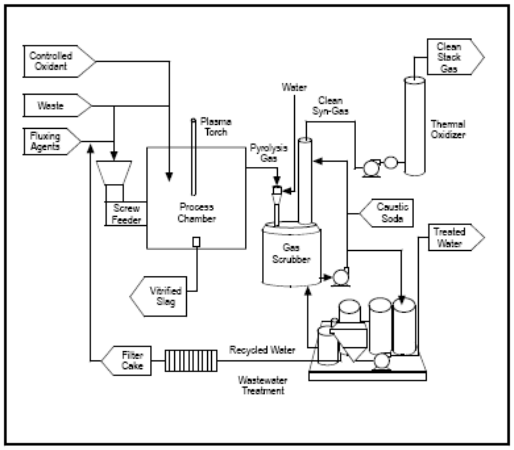


Figure 4-2. Sample Plasma Arc Gasification Process. Source: 2003 R.W. Beck, Inc., City of Honolulu, Review of Plasma Arc Gasification and Vitrification Technology for Waste Disposal.

JUST PLAIN GROSS

Honolulu's Task Force on Waste Management, a legislative task force led by Senator Melodie Aduja, found approximately 8,000 containers encompassing 30 tons of medical waste—some sitting in the sun—backlogged and waiting to be processed at the Hawaii Medical Vitrification facility on 11 December 2003. "It's very hazardous toxic material, and it should have gone through the vitrification process. If they cannot handle it, they should not be taking it in." – *Sen. Aduja, 11 December 2003*. *(*Augiar, *Honolulu Advertiser.com*, 12 December 2003*)*

On May 28, 2004, the state Department of Health ordered HMV to pay $60,270 for storing excessive amounts of infectious waste, failing to properly test products and procedures, and accepting waste while their equipment was out of service. HMV violated state laws regarding permitting and inspection. (Honolulu Star Bulletin, May 29, 2004)

H-POWER

The technology used in the H-POWER waste-to-energy facility involves the incineration of all municipal solid waste. H-POWER does not process hazardous waste, medical waste, sewage sludge, or large, bulky items that do not fit in the facility's shredders, such as mattresses and refrigerators. The facility includes a source separation system in which almost 100 percent of all ferrous and nonferrous metal are recovered for recycling. The facility's preprocessing system uses magnets to pull metals from the refuse and eddy current separators extract nonferrous metals from the ash (H-POWER, 2003).

The H-POWER facility incinerates approximately 1,650 tons per day using two 854-tons per day waterwall boilers, with traveling grates that feed a condensing steam turbine generator. The generator, in turn, has a maximum electrical production capacity of 57 megawatts, generating annual power sales of roughly $25 million (TenBruggencate, 2003). The power generated from H-POWER supplies approximately 7% of the city's electricity needs (Pacific Waste Consulting Group, 2004). The only input is municipal solid waste. According to Scott Turn, PhD, Hawaii Natural Research Institute, metals are recovered from the municipal solid waste prior to use in the power plant, while other grate residues may be used for such things as road building aggregates; however, they are not permitted for this purpose at present (personal communication, March 8, 2005). The only output, besides the generated electricity, is approximately 200 tons per day of ash which is sent to landfill. The H-POWER facility reduces the volume of refuse going to landfill by 90 percent. The output ash costs the facility about $12 per ton to dispose of in a landfill. Part of the facility management contract includes hauling and disposal of the ash (Smith, 2005). Pollution controls are as follows: flue gas scrubbers that inject lime; fabric filter baghouses; electrostatic precipitators that place a charge on dust particles, which then attach themselves to a metal plate instead of going out the smokestack (TenBruggencate, 2003). These controls meet and exceed environmental requirements.

The H-POWER waste-to-energy facility was constructed in 1985, at a cost of $181 million. It began operations in 1990. The facility was constructed on a 28 acre industrial lot purchased from Campbell Industrial Park. The equipment has been upgraded over time, and it is estimated that a facility similar to H-POWER would cost between $300 - $400 million dollars to build today (H-POWER, 2004). The project was originally financed through general obligation bonds issued by the City of Honolulu. In 1989, the city sold the facility to the Ford Motor Credit Corporation on a twenty year sale, to be refinanced back to the city by 2010. At that time, the city may buy back the facility at a market value or it may continue to lease the facility. One estimate indicates that the facility has a current value of about $80 million (Smith, 2005).

H-POWER employs 150 county residents and has an annual payroll of $10 million (HPOWER, 2003). The facility obtains revenue by two means: the generated power sales mentioned above, and through fees for solid waste disposal. It costs the city $70 per ton to pick up refuse curbside and haul it to H-POWER, where it costs an additional $50 per ton to dump it onto the tipping floor. There are approximately 1,000 tons per day of commercial waste and 1,000 of city and county waste. The city charges a commercial tipping fee of $84.25 per ton with an additional 18 percent recycling surcharge, for a total commercial tipping fee of about $95 per ton (Smith, 2005).

City History with Alternative Waste

Based on accounts provided by Joe Ryan, Waimanalo Neighborhood Board Vice Chair, a manure processing facility was constructed in the Waimanalo community in the early 1990's by Unisyn Biowaste Technologies, a private corporation. The facility was constructed on a 20-acre parcel of state land, leased to a dairy with a 3,000 head dairy herd. The facility was established to process the manure from the herd, extract methane, compost the solids, and recycle the water back to the dairy waste removal system. The project also involved growing two million pounds of hydroponic tomatoes a year.[2] The Unisyn facility was established as accessory land use to resolve agricultural runoff and manure accumulation problems. Because the project fulfilled a public need (for pollution reduction), and possibly due to lack of public notice, community concern was not an issue.

By 1995, the Unisyn facility shifted its operations to organic waste processing and imported seventy-five tons per day of garbage. The waste stream consisted of fish waste from the United Fishing Agency, meat from a grocery chain, grease trap waste, commercial food waste from a major shopping center, as well as waste from hotels and restaurants island-wide. The odor from the plant was overwhelming and caused the facility to close in 1998. Although negotiations were initiated to compensate the community for hosting Unisyn through educational projects, they were not finalized.

Several problems materialized around the Unisyn facility's siting and conversion to what some referred to as an "open dump". First, following the property's initial environmental assessments, use alterations did not require a follow-up assessment, allowing a manure processor (beneficial use) to convert to a public nuisance, due to the increased organic waste intake, in the absence of an updated environmental assessment. Second, while control of land use on parcels over 15 acres is controlled by the State of Hawaii's Land Use Commission under four general classifications (urban, rural, agricultural, and conservation), sub-classifications reside in the county. With this, a county industrial zone is a sub-classification of general urban land classification. Prior to this event, waste processing was limited to state urban and county industrial. Without public hearing or legislative process through the city council, the county altered the definition of "green waste" (organic waste) to include food waste and garbage processing as a permitted use of agricultural land. Finally, the state failed to obtain a site closure plan (J. Ryan, personal communication, March 23, 2005). In part due to its history, there is some public concern about waste management in Hawaii.

The City's Findings

The Honolulu City Department of Environmental Services (ENV) concluded, following proposal reviews, that plasma arc technology would significantly increase Oahu's waste disposal costs without offering environmental advantages to justify such increased costs. The City Department of Environmental Services briefed the City Council with recommendations for landfill reduction, which included increased recycling opportunities, expansion of the existing H-POWER waste-to-energy facility and utilization of best available alternative disposal technologies (City and County of Honolulu, 2005).

Honolulu may petition the State Land Use Board to extend the existing Waimanalo Gulch Landfill permit, or seek to keep the landfill open. At the current disposal rate, the landfill will be able to accept waste for twenty more years. If the H-POWER waste to energy plant expands, and recycling increases, the disposal rate would decrease and landfill life would be extended (Pacific Waste Consulting Group, 2004). The local Neighborhood Board recommended that city officials keep the Waimanalo Gulch Landfill open for a few more years until a new site is identified. The

[2] Hydroponic tomatoes are tomatoes that are cultivated in a nutrient solution rather than soil.

Board also expressed concern that landfill expansion would affect the planned development of a new resort, which would affect jobs and the local economy (Ishikawa, 2002).

Conclusion

The City and County of Honolulu embarked on a waste management campaign to reduce landfill requirements through increased recycling and a continued pursuit of feasible alternative technology options. Citizens and community groups support the expansion of the city's H-POWER incineration facility, reflecting a widespread desire to refrain from increased landfill activity and the limited availability of waste export options. As Wai'anae Coast Neighborhood Board member Adrian Silva, Jr., noted when commenting on public concern toward relieving the current trash problems, "I think any expansion of H-POWER would be a blessing" (Blakeman, 2004).

Honolulu's waste management policies also reflect a sense of public responsibility to future generations. A recent solid waste management plan generated for the County of Honolulu noted the following regarding Hawaii's "opala", or waste:

> The shipping of waste to the mainland has been evaluated and discarded because of its significant impact to our sustainability efforts, increasing our dependence on offshore resources and potential to detract from, and delay, the immediate decisions on landfill selections, H-POWER expansion, and the use of alternative technologies. In addition, the moral issue of shipping our *opala* for burial by others cannot be discounted (Pacific Waste Consulting Group, 2004).

Public education efforts in Honolulu have resulted in waste reduction, improved recycling levels and awareness of waste disposal alternatives. This has improved the overall effectiveness of waste management and allowed the decision making process to occur unencumbered by public opposition. The experiences of Honolulu indicate that waste-to-energy incineration may still be a feasible option for New York City. Despite political sentiment that it is not acceptable to the public, the limitations of alternative waste disposal methods could result in greater public acceptance of incineration. The technology is comparable to high-temperature thermal processes like gasification in environmental benefits and is cheaper and technologically simpler.

CHAPTER 5: NEWMARKET ORGANIC WASTE PROCESSING FACILITY

In the late 1990s, Ontario, Canada found itself in a waste management predicament. Toronto, the region's capital city, had tons of trash and no long-term disposal plan. Toronto's reliance on the Keele Valley Landfill in Michigan was scheduled to end in December 2002 (as of February 2005, Toronto still transports its waste to the landfill); and with an annual waste transport of 1.1 million tons at the cost of approximately $26 million per year, Toronto and the province of Ontario began exploring alternative organic disposal options (Kurth, 2003). Eventually, the region settled on the German patented Biotechnische Abfallverwertung Technology (BTA technology), a wet anaerobic digestion process that decomposes organic waste into biogas and compost, to address their long term waste disposal needs.

Canada Composting Incorporated, a private Canadian firm holding the exclusive North American license for BTA processing, received a government contract to construct North America's first BTA plant (26 similar plants are currently operating worldwide) in Newmarket, Ontario. Located approximately 33 miles north of Toronto on Highway 404, Newmarket is governed by the Region of York and has a population of 71,000 (Town of Newmarket, 2005). The Newmarket facility's processing capacity is approximately 150,000 tons of organic waste per year. Its pilot program processes approximately 66,000 tons of organic waste and 22,000 tons of yard trimmings yearly (Goldstein, 2004). In 2000, Toronto had plans to eventually ship 110,231 tons per year to the Newmarket plant (Maloney, 2000).

Financing

A grant from the region of York provided the initial funding for the Newmarket BTA facility. Canada Composting Inc. and Halton Recycling are private firms and are not required to release financial information. A York region city official stated that the plant's operational costs are partly recovered through a tax or collection fees. This is supported by local reporter Caroline Grech, who wrote about the $1.2 million cost of the pilot program and noted "Richmond Hill councilors have applied for funding that would see two-thirds of the cost paid for by other tiers of government" (Grech, 2005, February 27), and "eliminating the program in Newmarket would save the county about $778,000 annually" (Grech, 2005, February 24).

Due to the expense of the program "numerous regions within Ontario deferred entry into the waste disposal program to save cash" (Grech, 2005, February 24). According to town official Wanda Bennett, only one of the nine municipalities originally slated to ship waste to the Newmarket facility followed through. The remaining eight either backed out or delayed their entry into the program (Bennett, 2005).

PROFITABLE WASTE
The compost produced by the Newmarket plant is AAA grade and can be sold for profit at a going rate of approximately "$24 per ton (Antler, 2005). The biogas, which is composed of methane and carbon dioxide, "fuels three 16-cyclinder engines that can crank out 1.2 megawatts of electricity, enough to both run the plant and sell power to the Ontario Power Generation grid" (McAndrew, 2001). Finally, "most of the acidic water produced is reused in the anaerobic process, although some water is flushed into the York Region sewer (McAndrew, 2001).

Operations

Canada Composting won community support for the facility early on. BTA processing plants are designed to have small footprints, meaning that the facility should require no more than five acres of space. According to Mike Birrett of the York Region Transportation and Works Department, Canada Composting had no difficulty siting the plant (M. Birrett, personal communication, February, 2005). While there was little contention in designating the site for the facility, the plant suffered repeatedly from financial insolvency, leading to long-term consequences at the site. Stone & Webster, the original construction company, filed for bankruptcy mid-way through the plant's construction; Canada Composting suffered the same fate months after the plant's opening in July 2002 (Birrett, personal communication, February 2005).

Our research and interviewees offered little information on the causes of either organization's bankruptcy, indicating only that the plant's organization was a controversial matter. Canada Composting Inc. eventually resumed operations, but not before the bank foreclosed on the facility. Halton Recycling Ltd., a Canadian company, acquired the plant in November 2003 (Green, 2004). Halton Recycling completed a series of upgrades on the plant to improve reliability and reduce the potency of odors emitted from the plant. The most significant upgrade was the installation of a hydropulper, a wet separation step designed to remove inorganics (e.g. plastics and other non-biodegradable materials in the source separated stream) and reduce the solids content to lower than ten percent (Goldstein, 2004). The Newmarket plant is operational under Halton but not yet running at full capacity.

According to a local reporter, Ms.Grech, the plant currently collects 44 tons of trash per week (Grech, 2005, February 27) from the 12,000 Markham families in the pilot program, which began in September 2004. "The second phase, which will include Markham's other 55,000 homes, is slated to start in September 2005" (Volpe, 2005). Due to technical difficulties, particularly an odor issue, the city council decided to delay the plant from entering full operations until the spring of 2007" (Volpe, 2005).

Community Relations

"Newmarket residents will not put up with this odor. If we don't receive immediate resolution by Halton Recycling we will begin the legal process to try and shut them down,"

- Newmarket Mayor Tom Taylor (Press Release 2004)

Citizens of Ontario support alternative waste technologies, such as the BTA process. However, the persistent odor problem strained relations between Canada Composting and the local community soon after the plant's opening. According to Toronto columnist Mark Green, "bad odor problems experienced in 2002" led to the Environmental Ministry filing a charge against Canada Composting (Green 2004). Two years later, "with odor problems still causing area residents grief, some councilors are looking to pursue a court injunction to stop composting at the facility" (Grech, 2005, February 17).

Patrick Casey, senior media relations officer for the York region, claims that "representatives from the region have been meeting with Halton officials to try to alleviate problems at the site" (Grech, 2005, February 17). In early February 2005, Bill Palmer of Halton Recycling claimed that the company responded to the odor problem by "changing equipment [they built a hydropulper] and adding 7,200 square feet to the tipping area" (Grech, 2005, February 10). Nevertheless, the odor problem persists. Mr. Birrett believes that the stench is due to shallow tanks that inhibit the material from fully digesting before methanization (M. Birrett, personal communication, February). It is important to note that BTA processing should not emit an odor and does not in many of the plants worldwide, including the BTA plant located in Toronto.

The plant's odor, described as similar to raw sewage, is particularly disturbing to the community because of its close proximity to a developing residential and commercial district although the plant is situated in an industrial district. According to Mr. Birrett, the city altered its development plans for the district after construction of the Newmarket plant noting that the BTA processing plant should be located at least one kilometer (0.62 miles) away from a commercial/residential center (Birrett, personal communication, February 2005). Local news articles indicate that Halton is working with the City Council to ameliorate this problem. However, the plant's future remains tenuous, especially in light of Newmarket Mayor Tom Taylor's comment "For the Town, there are only two acceptable options: either operate properly or cease operations" (Press Release, 2004).

Conclusion

The Newmarket BTA facility's operations, financing and social issues provide an indication of the benefits and difficulties New York City could face if they constructed a similar plant despite the limited comparative potential resulting from demographic and socio-political differences between the two cities. However, it might be possible to site a facility in a small town in the New York metropolitan region. As previously noted, Newmarket is a developing town located approximately 40 minutes away from Toronto, the region's main metropolitan area. Siting will be much more difficult in New York City, or in the metropolitan New York area than it was in Ontario, given New York's zoning laws, regulations and public sentiment. There are also a number of demographic differences between New York and Newmarket, the most prominent being population size.

Technical differences also hinder Newmarket's applicability to New York. The Newmarket plant receives source-separated organic waste, giving them a zero rejection rate and reduced overall cost; New York City does not separate its organics before processing and does not intend to institute a source-separation program. It is possible to include mechanical separation of waste in such facilities to solve this problem. Despite the differences between New York City and

Newmarket, Ontario, we believe that the technical facility and social issues surrounding the Newmarket plant provide valuable insight into the feasibility of constructing a BTA Anaerobic Digestion processing plant in New York City, and lessons for the construction of any major waste management facility.

CHAPTER 6: ECOPARK 2 ANAEROBIC DIGESTION FACILITY

Among the world's leaders in environmental progressivism, the Spanish Parliament created the Metropolitan Environment Agency in 1987 to be responsible for the Barcelona Metropolitan Area's sewage treatment and garbage disposal (Area Metropolitana de Barcelona Entitat del Medi Ambient, 2005). The Metropolitan Environment Agency also enabled 33 town councils in Barcelona to jointly manage the treatment of urban waste. However, the Agency's involvement in waste management policy would extend beyond this provision (Area Metropolitana de Barcelona, 2003).

With a growing population of over 5 million, Barcelona's Metropolitan Environmental Agency took the initiative to create a long-term sustainable waste management plan. This innovative waste management plan, entitled Metropolitan Programme for Urban Waste Management (PMGRM), included blueprints for two facilities (Ecopark and Ecopark 2) with alternative technologies for waste processing. A key component of the Programme was an agenda for community relations actions that the Agency would initiate three years prior to constructions of the facilities (Area Metropolitana de Barcelona, 1999).

Barcelona's Ecoparks consist of an integrated waste treatment complex that combines various facilities at a single site to treat different types of waste. The site consists of Ecopark 1 (Barcelona Ecopark) and Ecopark 2 (Montcada i Reixax Ecopark). Barcelona Ecopark was the first alternative facility to treat municipal waste from the Barcelona metropolitan area with a process other than landfilling (Area Metropolitana de Barcelona, 1999). Barcelona Ecopark began operations in August, 2001. During this same year, Ecoparc del Besos, SA[3], a private corporation, won a contract for construction of the Montacada i Reixac Ecopark, a facility that to process organic waste through the Valorga anaerobic digestion process. In March of 2004, Ecopark 2 commenced operations (Area Metropolitana de Barcelona, 2003).

Ecopark 2 is located in a commercial and industrial zone in Montaca i Reixac, just north of Barcelona. The area where the aerobic digestion facility is installed was previously an agriculture area but is now classified as an "area for public facilities" (C. Gonzalez, personal communication, February 22, 2005). The facility sits on a 24 acre site (The City of Los Angeles, 2003).

Community Relations

The success of Ecopark 2 depended on involving the local community and gaining their approval. Barcelona is the home of well known modernist architects such as Antonio Gaudi, and residents are known for their artistic tastes. The city sought to focus on aesthetic appeal in the design of this facility, and hired Joseph Crivillers Costa, a world renowned architect, to design the façade for Ecopark 2. Two slopes have been constructed on either side of the site to make the facility resemble a landscape (McGuirk, 2004). The design and construction of this facility constituted a major improvement to the abandoned industrial area.

[3] Ecoparc del Besos, SA is a joint venture between Urbaser, Fomento, TIRSSA, and TERSA.

Before and during the construction of Ecopark 2, Ecoember and Ecovidrio, non-profit organizations responsible for supervising recycling, spent $4.2 million over 5 years on community relations for the Ecopark facilities (Area Metropolitana de Barcelona, 2003). The city undertook major efforts to promote organic waste separation. In order to inform the residents of the new service, a community relations team made door to door visits, providing residents with starter kits for separating materials in kitchens and information on how to separate their waste. The town councils initiated a separate collection for organic waste. Signs with graphic designs were generated for each municipality to promote awareness on the new program. Neighborhood associations were invited to be involved in the design of the campaign and disseminate information to area residents (Area Metropolitana de Barcelona, 2003).

The Metropolitan Environment Agency launched a “Sorting Is In” campaign, with the slogan, *What do your containers eat?* to educate children about composting. Agency representatives made visits to schools and provided all metropolitan schools with indoor collection containers (Area Metropolitana, 1999). Facility and governmental officials sponsored a communication campaign to promote selective collection of packaging at drop-off points. In May of 1999, colored containers were installed throughout the city to enable citizens to properly dispose of their separated waste (Area Metropolitana de Barcelona, 2003).

While many Barcelona residents favor the Ecoparks as an environmentally-friendly component of their city, residents of the community located nearest the facility (3,300 feet from Ecopark 2) opposed the siting of a large waste management facility near their homes. Some residents argued for smaller sized facilities dispersed throughout the area rather than one centralized industrial complex. However, because of the cost effectiveness of a centralized, the project was ultimately constructed as a single centralized facility. Opposition to the Ecoparks decreased due to special advertising campaigns, attention to facility design, and publicized measures to control the odor. There has been persistent opposition from a farm that is located 165 feet from the site (C. Gonzalez, personal communication, February 22, 2005).

Financing

The City of Barcelona owns both Ecopark 1 and Ecopark 2. The city contracted Ecoparc del Besos S.A. to operate and maintain Ecopark 2. The technology used at the facility is supplied by Valorga International, a French company that built numerous anaerobic digestion plants throughout Europe since 1987. Valorga normally limits its services to design, construction, and startup operations (Valorga International, 2005).

The total cost of Ecopark 2 is $76.6 million;[4] $52 million (67 percent) are from loans to the private corporation that operates the facility and $24.6 million (33 percent) are from the local and federal government. The loans to Ecoparc del Besos S.A. are provided by the European Union Cohesion Fund, an endowment which aims to promote economic cohesion in the European Union by investing in infrastructure. The main sources for financing waste management are the Metropolition Urban Waste Environment Tax (TAMGREM) and the income from the Catalan Packaging Waste Act (Area Metropolitana de Barcelona, 2003). The citizens of the Barcelona Metropolitan Area (33 municipalities) pay a dedicated tax for the treatment of the waste as part

[4] In 2004 dollars

of a collection tax but there is no tax specifically for Ecopark 2. In 2004 the city spent $47 dollars to process each ton of waste (C. Gonzalez, personal communication, February 22, 2005). Investors are expected to recover their investments in ten years. Ecopark 2 employs 105 workers (Area Metropolitana, 2004).

Technology

The Barcelona Metropolitan Area produces about 1,380,000 tons of waste per year, which is 29 percent of the waste that New York City generates. The full facility capacity is 265,000 tons per year, which includes the recycling component of the facility. This is approximately 726 tons per day, five percent of New York City's needs. The purpose of Ecopark 2 is to transform the organic material into compost and biogas and recover recyclable materials. Using this process, Ecopark 2 is able to process 19 percent of the Barcelona metropolitan area's waste. The Valorga anaerobic digestion section of Ecopark 2 treats about 130,000 tons per year (City of Los Angeles, 2004).

Approximately 45 percent of the incoming solid waste is not processed at the facility and is sent to a landfill in Garraf, Spain, 19 miles from the Ecoparks, on the opposite side of Barcelona. Five percent of inputs are recovered through the plant's pre-processing and recycled. The remaining 50 percent of the total input is biogasified in the digesters. The digesters further screen the resulting effluent, rejecting an additional 8 percent. The remaining 42 percent of the input is either biogasified or converted to marketable compost (City of Los Angeles, 2003).

For every 100 tons entering Ecopark:
45 tons are rejected during pre-processing and sent to a landfill
5 tons are recycled
8 tons are rejected in post processing
42 tons are converted to biogas and compost
(City of Los Angeles, 2003)

Municipal solid waste is pre-processed to remove all recyclable materials before the organic residual is processed. The Valorga digesters are cylindrical chambers, approximately 54 feet in diameter and 75 feet high. There are three digesters in Ecopark 2. The digesters are fed once a day and the process takes a few hours. The retention time is 30 days (Valorga International, 2005).

The facility produces methane and biogas, which are used for electricity production. Ecopark 2 produces 3.249 billion gallons of biogas and 26.3 gigawatts of electricity per year. The gas is 65 percent methane and 35 percent carbon dioxide. It also contains hydrogen sulfide. The facility sells 100 percent of the electricity it generates to a grid but buys 59 percent of that to support its operations. This buyback is cost-effective to the facility because of green energy initiatives. The treatment of organic matter at Ecopark 2 is environmentally progressive because it is able to capture and use the biogas produced, which constitutes a cleaner fuel source represents low emissions of greenhouse gasses (Area Metropolitana de Barcelona, 2003).

The facility produces 38,000 tons of compost per year. 22,000 tons per year of plant inputs are recyclable, and sent to recycling facilities; 120,000 tons of inputs every year are rejected and landfilled. The facility has its own waste water purification plant. Wastewater undergoes a chemical/physical treatment followed by nitrification and is eventually reused in the process. Solids entering the anaerobic compost are enclosed in 17 composers. The compost is maintained at 104º Fahrenheit for two weeks. After the two week treatment, the compost is post-processed to screen and separate. The finished composted in marketed (The City of Los Angeles, 2003).

Long-Term Community Relations

After the construction of Ecopark 2, Barcelona continued their proactive community relations processes. The Metropolitan Environment Agency (EMMA) worked with town councils and the Barcelona Provincial Council to establish local Agenda 21 processes. The agency created a program called *A Shared Future*, which sponsored various activities designed to involve citizen groups and increase awareness of the treatment facilities. Activities included visits to Ecopark 2, written and graphic information, discussions, conferences, and specific training programs. Since opening, 15,417 visitors toured the facilities, many of whom have been secondary school students. On February 24, 2002, Ecopark 2 sponsored an event for more than 4,000 guests to introduce the facility and its operations (Area Metropolitana de Barcelona, 2003).

Along with organized tours of Ecopark 2, four waste workshops were offered to Barcelona residents. The first workshop was called the New Solid Waste Late and the Tax Law. Eocpark 2 staff prepared information explaining the new metropolitan environmental tax on municipal waste management to the residents. The second workshop was The Solid Waste Resource workshop. The third workshop explained the integrated system for packaging and the last workshop focused on financing solid waste.

The Metropolitan Programme for Urban Waste Management (PMGRM) carried out a series of seven seminars organized for university students at the Polytechnic University of Catalonia. The seminars were successful and attended by the heads of various municipalities in Barcelona. In 2003, the city aired a television commercial thanking the citizens of Barcelona for separating their waste (Area Metropolitana de Barcelona, 2003).

Conclusion

The Metropoliation Programme for Urban Waste Management (PMGRM) created a Review Council to communicate information from The Metropolitan Environment Agency (EMMA) to the public and vice versa. The Review Council consists of a Finance Committee, Infrastructure Committee, and an Implementation Committee. The Finance Committee pursues alternatives for waste management financing; The Infrastructure Committee conducts studies for the Ecoparks; and the Implementation Committee works on community participation. Collectively, these various committees enable Barcelona's residents to remain involved with solid waste management.

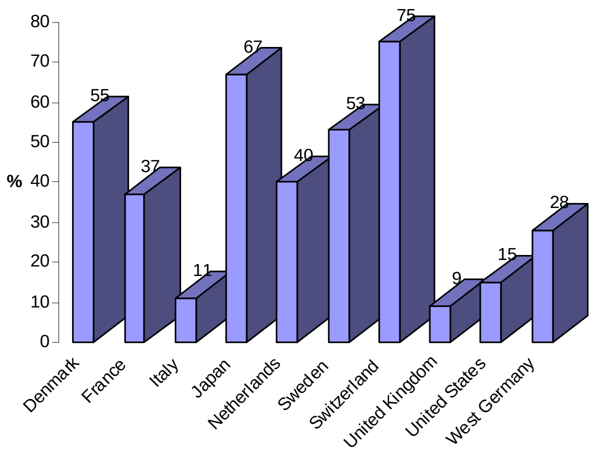
The money spent on public participation and community relations in Barcelona led to unusually high community acceptance of a waste management facility. Barcelona residents became involved, and this open process of public participation helped build support for the facility.

Advertising and community participation prepared the public in advance, allowing community concerns to be addressed before Ecopark 2 was operational. With high transparency and attention to public preferences, Barcelona was able to frame the project in a positive light. Support from the city government, local universities, and community groups secured a positive response to Ecopark 2 (Area Metropolitana, 2003).

This case is applicable to New York City because both areas are large urban environments with high population density and competition for land. Barcelona's waste management plan and comprehensive community relations campaign can be applied to New York City. Ecopark 2 is a cost-effective, environmentally progressive facility for waste management.

CHAPTER 7: AKITA CITY GASIFICATION FACILITY

Solid waste management in Japan is currently dominated by incineration. Approximately 67% of Japan's solid waste is treated by incineration processes—one of the highest rates of incineration in the world (Office of Technology Assessment, 1989). In the late 19th Century, Japan promoted incineration in response to a long-term outbreak of cholera (Yorimoto, 1995). The Japanese government also encouraged the use of incineration to address sanitation and landfill capacity concerns.



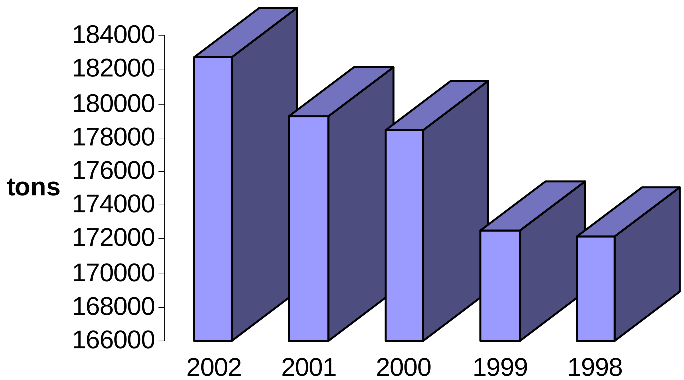
Estimates of the Percentage of Post-Recycling MSW Incinerated in the United States, Europe and Japan by Weight (Office of Technology Assessment, 1989)

National Government Policy

Waste management in Japan is the responsibility of the 3,200 regional governments. For this reason, incineration facilities tend to be small. Smaller incinerators usually combust waste at lower temperatures, resulting in incomplete combustion and increased dioxin emissions. The US Environmental Protection Agency (EPA) considers dioxins to be a potential human carcinogen and it is currently reviewing its dioxin exposure standards (EPA, 2004).

The identification of potentially carcinogenic emissions from incineration resulted in a policy change in Japan. The Basic Guidelines for the Promoting of Measures against Dioxins were formulated in March 1999 to reduce emissions levels to approximately 10 percent of 1997 emissions levels within four years (MOHW, 1999). The Government of Japan also instituted a policy to encourage a high temperature thermal treatment processes that would result in more complete combustion (MOHW, 1999). The Ministry of Health and Welfare (1999) states that "waste incineration…cannot be abandoned, because the Japanese land is small and the country is hot and humid, making it necessary to reduce and hygienically treat wastes."

DIOXINS IN SPINACH?
Over 80 per cent of Japan's dioxin emissions come from solid waste incineration (Japan Times, Feb 17, 1999). Dioxins are linked to low-temperature incineration and the incineration of plastics such as polyvinylchloride (PVC). The dioxin emission issue produced public outrage in Japan in February, 1999, when TV Asahi reported high levels of dioxins found in spinach grown in Tokorozawa, a suburb of 30 miles west of Tokyo and the site of a number of solid waste incineration facilities. Although the reports were found to be incorrect, five of the fourteen incinerators situated in Tokorozawa were closed in December 1999 due to failure to meet the new standards for dioxin emissions. At the time of these reports, conflicting dioxin exposure limits had been set by the Ministry of Health and Welfare and the Environmental Agency (Japan Times, March 11, 1999).



Annual Municipal Solid Waste Collection, Akita City, 1998-2000, (tons per year)
(Akita City Environmental Department, 2003)

Siting and Planning

In order to process this volume of solid waste, Akita City constructed an incineration plant with three incineration chambers capable of processing 165 tons each day in 1983. This facility was sited in a rural area of a neighboring municipality, which has since been assumed by Akita City. In 2000, following the introduction of the national policy on high-temperature thermal processes, the city secured subsidies from the Government of Japan for the construction of two gasification chambers to replace existing incinerators. The City Congress debated the choice of technology, contract and budget, eventually deciding to construct a Nippon Steel-designed, shaft-type gasification chamber because of its lower emissions and high reliability (Akita City Congress, 1998).

The Japan Waste Management Association, an independent non-governmental organization and member of International Solid Waste Association, frequently provides impartial information about waste management technology to city governments and other interested parties (H. Kurihawa, personal communication, 2005). Because information provided by some technology vendors presents only best case scenarios and can be biased, the Japan Waste Management Association can provide additional information to cities in cases such as this.

The siting and development process for the Akita City facility included discussions with the local community mandated by both the Akita prefecture Environmental Assessment Law and the rules governing national government subsidies. Since the facility is located on a site owned by Akita City and replaced an existing incinerator, there was no apparent opposition. As a requirement of the national subsidy, the city needed to reach an agreement with the public. Eventually, a decision was made to maintain an ongoing dialogue with the public through biannual conferences. The conferences are attended by Akita City township appointees, each of whom represents a local community. An environmental assessment was undertaken in accordance with the prefecture law, which requires evaluation of air pollution, water pollution and traffic effects. The assessment's results were published, and residents were granted a one-month comment period to submit comments to the Governor.

Nippon Steel began construction of the facility in September 1998; operations began in March 2002 (Akita City Environmental Department, 2003). The facility is wholly owned by Akita City and jointly operated by the city's General Environmental Center, Management Division and Nittetsu Kankyou, a subsidiary of technology provider Nippon Steel (Government Officer of Akita City, personal communication, March 2005).

Financing

The total construction cost for the facility was $174 million and was funded through national government subsidies of $59 million, $102 million in city-issued bonds, and $13 million from the city's general budget (Akita City, Record of Congress, 2003)[5]. The subsidies included a Ministry of Economy, Trade and Industry subsidy for the construction of the power plant and a subsidy from the Ministry for the Environment for the construction of the gasification chambers. The bonds were issued for a 15-year term with an interest rate of approximately three percent guaranteed by the Government of Japan (Akita City Congress, 1998). Nippon Steel asserts that the construction cost is now $25,000[6] per metric ton (versus $42,000[7] per metric ton it cost to construct the facility in Akita).

Plant operation costs (including both gasification and incineration) are comprised of:

Labor	$2.9 million
Inputs (fuel, water, etc)	$4.4 million
Gasification Operation	$5.3 million
Interest	$1.6 million
Miscellaneous	$0.7 million

This cost does not include the depreciation of the facility—approximately $6.3 million per annum (Akita City Environmental Department, 2003). (All figures in constant 2003 US dollars.)

Technology and Environmental Facts

The gasification facility is capable of processing a total of 440 tons per day of mixed waste in two identical chambers, (Akita City Environmental Department, 2003). This volume represents approximately 3.4 percent of New York City's needs. In 2003, the gasification facility processed a total of 125,000 tons or 340 tons per day of mixed waste, the majority of which was municipal solid waste (Akita City Environmental Department, 2003).

The facility uses shaft-type gasification technology, one of the few fully-commercialized advanced thermal technologies used for municipal solid waste processing. The waste is passed through a shredder and then fed into a large vertical shaft furnace with a small amount of coke[8]. A small amount of limestone is also added to the feedstock to reduce harmful emissions (Nippon Steel, 2005).

5 Converted from 2003 Japanese Yen at a rate of $1 US to 113 Japanese Yen.
6 30 million yen
7 50 million yen
8 The facility uses approximately 140 pounds of coke per ton of waste processed.

The waste is dried and gasified at temperatures of around 2000 degrees Fahrenheit (Nippon Steel, 2005). This temperature is achieved through the combustion of coke and a portion of the pyrolysis gas, which is a product of the process (Nippon Steel, 2005). The 2003 average solid by-product of 100 tons of feedstock included 11.3 tons of slag and 2.1 tons of metal alloys which are reused, and 2.7 tons of ash which is landfilled (Akita City Environmental Department, 2003). The remaining 85 tons go into the pyrolysis gas.

Akita City negotiated a contract for the sale of the slag and metal alloy, which represents 27 percent by weight of the initial feedstock. The low sale price of $10,000 for the total 2003 slag output indicates that the market for this by-product is not strong (Government Officer of Akita City, personal communication, March 2005). The sale of the slag may be important to ensure that the final amount of waste sent to landfill is as low as possible and may have involved additional incentives to the purchaser. The Slag Standards Committee was formed in 2004 by Japan's Industrial Machinery Association and is currently testing slag samples to provide recommendations for a national standard (H. Kurihawa, personal communication, 2005). The Government of Japan intends to adopt a slag standard in the near future and has now created an Eco-Slag Promotion Center.

Prior to combustion for energy recovery, pyrolysis gases are passed through bag filters to remove particulate matter and associated chemicals, while the combustion of limestone reduces the emission of hydrogen chloride gases (Nippon Steel, 2005). In 2003, the facility generated 52.5 million kilowatt hours of electricity through the combustion of pyrolysis gas producing an income of approximately $1.6 million (Akita City Environmental Department, 2003).

The Emissions Facts:
Flue gas emissions from the facility

CO	0.5-1.3 ppm
NO_X	47-48 ppm
SO_2	3.3-3.9 ppm
Particulate Matter	0.02 g/Nm^3 or less
Dioxins	0.1 ng-TEQ/Nm^3 or less

(Source: Akita City Environmental Department, 2003)

Conclusion

The Akita case study lends itself to an examination of gasification technology and aspects of implementation including siting, planning, financing, construction and operation. The location of this facility in Japan, while reflecting some of the challenges presented in New York, subjects it to a conservative political environment more accepting of government authority. The siting process in this case included some public involvement, but it is important to note that public participation and the political milieu in Japan significantly differ from those that we face in New York City.

Experts consider the decision-making process regarding environmental policy in Japan a consensual process (Reed, 1981); whereas in the US, we expect that initial proposals will be challenged both in the political system and potentially in the courts (Reed, 1981). This indicates that the legislative decision making process in Japan is far less contentious and occurs to a large extent in the bureaucratic arena, which provides a forum for private interests to be conveyed and incorporated (Reed, 1981).

Akita City operationalized the national government policy recommendation to convert from incineration to high-temperature thermal processes. New York City's initiative to develop alternative waste management processes is not directly comparable because it is proactive rather than responsive. However, some relevant observations can be made including the benefits of the siting and consultation processes.

There is little doubt that the siting of the Akita gasification chambers as a replacement for existing incineration chambers minimized public concern. The difficulties currently faced by New York in upgrading existing waste transfer stations indicate that this approach would not completely satisfy public concern. However, siting a facility on city-owned land, which is zoned appropriately for waste management uses, may go some way towards mitigating public outcry.

Statutory requirements for community consultation on this project occurred through the national government subsidies and the prefecture government Environmental Assessment. An initial one month public-comment period following publication of the Environmental Assessment preceded conferences attended by city representatives and representatives of each township within Akita City. This provided a venue for the public to voice their concerns. This approach of early and on-going consultation might be an example that New York City could emulate.

The Nippon Steel shaft-type gasification technology has potential for implementation in or around New York City. This technology suits the mixed waste stream as collected and has the potential to process bulk waste. In 2003, the facility reduced Akita's waste weight by approximately 85 percent[9] (Akita City Environmental Department, 2003). The market for this byproduct remains unclear. It could possibly be used as a replacement for gravel in construction projects but the commercial sale arrangement in Akita does not indicate a strong market. Emissions from the facility are otherwise minimal.

Financing a gasification facility would be a major undertaking for New York given the high capital costs. Akita City's cost per ton exceeds New York City's current transport and landfill costs per ton significantly. However, according to a Nippon Steel engineer, construction costs are decreasing and greater economies of scale are now being achieved. Increasing landfilling costs may make such an investment more attractive to New York City in future.

[9] When 100 tons go through the gasifier, 15 tons come out, so the process reduces the waste 85 percent by weight.

CHAPTER 8: CONCLUSION

Emerging and alternative technologies are a viable partial solution for solid waste management in New York City. The Spanish, Japanese and Canadian cases presented in this report demonstrate that technologies for anaerobic digestion and gasification dispose of waste efficiently and effectively. It is no longer necessary to rely solely on landfilling and incineration as has been proven in major cities around the world.

New York currently relies on out-of-state landfilling and incineration to dispose of all municipal solid waste, a strategy that minimizes local public concern. Public opposition to the proposed Solid Waste Management Plan illustrates the difficulties in siting any waste management facility in New York. Public concerns generally materialize around the negative implications of garbage disposal and the associated odor and traffic. Other cities faced similar siting concerns and applied a range of strategies to successfully win public support.

Successful community relations strategies are characterized by proactive education campaigns, high transparency, and attention to public concerns in facility construction. In Honolulu, Spain and Japan, public awareness regarding solid waste management options significantly minimized opposition to new facilities. In all cases, consultation with communities about the appearance and operations of proposed facilities served to mediate community concerns. Barcelona’s on-site community education programs and award-winning design, and Middletown’s alliance with a prominent environmental group also improved perceptions about the respective waste management facilities. These efforts are part of an inclusive waste management strategy that helps citizens perceive these disposal facilities as environmentally sound. The public learns that these new technologies pollute less than existing waste management methods.

Situating waste management facilities on sites already occupied by municipal utilities or waste management facilities was one way that the cities reviewed in this report dealt with public opposition to siting. In Newmarket, Canada, and Middletown, New York, concerns were further minimized by siting the facilities in smaller communities and providing incentives for these communities such as reduced waste disposal costs.

Implementing a new waste disposal facility would allow New York to control waste disposal costs. The potential for significant increases in tipping fees and landfilling costs presents a financial risk to the city. Although new technologies would require a large initial capital investment, a range of financing options have been used in the cases reviewed and traditional financing methods, such as the sale of general obligation bonds, have been effective. Siting an alternative facility would minimize the city’s exposure to landfill price increases.

Estimated Facility Costs in Constant 2005 US Dollars
(see Appendix II for detailed summary of costs)

	Newmarket, *Anaerobic Digestion*	Honolulu		Barcelona, Ecoparc 2, *Anaerobic Digestion*	Middletown, *Recycling & Ethanol Production Facility*	Akita, *Gasification Plant*
		HMV *Gasification*	HPower *Waste to Energy*			
Tons processed (per year)	150,000	365	600,000	265,000	275,000	160,600
Cost per ton	$39.27	$150*	$50	$48.41	$65	$145-187
Total capital costs	$19.10-$21.23 Million	$1.95 Million	$325.54 Million	$67.75 - 78.90 Million	$150-$285 Million	$187.4 Million
Annual cost of capital	$3.03 Million	NA	$30 Million	$4.44 Million	$7.50-$14.25 Million	$11.44 Million
Operation and Maintenance costs (per year)	$2.87 Million	$200,000	$29.79 Million	$19.35 Million	$19.10 Million	$11.88 Million
Revenue	NA	NA	$26.54 Million	NA	$12.6 Million	$1.69 Million

The above table compares the full capacities and various costs for each of the facilities. The cost per ton is based on the tipping fee charged to municipalities for treatment per ton of waste. This cost includes the input, labor, and maintenance costs, profit to the operator, and the cost of capital; it does not include transportation costs. Depreciation may also mean significant costs for any of the facilities; Akita reported a depreciation cost of $6.8 million in their 2003 Outlook (Akita City Environmental Department, 2003). It is important to note that we have obtained the figures from various sources, including technology vendors, plant operators, and city officials, and that possible variations in accounting techniques exist. It is therefore a recommendation of this report that the City undertake a more detailed cost analysis and comparison to obtain more precise cost data on alternative waste management facilities.

New York City currently pays an average cost of $69.18 per ton for waste disposal and processing (New York City Independent Budget Office, 2004).[10] Because no local disposal options are available, this cost is subject to the instability of rising tipping fees and fuel prices. The cost comparison in this report indicates that alternative technologies, with a range of costs, can be cost competitive, depending on the process and scale of the facility. These technologies are advancing and can utilize economies of scale to reduce the cost per ton of disposal.

Emerging waste disposal technologies are capable of processing the large volume of waste generated in modern cities. The facilities in this study have capacities of up to 275,000 tons per year, which represents approximately twenty per cent of New York's municipal solid waste

[10] The New York City Independent Budget Office February 2004 Fiscal Brief reports the average cost of contract fees, including transportation and disposal, but not collection, to be $64.81 in 2002. We have brought this figure to 2005 dollars.

disposal needs. These reliable facilities have been located in metropolitan areas without odor or emission problems, reducing the need for transport and allowing for reduced levels of landfilling.

The environmental advantages of emerging technologies include recovery of usable byproducts. Most processes can be used to generate electricity. There are established markets for ethanol and high-grade compost produced by hydrolysis and anaerobic digestion. Sale of these products, especially electricity, has the potential to generate revenue. All the processes reduce the need for landfilling and result in fewer environmental hazards than landfilling. Locating a facility closer to New York City will also reduce the air emissions generated by the thousands of miles of waste transport by diesel-fueled trucks.

By actively working to develop community support, it might be possible to site an alternative-technology waste management facility in New York. This would require a proactive approach that took public concern seriously, and provided the public with a direct voice in facility design. Careful attention to environmental equity and justice issues would also be critical. The proposed hydrolysis plant in Middletown, New York, proves that it is possible to secure the necessary environmental permits and public support in New York State. Having an environmental organization as an ally also improves public credibility, while the appropriate decision-making and design processes can address public concerns. It would not be easy, but the result could be a modern, less expensive, less polluting system of waste management.

	Summary
Politics	• Community concerns can be minimized with proactive and ongoing consultation. • Support between government and other organizations is essential to implementation.
Financing	• Public control over infrastructure financing to minimizes the risk of exposure to tipping fees and private financiers.
Siting	• Site by replacing existing municipal waste utilities where possible. • Small towns near the metropolitan area may be given incentives to host a facility.
Technology	• Waste-to-Energy gasification, anaerobic digestion, and incineration are all being successfully used. • Capacities are appropriate for a significant portion New York City's waste stream. • Technologies produce some marketable products.
Environmental	• New technologies maximize resource and energy recovery and minimize land use and emissions.

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APPENDIX I: TABLE SUMMARY OF FINDINGS

	Politics	Financing	Siting	Technology	Environment
Middletown	• Conflict between city and county over control of waste (country controls landfills) • Major involvement and support of Orange Environment (citizens group) • **Formation of Citizens Advisory Board (CAB)** • 24 of 41 Municipalities have signed waste contracts with Masada ($10/ton financial incentive) • PR made presentations to different municipalities • Mayor and city officials indicted during process on unrelated issue • Traditional waste management organizations funded additional opposition through advertising, which swayed public opinion against the project	• Private equity model and a tax-free municipal revenue bond • Lower cost per ton ($65) (vs. $75 for landfilling) • Middletown will receive a $1M/year Host Fee • Masada estimates $100M economic gain for the area • Construction/operation will create up to 600 jobs	• Proposed to be sited on a closed landfill • Proposed location next to a shopping center (point of contention) • Agreed to take care of cleanup costs for site (hazardous waste site)	• Will use acid-hydrolysis technology to convert MSW + sludge + acid to ethanol • Off-the shelf technology, but 1st time combination of MRF/EPF • 90% waste reduction; 10% landfill • use lignin as energy source within facility • recycle acid • Source and site separation • 2 facilities: o MRF (Materials Recovery Facility o EPF (Ethanol Production Facility) o Processes mixed MSW and dewatered sludge	• There is some CO2, NOx and Sox emitted from burning lignin • The (proposed) landfill site possibly contains hazardous waste • Have secured a Title V permit under Clean Air Act

	Politics	Financing	Siting	Technology	Environment
Honolulu	• Waimanalo landfill nearing capacity; associated expansion and new landfill siting issues • **H-POWER expansion: community preferred (city council meetings)** • Distinct lack of community outreach and education • Complaints, but low level of conflict • Recycling initiatives • Change in City Hall administration • HMV exceeded permit limitations • All complaints directed to City Planning and Permitting	• HMV financed through general obligation bonds, sold to a private company, city leases facility • HMV: high cost per ton (estd. $150/ton) • HPOWER: lower cost per ton ($50/ton) • Tipping fees • H-POWER expansion costs • Sale of generated electricity • Metals recovered prior to MSW processing	• H-POWER existing site (1985), on industrial zoned land • HMV on industrial site • Waimanalo Gulch landfill expansion • Search for new landfill site • H-POWER expansion • Feasibility of new technology facility • HMV began operations 1998, located near existing landfill	• HMV non-operational for period of time citing electrode issues • WTE proven technology • WTE doesn't take bulky items • WTE: recycling front end separation • 8% of Oahu's electricity • Syngas in HMV is reused within the process	• Stack emissions to the atmosphere • Ash and slag (both facilities) transfer to landfill • Expansion of Waimanalo landfill (traffic, odor) • H-POWER meets and exceeds environmental requirements • HMV exempt from environmental monitoring • HPOWER produces cleaner power than oil-fired plants (lower emissions)

	Politics	Financing	Siting	Technology	Environment
Newmarket	• No contention before construction of facility • Community wanted to change zoning subsequent to plant construction, opposition to plant arose • Community supported idea of plant, but negative response to odor • Siting was made easier because smaller town • Citizen dissatisfaction with odor and management • Citizens embrace green technology and environmentally friendly alternatives for waste disposal • Major push from govt. to make this work • Taxes to Newmarket made it attractive to public • Ministry of environment logs all complaints (federal-level)	• Financed through private funding from Banks • Low cost ($37/ton) • municipalities to delay entry into the program	• No issues with siting • Sited in Industrial zone • Smaller town: a big plus • Site chosen before technology chosen	• **Source separated waste stream*** • Established source for byproducts (electricity and compost) • Established technology in 26 locations worldwide, in use for at least 8 years • Location on highway helped a lot • 1^{st} plant in North America • Odor problem due to construction flaw (not technology) • Possible problem with ingredient mix	• Biogas produced but converted to electricity • Odor due to construction flaw • AAA-grade compost produced

	Politics	Financing	Siting	Technology	Environment
Barcelona	• Initial opposition from residents in the nearest municipalities • Gained residents' support with use of high-profile architect • Active and aggressive community consultation and involvement • Problems are now only with a farm that is located 165 feet from the facility • Review council served as medium between Metropolitan Environment Agency and the public • $4.2 million spent on PR over 5 years	• Total cost of Ecoparc: $76.6 million • $52 million (67%) from loans given to Ecoparc del Besos (EBESA) • $24.6 million (33%) from the local and federal government • The loans were given by five major banks in Spain, and they expect to generate profit in 10 years • The citizens of Area Metropolitana of Barcelona (33 municipalities) pay a **dedicated tax** for the treatment of municipal residues a part of collection tax, but there is not a special tax for this facility specifically • The cost of exploitation fee is $46. 70 per ton	• The area where the facility is installed had a classification as "area for public facilities" in Spanish is "zona de equipamientos" • It was used as agriculture area but intended for these kinds of facilities • Used high-profile architecture firm to focus on aesthetics of facility	• MSW is pre-processed to remove all recyclables (42% converted to biogas) • There are three digesters, each approximately 54 feet in diameter and 75 feet high. • They are fed once a day and it takes a few hours. • A side stream of biogas is compressed to 5 atmospheres and injected in brief pulses from the bottom of the digester to mix the contents. • Processes 60% Barcelona's waste • Uses Valorga technology, established technology since 1981	• Low emissions • Rejects are sent to a landfill 19 miles from the facility • Biogas converted into electricity • Residual wastewater, treated through de-nitrification • Use compost in public parks • 120,000 TPY landfilled from this facility (50% of process waste)

*Separated in homes

	Politics	Financing	Siting	Technology	Environment
Akita	• National government policy recommendation • Community agreement required by subsidy rules • **Ongoing community meetings with town appointees and city to discuss facility** • Environmental permit process, prefecture level • No community movement against siting	• High cost per ton: $150-200 • Major national government subsidy: $59 million • Municipal bonds: $102 million • Municipal expenditure budget: $13 million	• Sited on existing incinerator site (replaced incineration chambers) • Low opposition • City-owned land	• Off the shelf technology • Mixed waste stream • Source separation of recyclables; site accepts mixed waste, bulk waste; sewerage sludge • Waste reduced 85% by volume • Solid outputs include 11.3% slag, 2.1% metals and 2.7% ash • Contract for sale of slag (nominal charge) • Electricity generated from gas produced	• Low emissions • Some ash residue landfilled • Standards for use of slag are not yet established • No clear use for slag although it is currently being promoted for paving and construction uses

APPENDIX II: TABLE SUMMARY OF COSTS

Estimated Costs (In 2005 USD)

	Newmarket, *Anaerobic Digestion*[1]	Honolulu		Barcelona, Ecoparc 2, *Anaerobic Digestion*	Middletown, *Recycling & Ethanol Production Facility*	Akita, *Gasification Plant*[2]
		HMV *Gasification*	HPower *Waste to Energy*			
Tons processed (per year)	150,000	365	600,000[3]	265,000[4]	274,000 Tons[5]	160,600 Tons
Cost per ton	$39.27	$150[6]	$50[7]	$48.41 [8]	$65[9]	$145-$187[10]
Total capital costs	$19.10-$21.23 Million	$1.95 Million[11]	325.54 Million[12]	$67.75[13]-$78.90 Million[14]	$150-$285 Million[15]	$187.4 Million[16]
Annual cost of capital	$3.03 Million	NA	$30 Million[17]	$4.44 Million[18]	$7.50 – 14.25 Million[19]	$11.44 Million
Operation and Maintenance costs (per year)	$2.87 Million	$200,000[20]	$29.79 Million[21]	$19.35 Million[22]	NA	$11.88 Million[23]
Revenue	NA	NA	$26.54 Million[24]	NA	$12.6 Million[25]	$1.69 Million[26]

*Estimated figures.
[1/] All figures were adjusted for inflation using the following conversion factors: for 1985: 1.82; 2003: 1.06; and, 2004: 1.03.
[2/] Does not include transportation costs.

APPENDIX III: INTERVIEW GUIDE

Hello. My name is _________________. I am a graduate student at Columbia University and I'm working on a project concerning alternative technologies for solid waste disposal in New York City. I'd like to ask you some questions about ________________. I appreciate any information that you can provide.

***For some interviews, it might be advantageous to state your affiliation with EDC.*

***(1) Other Observers** (General Questions for all Interviewees):*

- What is the technical process used at the facility to treat waste?
- Would you make any changes regarding the planning, construction or operation of this facility on a future project?
- Can you make any general or specific suggestions for future development of similar facilities?
- What do you see as the major costs and benefits of this facility?
- What was the greatest challenge faced in planning, constructing, and operating this facility?
- Can you provide me with any written material regarding this facility such as: data, news articles, reports, or presentations?

***(2) Government Officials:** Political, Economic, Social Components*

(A) Political Components

- Is the facility privately or publicly owned and operated?
- How did you involve your constituents in the decision to build this facility?
- Was the public interested in participating?
- What issues generated political support or opposition during siting this facility?
  - What issues arose?
  - What was the degree of support or opposition to the facility?
  - Who were the key stakeholders (participants) and what positions did they take?

    - Was the facility design, operation procedures or location modified in response to community or political concerns?

- How did you and your colleagues arrive at the decision to implement this specific type of facility?

(B) Economic Components

- How much did the facility cost to construct and how was it financed?
    - How much does the facility cost to operate and maintain who pays these costs, and how are revenues collected or obtain to run the facility?
    - How do these costs compare the projected costs of continuing previous practices?
- Are there any byproducts from the facilities that could generate additional revenue?
- How many jobs were created for planning, constructing, operating this facility?
- How many towns, counties, cities, states are serviced by this facility?
- What additional costs are associated with the operation of this plant (i.e. Transportation, Labor, Chemicals)?

(C)Social Components

- What existed in this area (landscape, vegetation, animals, homes) prior to the facility's development?
- Do the local stakeholders consider the facility to be a success and why?
- (Only ask if the interviewee discussed negative public views of the facility.) What was the greatest obstacle to overcome regarding any negative public perception of the facility (regarding siting, aesthetic, environmental, social impacts)?
- Was it necessary to compensate anyone for perceived negative impacts from the facility? If so, how have you compensated individuals within the community where the plant was built (i.e. Community Center, School Donations, Tax Breaks)?

(3) <u>Community Groups:</u> *Social, Technical, Economic Components*

(A) Social Components

- What were your group's primary concerns regarding the construction of this facility?

- Was your group, or the community at large, involved in the planning, development, construction, and operational phases of this facility?
    - If yes, how?

- Do you have any suggestions for a city in the planning phase of an alternative waste management facility?

- What existed in this area (commercial or industrial facilities, landscape, vegetation, animals, homes) prior to the facility's development?

(B) Technical Components

- Are you familiar with the technology used by the facility? Do you know what company built it?

- Do you know who owns or operates this facility?

- Do you know how much waste the facility processes?

- Are there any emissions or effluents released by of the plant's process? What do you believe the impact of these emissions or effluents to be?

- Have there been any operational problems in managing the facility?

    - What were these problems and how were they addressed?

- Do you know of any specific complaints about the facility (i.e. aesthetic quality, traffic, emissions, odor)? Who are the sources of these complaints?

(C)Economic Components

- How has your community been compensated for inconvenience or impact due to the plant's construction or operation (i.e. Community Center, School Donations, Tax Breaks)?

- Do you know if the public is provided with financial information regarding costs or savings from implementation of this facility?

(4) <u>Private Contractors</u>: *Technical and Environmental Components*

(A) Technical Components

- What is the technology employed at the facility?
- How often has this technology been used in other places?
    - How new is this technology?
- What is the capacity of this facility?
- What was the cost to build and/or operate this facility?
- How many jobs were created for planning, constructing, operating this facility?
- What is the perceived "life" of this facility? How long can it operate?
- Could this facility be augmented to integrate future innovations?
- What were the greatest challenges faced in constructing this facility?
- What are the potential dangers (if any) (to the public or workers) of operation?
- Are there any byproducts from the facilities that could generate additional revenue?

(B) Environmental Components

- What are the measurable environmental impacts of the facility?
- What types of emissions or effluents are released by this facility?
- What are the potential environmental or health effects of those by products?
    - How are the impacts measured and audited?
    - How do these impacts compare with previous waste methods?
        - What is the degree of impact from construction/operation?
        - Who (humans, animals, vegetation) is affected?

APPENDIX IV: TRANSCRIPTS OF MAJOR INTERVIEWS

APPENDIX IV a (Hawaii): Interview with Joseph Ryan

E-mail Interview by Karen DiPaulo and Kateryna Wowk

Joseph Ryan
Vice Chair, Waimanalo Neighborhood Board No. 32
Subdistrict 10
P.O. Box 562 96795
Fax: 259-6870
email: ryant003@hawaii.rr.com

[NOTE: Mr. Ryan provided the entire account regarding the (Unisyn) biowaste facility provided within the report's Honolulu chapter, as well as the map of the island of Oahu, which identified the location of Waimanalo Gulch Landfill.]

Q. Is information about alternative technology in waste disposal made available or disseminated to Honolulu's citizens? Are Honolulu's citizens aware of the city government's investigations into alternative waste disposal technologies to address the increasing amounts of solid municipal waste?

A. Frankly, no, but not because of a lack of effort. Again, LULUs (Locally Undesirable Land Uses) will always be NIMBY (Not In My Back Yard) issues. There has been a state effort to publicize the issue with newspaper inserts, implementation of a highly controversial can and bottle recycling program, and the Waimanalo gulch expansion issue. There have also been proposals at the county level to ship garbage to Kent, Washington, to site a landfill in an affluent part of the island, and to construct an interim landfill on a small site in Campbell Park next to the ocean. The owners of the biowaste processor (noted within the report) also proposed to site another similar facility over a major drinking water aquifer. The proposal was defeated.

APPENDIX IV b (Hawaii): Interview with Jan TenBruggencate

E-mail Interview by Karen DiPaulo and Kateryna Wowk

Jan TenBruggencate
Honolulu Advertiser
Kaua'i Bureau Chief
Phone: (808) 245–3074
Fax: (808) 246–9107
jant@honoluluadvertiser.com

[NOTE: Rather than addressing questions regarding the Hawaii Medical Vitrification facility, H-POWER, and Waimanalo Gulch Landfill individually, Mr. TenBruggencate provided the following information in paragraph format.]

COMMUNITY REACTION:

- I haven't heard any complaints about medical vitrification facilities from anyone.
- Lots of discussion at public hearings and in newspapers about alternative waste disposal technologies. I'm afraid I can't speak to the concerns of Honolulu citizens about them.
- There are some HPOWER issues, primarily dealing with the potential toxicity of the ash, which needs to be landfilled.

BYPRODUCTS:

- I am not aware that there are alternative uses for the ash. I don't think it can be used as soil amendment.
- Unsure if it can be used in making concrete, for example. As for your detailed questions about HPOWER, I haven't looked into it recently, and don't have updated info.

WAIMANALO:

Community Reaction

- Specific complaints about Waimanalo include dust, flies, smell and the perception that landfills are dumped on areas that are economically depressed, and the folks of that part of the island are tired of being dumped on.
- Not sure how valid the dust, flies and smell are as complaints, but the last is a recurrent concern. It's not clear to me that the community feels it has been compensated for putting up with the landfill.

Siting

- The industrial park is an industrial park, and I don't believe anyone was compensated for that inconvenience. I think Campbell Industrial Park was sugar fields before being an industrial park, but it was an industrial park already before the waste disposal facilities got there.
- Last I heard, the City Council in 2004 voted to expand the landfill at Waimanalo Gulch in preference over other sites. But a campaign promise of current mayor Mufi Hannemann was to close it by 2008. Don't know how that will work itself out.

APPENDIX IV c (Hawaii): Interview with Scott Q. Turn, Ph.D

E-mail Interview by Karen DiPaulo and Kateryna Wowk

Scott Q. Turn, Ph.D.
Associate Researcher
Hawaii Natural Energy Institute
School of Ocean and Earth Science and Technology
1680 East-West Rd., POST 109
University of Hawaii
Honolulu, HI 96822
email: sturn@hawaii.edu
Phone (808) 956-2346; Fax: (808) 956-2336

Q. What is the perceived "life" of the H-POWER facility?

A. Life is largely determined by economics. Although I don't have experience with waste fueled power plants, many other types are repaired on an annual basis and can keep going almost indefinitely. Consider the cost of siting a new plant against the cost of maintaining an existing one.

Q. What are the measurable environmental impacts of the facility?

A. Stack emissions to the atmosphere is the obvious one. All stationary sources in the state must undergo annual stack emission compliance tests and this falls under the jurisdiction of the State Department of Health I'm not sure how water use and discharge are managed at HPOWER. I would expect that both are serviced by City water and sewerage utilities. The solid, non-combustible residue removed from the grate is sent to the land fill.

Q. Do you know of any specific complaints about the facility (aesthetic quality, traffic, emissions, and odor)? Who are the sources of these complaints?

A. Not specifically.

Q. Are there any byproducts from the facility that could generate (additional) revenue?

A. Electricity is generated and sold and metals are recovered from the MSW prior to use in the power plant. The other grate residues may be used for such things as road building aggregates but to my knowledge they are not permitted for this purpose at present.

Q. Have there been any operational problems in managing the H-Power facility? If so, what were these problems and how were they addressed?

A. I'm sure there are issues; ash vaporization and fouling of heat transfer surfaces are common problems in RDF facilities and these are addressed by periodic maintenance.

Q. There has been some talk of expanding the Waimanalo Gulch Landfill to increase landfill capacity. Is this still a consideration? Do you recommend it?

A. My understanding is that the city is seeking permission to expand Waimanalo Gulch again.

Q. The Hawaii Medical Vitrification (HMV) has been in operation for several years. Have there been any environmental, operational or political issues regarding the facility; i.e. has it operated successfully?

A. They were recently fined for storing more waste on site than is allowed by their permit. …The reason for the excessive amounts of stored material was that the facility was not operating. Otherwise I know of no other problems.

Q. Given that plasma arc gasification was found to be unfeasible, what "proven" waste disposal technology methods do you think the City will consider with the new RFP? Why? What benefits will be realized with such technology (environmental, economic, etc.)?

A. It's always a balance between cost and everything else. We already pay what is probably one of the highest tipping fees in the country for solid waste disposal. I think they will look at expanding HPOWER and will consider other technologies but will require that they be proven at sufficient scale to satisfy concerns about long-term, steady, dependable operations. To all this I add the caveat that we've had a change in administration in City Hall and that plans developed under the previous mayor may not be continued by the current administration. Stay tuned.

APPENDIX IV d (Akita): Interview with Mr. Suzuki

Summary Translation of Email from Mr. Suzuki, Project Manager, Nippon Steel, Tokyo

Email interviews on February 24 and 25, 2005 by Kazuhiko Muto and Palitja Woodruff

NIPPON STEEL GASIFICATION HISTORY:
Construction costs

- 50 million yen/tonne/hour
- depending on design capacity of facility
- new cost reduced to 30 million yen/tonne/hour

Operation costs

- 15,000 yen/tonne

Operating staff for Akita gasification component

- 30 people

Facility life

- Approximately 20 years
- First chamber constructed lasted 26 years

Maximum capacity limit of technology

- 300 tonnes/day

Emissions

- CO_2 emissions are relatively high due to the use of coke, however, the magnitude of the difference is not significant especially in comparison to other facilities that use oil.
- Dioxin emissions are approximately 10% of the national standard
- Limestone reduces the HCl, SOX and NOX emissions

Additional Information

- "Nippon Steel has had no trouble and no disasters for 25 years. There have been no concerns, hazards, gas odors, or noises experienced by residents."

APPENDIX IV e (Akita): Interview with Anonymous Contact

Summary Translation of Email from (the contact asked to remain anonymous), Akita City, Environmental Department, General Division

Telephone and Email interviews on February 14, 2005 by Kazuhiko Muto and Palitja Woodruff

This anonymous contact was responsible for the construction of the Akita City gasification plant.
Date: 14 February, 2005, 4.00pm JST

CASE INFORMATION

- Ownership: Akita City
- Operation, general: Akita City
- Operation, gasification chamber: Nittetsu Kankyou (subsidiary of Nippon Steel)

TECHNOLOGY SELECTION PROCESS:

- Committee established within the Environmental Department
- Chaired by Director of Environmental Department

SITING AND PERMITTING:

- Environmental Impact Assessment prepared in accordance with National Waste Management Law
- Consent of local residents is not officially required
- A subsidy from the national government required some consultation/negotiation with the community
- Biannual conference with city government and local residents to discuss the facility

CONSTRUCTION COSTS:

- JPY 20 billion, approximately USD 200 million
- Funded through national government subsidy and local government bond issue

OPERATION AND MAINTAINANCE COSTS:

- Covered by Akita City budget
- Household disposal is free
- Minor income stream from commercial waste disposal
- Minor income stream from electricity generation approximately USD 1 million/year

PRODUCT USE:

- Slag and Metals sold to private companies for approximately USD 10,000/year
- Deal may have included additional incentives to purchase waste by-product

[1] Integrated Solid Waste Management Plan for the County of Hawaii, December 2002. Retrieved from http://www.hawaii-county.com/env_mng/iswmp_final/appendixe.pdf

[2] Akita City Environmental Department. Outlook Statement 2003.

[3] HPOWER. 2004. "About HPOWER: Keeping Oahu Clean & Beautiful by Recycling Waste into Energy". Retrieved February 11, 2005, from http://www.honoluluhpower.com/About.asp

[4] Entitat del medi ambient, 2004. "Technical Script. Ecoparc 2, Pensem en positiu."

[5] The New York Department of Environmental Conservation Website, March 2005. "ENB Region 3 Completed Applications 03/16/2005, Orange County." Retrieved March 24, 2005 from http://www.dec.state.ny.us/website/enb2005/20050316/Reg3.html

[6] Estimate based on phone interview with Asia Pacific Environmental Technology on March 8, 2005

[7] Smith, Rodney. Facility Finance Director, HPOWER. Phone Interview, March 15, 2005.

[8] Entitat del medi ambient, 2004. "Technical Script. Ecoparc 2, Pensem en positiu."

[9] Judge, Tim. Estimation based on Phone Interview., February 2005.

[10] Estimate based on annual capital costs and operation and maintenance costs divided by the number of tons processed.

[11] Ueno, Thomas. Assistant to S. Y. K. Liu, Director Hawaii Medical Waste Vitrification Facility. email interview, April 6, 2005.

[12] HPOWER. 2004. "About HPOWER: Keeping Oahu Clean & Beautiful by Recycling Waste into Energy". Retrieved March 2, 2005, from http://www.honoluluhpower.comFAQ.asp#7. Conversion factor for 1985 dollars: 0.556.

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[16] Includes subsidies, municipal budget, and 15-year bonds with a 3% interest rate.

[17] This cost includes interest rates on capital. Obtained from Rodney Smith, Facility Finance Director, HPOWER. Phone Interview, April 7, 2005.

[18] Estimation based on capital costs and a 15 year useful life. Obtained from Javier Cerezo, Ecopark Manager, personal communication, April 2005. Converted from Euros using a conversion factor of 1.31.

[19] Judge, Tim. Estimation based on Phone Interview., February 2005.

[20] Estimation based on comparable facility's operating costs

[21] Cost includes salaries, fringe benefits, and contractual services. Refuse Division, Department of Environmental Services, Honolulu, Hawaii, 2004, "Solid Waste Integrated Management Plan", Attachment D, Table 6, p. 22.

[22] Javier Cerezo, Ecopark Manager, personal communication, April 2005. The greatest proportion of this cost comes from disposing of the facility's rejection: $8.76 million.

[23] Includes operation, inputs, and labor.

[24] Electricity sales in 2005 USD. Obtained from: TenBruggencate, January 2003. "H-POWER plan would boost O'ahu's trash capacity" The Honolulu Advertiser. Retrieved February 5, 2005, from http://the.honoluluadvertiser.com

[25] Estimate based on 7.1 million gallons of ethanol (New York State DEC, Title V permit, ENB Region 3 Completed Applications 2005) at a price of $1.80 per gallon (Tim Judge, personal communication, 2005).

[26] Electricity sales in 2005 USD.