Report

Hunts Point Anaerobic Digestion Feasibility Study

Prepared for the
New York City Economic Development Corporation

July 2010

R·W·BECK
An SAIC Company

Prepared in Association with:
DSM Environmental Services, Inc.
and
R.S. Lynch & Company

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EXECUTIVE SUMMARY

R. W. Beck was retained by the New York City Economic Development Corporation ("NYCEDC") to investigate the feasibility of developing an anaerobic digestion facility ("AD Facility") in the Hunts Point Food Distribution Center ("FDC") area of the Hunts Point peninsula ("Study"). Situated on 329 acres, the FDC is among the largest food distribution centers in the world. The FDC is the site of New York City's ("NYC") major wholesale markets, including the Hunts Point Cooperative Market ("Meat Market"), the New York City Terminal Produce Market ("Produce Market") and the New Fulton Fish Market at Hunts Point ("Fish Market"). As the FDC is located entirely on NYC-owned property, NYCEDC, on behalf of NYC, administers long-term leases to these and other food-related businesses. NYCEDC currently anticipates that the AD Facility would be developed and operated by a private entity (the "AD Developer") in cooperation with the NYCEDC.

NYCEDC, as administrator of the FDC, is currently exploring a number of development projects at the FDC. Among these is the AD Facility, which is being studied in coordination with the Hunts Point Vision Plan (http://www.nycedc.com/ProjectsOpportunities/CurrentProjects/Bronx/HuntsPointVisionPlan/Pages/HuntsPointVisionPlan1.aspx) and PlaNYC (www.nyc.gov/planyc2030). The AD Facility is consistent with the NYC Solid Waste Management Plan component that addresses the testing of technologies which produce energy from solid waste.

This Study was preceded and informed by the Hunts Point Food Distribution Center Organics Recovery Feasibility Study dated December 30, 2005 ("Organics Recovery Feasibility Study"). The Organics Recovery Feasibility Study concluded in part that:

1. Anaerobic digestion ("AD") was more advantageous, as compared to composting, for an organics recovery project at Hunts Point,
2. It would be unreasonable to expect the organic waste generators at the FDC to source separate their organic waste,
3. There are an estimated 27,400 tons of waste generated at the Fish Market and Produce Market each year that are suitable for disposal at the AD Facility, and
4. Under some specific financing circumstances the AD Facility would be profitable while offering competitive disposal prices.

The objectives of this Study, which built upon the results of the Organics Recovery Feasibility Study, were to:

1. Identify and characterize additional potential waste sources on the Hunts Point peninsula,
2. Screen various biogas use options and select three for detailed analysis,

3. Evaluate potential project sites and estimate the extraordinary costs of site development,
4. Document the environmental regulatory framework and permitting process,
5. Identify the potential environmental benefits related to the AD Facility development, and
6. Analyze the financial feasibility of developing the AD Facility under three different potential biogas use scenarios.

AD is a natural microbiological process in which bacteria decompose organic material in the absence of oxygen. The AD process produces a biogas that consists primarily of methane, carbon dioxide and water vapor. The nutrient-rich material that remains is called digestate (a fibrous byproduct and water). The digestate can be used as a fertilizer or soil amendment and is often de-watered and composted before shipment as a product. AD facilities control and enhance the decomposition process to maximize efficiency, manage byproducts and control odors.

AD is best suited for the treatment of moisture-rich organic waste such as waste from wholesale food markets, restaurant waste and food processing waste. Within a controlled and managed facility, AD can be utilized to both divert waste from increasingly space limited landfills and as a source of two valuable renewable byproducts - “green” energy and a soil amendment.

Waste Stream Identification and Characterization

The Study included tasks related to identifying additional sources of waste beyond those previously identified in the Organics Recovery Feasibility Study. Four potential additional sources of organic waste on the Hunts Point peninsula were evaluated:

- Increases in generation at the Produce Market or the Fish Market subsequent to 2005 when the Organics Recovery Feasibility Study quantified waste availability;
- Additional organic waste from sources on FDC Drive that were not involved in the Organics Recovery Feasibility Study;
- Additional organic waste from the growing number of smaller, independent, food distribution companies located near FDC Drive; and,
- Organic wastes transported to the Hunts Point peninsula from other areas of NYC.

Previously 27,400 tons per year (“TPY”) of organic-rich waste was identified for potential disposal at the AD Facility. This Study identified an additional 37,600 TPY of organic-rich waste for potential disposal at the AD Facility. An assumed organic-rich waste flow of 60,000 TPY was used to analyze project feasibility.

Waste sorts and visual observations of the waste were employed to characterize the potential waste stream. Newly obtained data was combined with data obtained during the Organics Recovery Feasibility Study to estimate the composition of the waste currently.

The source of the waste would likely be the various wholesale food markets in the FDC area and commercial collection vehicles containing organic-rich loads of commercial municipal solid waste. The commercial collection vehicles are transporting waste for transfer at the Metropolitan Transfer Station, which is directly adjacent to the FDC. Waste generators are not expected to modify their existing waste management practices to produce a waste stream containing exclusively digestible organic waste. As a result the AD Facility must be capable of handling waste that contains non-digestible materials

For the purpose of the economic analysis the composition of the waste received at the AD Facility was assumed to be:

Meat and Fish Waste:	20%
Other Food Waste (mostly vegetative):	40%
Corrugated Cardboard and Other Paper:	20%
Wood:	10%
Plastic and Other Non-digestible Waste:	10%

These composition percentages are estimates based on several sources of data and analysis including previous studies, limited field sort data, and generator survey information.

Biogas Production

The AD of organic material results in the generation of biogas and digestate. Both the biogas and the digestate are typically refined in post-digestion processes which depend upon their intended use. Biogas contains primarily methane, carbon dioxide ("CO_2"), and water vapor. It also contains compounds such as hydrogen sulfide ("H_2S"), siloxane and ammonia, which need to be removed from the biogas. Digestate is the material remaining at the conclusion of the digestion process. The relative quantities of biogas and digestate depend upon two primary factors -- the characteristics of the feedstock and the type of digestion process employed. For the purpose of estimating the energy production of the AD Facility, based upon input from technology providers and operating data from the AD plant in Toronto, Canada, a biogas generation rate of 120 normal cubic meters ("ncm") per metric ton of waste received was assumed. Assuming the AD Facility receives 60,000 TPY of waste, the digestion process will produce approximately 230 million standard cubic feet ("scf") of biogas per year.

Energy Production and Use Options

This Study was preceded by the Hunts Point Food Distribution Center Energy Strategy Plan – Phase 1 ("Energy Strategy Plan"). Information contained in the Energy Strategy Plan was used in this Study to evaluate the potential for use of the energy produced by the AD Facility at the FDC facilities.

R. W. Beck performed a high-level evaluation (screening analysis) of the following eight biogas use scenarios in order to select three scenarios for a more detailed evaluation:

1. Biomethane production for use within FDC;
2. Biomethane production for introduction into the natural gas distribution system;
3. Steam production for use within the FDC;
4. Electricity production for use within the FDC using reciprocating engines;
5. Electricity production for export to the power grid using reciprocating engines;
6. Electricity production for use within the FDC using gas turbines;
7. Electricity production for export to the power grid using gas turbines; and
8. Biofuel production for use as a vehicle fuel.

The screening criteria established to evaluate the various biogas use options were:

1. Viability and strength of the associated energy market;
2. Environmental and social impacts;
3. Regulatory and institutional hurdles;
4. Technical complexity and degree of commercialization; and
5. Likelihood of being the low cost option.

The following three scenarios were selected for technical and financial evaluation.

- Biomethane production for introduction into the natural gas distribution system;
- Electricity production for export to the power grid using reciprocating engines; and
- Biofuel production for use as a vehicle fuel.

Facility Site

Three potential sites were evaluated as part of this Study. These sites are Site D, Site AOU2, and the Marine Transfer Station ("MTS") Site, as shown on Figure ES-1. The evaluation focused on determining the extraordinary site preparation costs associated with developing the AD Facility.

All three evaluated sites share some important attributes which affected the extraordinary site development cost estimates. The sites are within or immediately adjacent to areas subject to tidal action and flooding. Each of the sites includes disturbed soil strata and each has been (or will be) remediated or cleared of existing vegetation and structures.

Both Sites D and AOU2 contain residual waste related to former activities at a manufactured gas plant that existed in the vicinity of the site. These wastes include coal tar wastes and purifier-type waste. These sites will require remediation prior to the development of the AD Facility.

The MTS Site and Site D are waterfront sites and will require modification of the waterfront structures and importation of select fill to raise a portion of the site. It is

expected that on all three sites driven piles will be required for the foundations of the vertical structures. Piles will need to be protected from corrosion by any purifier-type waste that might remain following the remediation.

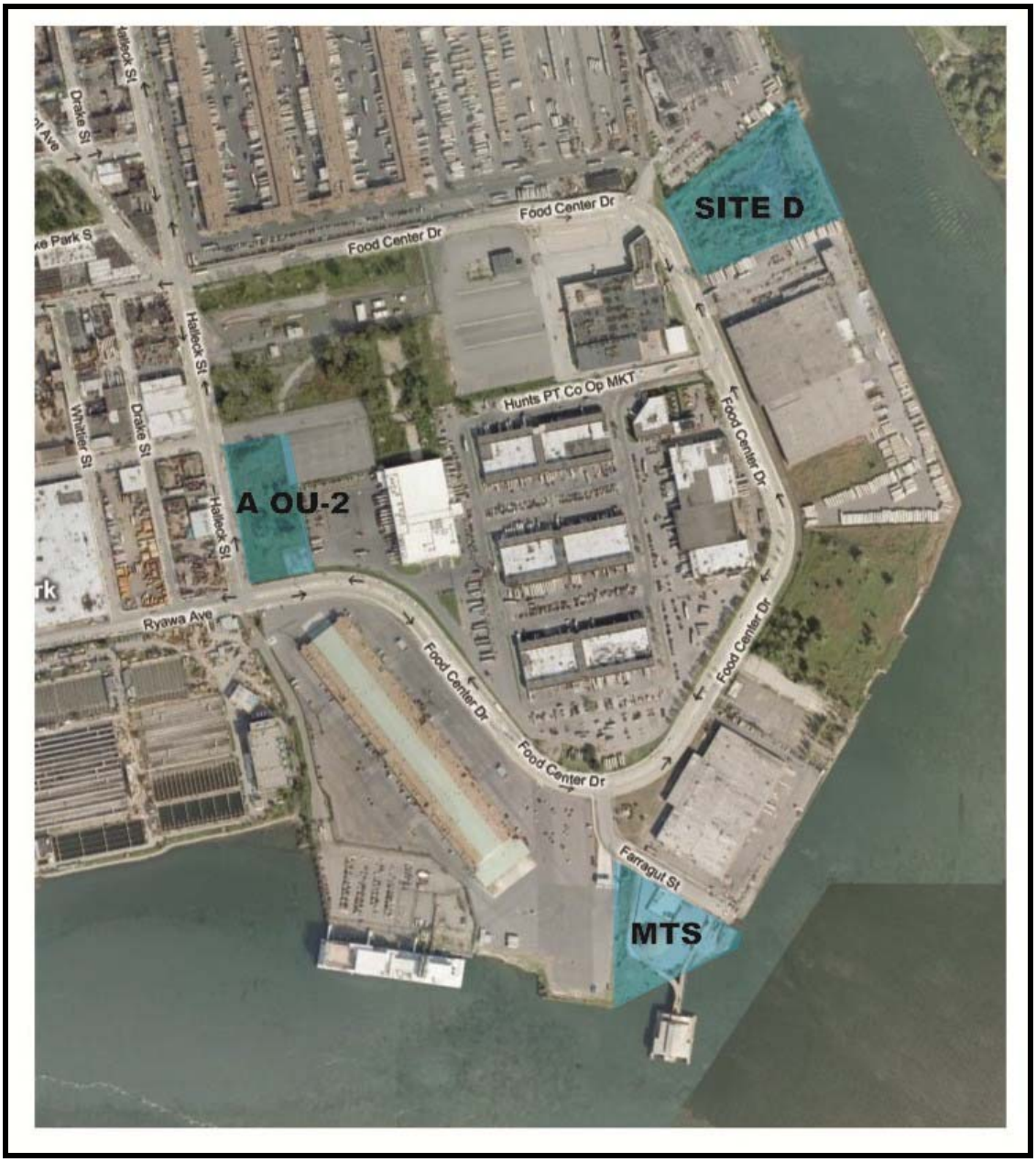

Figure ES-1. Hunts Point Site Map

Regulatory Framework and Permitting

The Study identified the regulatory framework and permitting required for the proposed AD Facility, with focus on the solid waste and AD aspects of the AD Project. The local, state and federal regulations and permits were identified which

may be applicable to the AD Facility. The AD Developer should anticipate pre-application meetings with the appropriate regulatory agencies to discuss project objectives and to identify specific permitting requirements. Although not an exhaustive list, the following permits and approvals were identified as likely to be applicable:

- State Environmental Quality Review Act ("SEQRA")
- City Environmental Quality Review ("CEQR")
- Part 360 Solid Waste Permit
- Air Permits
- Environmental Justice and Permitting compliance
- Stormwater Permits

Environmental Benefits

AD facilities provide a variety of environmental benefits which, given the proper design and a steady organics supply, offer a sustainable approach to waste management for the organic fraction of the waste stream. These environmental benefits include:

- A reduction in the number of trucks transporting waste on the Hunts Point peninsula,
- The production of renewable energy,
- An overall reduction in greenhouse gases,
- The conservation of landfill space, and
- The production of soil amendment from a renewable resource.

Waste Supply and Disposal Costs

The management of commercial waste in NYC is a private activity undertaken by private collection companies often referred to in NYC as "carters." The Business Integrity Commission ("BIC") is a regulatory and law enforcement agency that oversees the private sanitation industry and the public wholesale markets in NYC. Every commercial establishment in NYC is required by law to have its waste removed by a private carting company. BIC sets the maximum rates that private carters can charge for waste removal services.

It is unlikely that the AD Facility can be developed without one or more creditworthy entities guaranteeing the delivery of waste to the AD Facility at specified disposal fees. A number of AD Developers were contacted during this Study and they all indicated that waste delivery guarantees would be required. Although the quantity of waste under guarantee may not have to be the full capacity of the AD Facility, it will have to be a sufficient quantity of waste to assure the financial community that there

will be sufficient project revenues to pay the debt service and provide the expected return on equity.

The guarantees could be provided by waste generators, waste haulers or a government entity. The WTE facilities developed in the 1980s and 1990s typically required waste delivery guarantees and serve as a good example of the concept. The vast majority of the WTE facility financings were structured with a governmental entity guaranteeing the waste disposal revenues. There is no "rule of thumb" that provides guidance with regard to the percentage of the anticipated waste revenues that must be guaranteed.

Potential waste suppliers were interviewed to address this key element of a successful project development. Meetings were held at the Produce Market, the Meat Market and the Fish Market in an effort to better understand the potential for waste guarantees as one of the key components for any long-term financing. A meeting was also held with Sanitation Salvage, partial owner of the Metropolitan Transfer Station, and the contract hauler for the Fish Market. Securing a long term commitment for the delivery of waste from these markets is likely to require the continued active involvement of NYCEDC.

Key to determining the feasibility of the AD Facility will be the ability to charge relatively stable tipping fees at the AD Facility that are competitive with tipping fees at alternative transfer stations. Projections of future tipping fees are difficult to make, especially at this time of such economic uncertainty. NYC currently pays $90.97 per ton for waste disposal at the Harlem River Yards transfer station under NYC's long-term contract with Waste Management. The waste delivered to the Harlem River Yards transfer station under NYC's long-term contract is primarily residential waste generated in the Bronx; a limited amount is institutional or commercial waste for which NYC has disposal responsibility. By comparison, the reported rate for disposal of Fish Market waste at the Metropolitan Transfer Station was roughly $78 per ton in December of 2009. An additional point of reference are transfer stations in northern New Jersey. The statewide average for New Jersey is currently $81 per ton (October 2009) based on tipping fees reported to New Jersey Department of Environmental Protection. Based upon this information, a tip fee at the AD Facility of $80 per ton (escalated from 2009) was assumed.

Waste Processing Area and Digestion System Cost

The AD Facility is likely to consist of a number of different buildings, processes and systems including the following:

- Waste Receiving Building and Storage Area
- Waste Processing and Preparation
- Digestion
- Digestate Dewatering and Curing
- Biogas Treatment
- Wastewater Treatment

- Energy Production
- Odor Control

During the development phase of the project, a preliminary design for the project site and each of the facility buildings and systems will be developed. There are numerous proven AD technologies available to an AD Developer. Different AD Developers are likely to take different approaches to the facility design and use different technologies. Some of the differences will be driven by the AD process that is chosen. Some will be driven by the anticipated markets for the digestion byproducts.

In order to develop an estimated range of capital costs for the AD Facility, AD system suppliers were contacted and requested to submit cost information on a confidential basis. The submitted cost estimates were reviewed, adjusted as appropriate to account for project specifics and used on an aggregated basis. The adjusted estimates ranged from $20 to $45 million. These were planning level estimates and the actual cost of the AD Facility could vary significantly from these estimates. To be conservative, a cost for the AD system of $40 million was used in the base case to evaluate project feasibility. The sensitivity analysis that was conducted included evaluating the impact of capital costs on the overall project economics.

Environmental Attributes

The environmental attributes and tax credits listed below were considered in the economic analysis.

- Carbon Emission Reduction Credits (“Carbon Credits”)
- Renewable Energy Credits (“RECs”)
- Section 45 Renewable Energy Tax Credits and new Accelerated Depreciation options (“Tax Credits”)

Tax Credits that are established in the Emergency Economic Stabilization Act include both Investment Tax Credits (“ITC”) and Production Tax Credits (“PTC”). While revenue from the sale of Carbon Credits and RECs can be realized by both public and private project owners, the financial value of the project’s Tax Credits can only be realized by a private, taxable entity. The Tax Credits can only be fully maximized by a private owner who has other, non-project related taxable income against which it can apply tax losses in excess of project-generated taxable income. Furthermore, Section 45 Federal Tax Credits are only available to electric generation facilities.

Revenue and Expense Projections

Revenues and expenses were estimated for the AD Facility based on the three difference biogas use scenarios – electricity production, biomethane production and vehicle fuel production. The revenues and expenses related to waste processing and AD are the same in all three scenarios. In addition to evaluating the overall financial feasibility of the project, the economic analysis enabled the comparison of the three

biogas use scenarios under differing assumptions for key variables such as capital cost, operating cost, tip fee and energy prices.

Revenues and expenses were projected over a 20-year operating period and the net cash flow was calculated. The 20-year net present value ("NPV") of net cash flows was used to compare the three biogas use scenarios and as the metric used in the sensitivity analysis.

Economic Analysis Results

The economic analysis indicates that electricity production is the most feasible biogas use scenario. This result is primarily driven by the following factors:

- The electricity production scenario had the lowest estimated capital cost.
- The electricity production scenario had higher energy revenues than the biomethane production scenario and essentially the same energy revenues compared to the vehicle fuel production scenario.
- RECs and New York State Energy Research and Development Authority ("NYSERDA") grants only apply to electric generating facilities and, therefore, do not benefit either the biomethane production or vehicle fuel production scenarios.

Under the base case assumptions and cost estimates the biomethane production scenario also appears to be feasible. The vehicle fuel production scenario appears only to be feasible using a non-traditional financing structure such as grants or the advanced purchase of energy or disposal services by NYC. The vehicle fuel sale scenario appears to be more feasible than the biomethane scenario due to the relatively low current cost of natural gas. Government incentives to encourage compressed natural gas ("CNG") use by vehicles are being considered and could improve the feasibility of this option.

Specific Financing Arrangements

Five alternative project financing structures were identified and evaluated. Numerous combinations of these financing features may be considered by an AD Developer. In addition to a public ownership structure, four private ownership project finance structures were analyzed to demonstrate the impact of the various financing features on the economic feasibility of the project. The five project finance structures analyzed were:

- Public Ownership / General Obligation Bonds
- Third-Party Tax Equity Investor Utilizing the ITC
- Third-Party Tax Equity Investor Utilizing the ITC with Prepaid Revenue
- 80/20 Private Debt/Equity and PTC
- 80/20 Tax Exempt Solid Waste Revenue Bonds/Equity, and Grant or Prepaid Revenue

While all five of these financing structures are applicable to the electricity production scenario, ITCs are not applicable to either the biomethane or vehicle fuel production scenarios. The resulting 11 combinations of biogas use scenarios and project financing structures were analyzed using a 20-year life cycle analysis. The input variables to the analysis were capital cost and net cash flow available for debt service and investor return on equity. The analysis shows that when using the base case assumptions a number of the financial structures result in a feasible project.

Sensitivity Analysis

In order to understand the impact that various key assumptions have on project feasibility, a sensitivity analysis was performed by varying the model inputs for ten of the key parameters.

For purposes of the sensitivity analysis, the public debt financing structure was used since it was the only financing structure common to all biogas use scenarios. The net cash flow after debt service was calculated for each year in the 20-year analysis period and the net present value of those cash flows was used to evaluate the impact of a change in the variable being evaluated.

The sensitivity analysis reveals that the most important factors effecting financial feasibility are:

- Capital Cost
- Operating Cost
- Tip Fee and the Tip Fee Escalation Assumption
- Grant Funding Availability
- Willingness of NYC to Prepay for Disposal Services or Energy

The amortization of the AD Facility capital cost in the base case economic projections is larger than the total operating expense and is roughly 50 percent of the total revenues. The planning level cost estimates for the AD system portion of the capital cost obtained from AD Developers ranged from $20 to $45 million; $40 million was used in the base case economic projections. If this cost were $30 million, all of the biogas use scenarios would be feasible.

A variation in the operating costs can significantly impact project feasibility since the base case results show that the net cash flow is relatively low as a percentage of revenue.

Tipping fee revenues represent approximately 60 percent of the total revenues in the base case economic projections and are a major factor in the feasibility analysis. The base case included an assumed tip fee of $80 (in 2009). At a $70 tip fee the AD Facility does not appear to be feasible unless one of the other factors changed in a positive manner.

Although tip fees have declined recently, they have historically increased at a rate greater than the general inflation rate. The base case economic projections assume that both the general inflation rate and tipping fee escalation rate are 3 percent per year

over the 20-year analysis period. If tipping fees were to escalate at a rate of 4 percent or more, the project would be feasible for all biogas use scenarios.

Grant funding can have a significant positive impact on the feasibility of the project since the grants would be used to reduce the capital cost and the resultant debt service. The assumed maximum NYSERDA assistance of $1 million per project is not large enough to have a major impact on economic feasibility. Larger grants, such as the grants currently available for projects as a result of the American Recovery and Reinvestment Act of 2009, would greatly improve the feasibility. The AD Facility would only be eligible for these larger grants if new legislation extended the current deadline for construction initiation.

Financial Feasibility

The financial feasibility analysis identified a variety of scenarios and assumptions which result in the AD Facility being feasible on the Hunts Point peninsula.

Electricity production is the biogas use scenario most likely to be financially feasible. This scenario generates larger net cash flows for an AD Developer due to factors that include:

- Tax Credits
- Environmental Attribute Sales
- Lower Relative Capital Costs
- Higher Relative Energy Revenues

The vehicle fuel production scenario also appears to be feasible, especially if NYC makes a commitment to purchase the fuel. The biomethane scenario would only be feasible if one or more of the base case assumptions changed in a positive manner.

A relatively new financing structure, one in which NYC makes a prepayment for either waste disposal services or energy at the time of the financial closing, would benefit the project by effectively reducing the cost of capital and making the project more financially feasible.

Conclusions

The Hunts Point Anaerobic Digestion Feasibility Study was conducted by the R. W. Beck Project Team in support of NYC's ongoing efforts to develop an AD Facility to process the organic-rich waste generated on the Hunts Point peninsula. The primary findings are as follows:

- The previously performed Organics Recovery Feasibility Study determined that the Produce Market and the Fish Market generated approximately 27,400 TPY of organic-rich waste that could be processed at the AD Facility. This Study identified approximately 37,600 TPY of additional organic-rich waste as being potentially available for processing at the AD Facility. It should be noted that these waste flows may vary considerably on both a daily and seasonal basis. For the purposes of the economic analysis, 60,000 TPY of waste was assumed to be

processed at the AD Facility and 80 percent of that waste was considered to be digestible. The potentially available waste is currently either generated on the Hunts Point peninsula or delivered by carters to the Metropolitan Transfer Station, which is directly adjacent to the FDC.

- It is unlikely that the AD Facility can be developed without one or more creditworthy entities guaranteeing the delivery of waste to the AD Facility at specified disposal fees. A number of AD Developers were contacted during this Study and they all indicated that waste delivery guarantees would be required. Although the amount of the waste supply that must be guaranteed cannot be determined until the project is further developed, it is likely that most of the capacity of the AD Facility will need to be subject to the delivery guarantees. Waste delivery guarantees could be provided by waste generators, waste haulers or a government entity.
- The AD Facility is projected to generate biogas at the rate of 440 standard cubic feet per minute ("scfm") with an energy content of approximately 600 British thermal units ("Btu")/standard cubic feet ("scf") ("Btu/scf"). The energy value in the biogas produced is equal to approximately 1 million gallons of diesel fuel. An AD Facility using the biogas to produce electricity is estimated to have the capability of generating, net of on-site use, an average of 1,500 kilowatts ("kW').
- The biogas, a renewable energy source, can be used in a variety of different ways. Eight energy use scenarios were subjected to a screening analysis to determine which three were most likely to result in a feasible project. The screening analysis ranked each of the scenarios in the following five areas:
  - Viability and strength of the associated energy market;
  - Environmental impacts;
  - Regulatory and institutional hurdles;
  - Technical complexity and degree of commercialization; and
  - Likelihood of being the low cost option.

  The energy use scenarios selected for detailed evaluation were:
  - Electricity production for export to the power grid;
  - Biomethane production for introduction into the natural gas distribution system; and
  - Biofuel production for vehicle use.
- Three potential sites were identified by the NYCEDC as possible locations for the AD Facility. All three are either: (1) located in a Federal Emergency Management Agency ("FEMA") flood zone, (2) require remediation or (3) both. For purposes of this Study, it was assumed that site remediation costs would not be the responsibility of the AD Developer. The three sites were evaluated to determine the extent to which an AD Developer would experience extraordinary site development costs due to either the remediation impacts or their flood zone location. Extraordinary costs that were identified included:

- Modification of waterfront structures to protect the AD Facility from erosion during storms;
- Importation of fill to raise the base elevation of the site;
- Soil stabilization additives; and
- Corrosion resistant piles for foundation support.

The planning level estimates of the extraordinary costs ranged from $2.2 to $4.0 million depending upon the specific site analyzed. While these costs are significant, they are not of the magnitude that would, in and of themselves, render the AD Facility development at these sites infeasible.

- The financial feasibility of the AD Facility was evaluated by developing an economic model of revenues and expenses over a 20-year time horizon. A base case scenario was established and a sensitivity analysis was performed by varying the most critical model inputs. The financial feasibility of the various scenarios was compared by calculating the net present value of the net cash flows over the 20-year period. The economic analysis revealed that under multiple scenarios the AD Facility would generate net cash flows with a positive net present value.
- Under the base case assumptions electricity production for sale to the power grid generates greater net cash flow than the other biogas use scenarios analyzed. The economic analysis also revealed that:
  - Tipping fees are the largest revenue source and the tip fee escalation rate is a critical assumption in the analysis,
  - AD Facility capital cost is a critical factor in the analysis, and the resulting debt service was the largest expense and,
  - Grants, tax treatment and other financial incentives have a significant impact on economic feasibility.
- Several financing structures were identified and analyzed. The sale of environmental attributes, such as RECs and Carbon Credits, has become a key element in the financing of renewable energy projects. In addition, favorable tax treatment and grant programs have the potential to improve the feasibility of the project. The prepayment for either disposal services or energy by NYC represents a relatively new financing structure that could contribute to the feasibility of the project.

In order to foster the development of the AD Facility project, R. W. Beck recommends that NYCEDC take the following steps:

- Identify a specific site and develop a plan to remediate (or otherwise prepare) the site for leasing to an AD Developer. The site preparation plan should: (1) specify the expected responsibilities of the AD Developer and NYCEDC and (2) establish a timeframe for the remediation.
- Determine the actions that NYCEDC, and/or NYC, will take to facilitate the establishment of the waste flow or tip fee revenue guarantees an AD Developer will need in order to finance the construction of the AD Facility.

- Assess NYC's willingness to enter a long-term energy purchase contract with the AD Developer. Such a contract could be for electricity, biomethane or biofuel for vehicle use.
- Assess NYC's willingness to pre-purchase disposal services (and/or energy) to reduce the AD Developer's need to raise capital for the construction of the AD Facility.
- Prepare a Request for Expressions of Interest that describes the potential project, expresses NYC's commitment to the project's development and elicits information from potential AD Developers. The receipt of Expressions of Interest offers the following benefits:
  - Provides an indication of the level of interest in the project,
  - Generates information regarding the relevant experience of the potential AD Developers,
  - Provides an understanding of the various development approaches and project structures for consideration,
  - Serves as a vehicle to solicit critical project development information from the AD Developers, and
  - Generates a list of AD Developers willing to provide additional information as project development proceeds.

Section 1
INTRODUCTION

R. W. Beck was retained by the NYCEDC to investigate the feasibility of developing an AD Facility in the FDC area of the Hunts Point peninsula. Situated on 329 acres, the FDC is among the largest food distribution centers in the world. The FDC is the site of NYC's major wholesale markets, including the Meat Market, the Produce Market and the Fish Market. As the FDC is located entirely on NYC-owned property, NYCEDC, on behalf of NYC, administers long-term leases to these and other food-related businesses. NYCEDC currently anticipates that the AD Facility would be developed and operated by the AD Developer in cooperation with the NYCEDC.

NYCEDC, as administrator of the FDC, is currently exploring a number of development projects at the FDC. Among these is the AD Facility, which is being studied in coordination with the Hunts Point Vision Plan (http://www.nycedc.com/ ProjectsOpportunities/CurrentProjects/Bronx/HuntsPointVisionPlan/Pages/HuntsPoint VisionPlan1.aspx) and PlaNYC (www.nyc.gov/planyc2030*)*. The development of an AD Facility is consistent with the NYC Solid Waste Management Plan component that addresses the testing of technologies which produce energy from solid waste.

This Study was preceded by the Hunts Point Food Distribution Center Energy Strategy Plan – Phase 1 ("Energy Strategy Plan"). Information contained in the Energy Strategy Plan was used in this Study to evaluate the potential for use of the energy produced by the AD Facility at the FDC facilities.

This Study was also preceded and informed by the Organics Recovery Feasibility Study.

The Organics Recovery Feasibility Study concluded in part that:

1. AD was more advantageous, as compared to composting, for an organics recovery project at Hunts Point,
2. It would be unreasonable to expect the organic waste generators at the FDC to source separate their organic waste,
3. There are an estimated 27,400 tons of waste generated at the Fish Market and Produce Market each year that are suitable for disposal at the AD Facility, and
4. Under some specific financing circumstances the AD Facility would be profitable while offering competitive disposal prices.

The objectives of this Study, which built upon the results of the Organics Recovery Feasibility Study, were to:

1. Identify and characterize additional potential waste sources on the Hunts Point peninsula,
2. Screen various biogas use options and select three for detailed analysis,

3. Evaluate potential project sites and estimate the extraordinary costs of site development,
4. Document the environmental regulatory framework and permitting process,
5. Identify the potential environmental benefits the AD might present, and
6. Analyze the financial feasibility of developing the AD Facility under three different potential biogas use scenarios.

AD is a natural microbiological process in which bacteria decompose organic material in the absence of oxygen. The AD process produces a biogas that consists primarily of methane, carbon dioxide and water vapor. The nutrient-rich material that remains is called digestate (a fibrous byproduct and water). The digestate can be used as a fertilizer or soil amendment. AD facilities control and enhance the decomposition process to maximize efficiency, manage byproducts and control odors.

AD is best suited for the treatment of moisture-rich organic waste such as waste from wholesale food markets, restaurant waste and food processing waste. Within a controlled and managed facility, AD can be utilized to both divert waste from increasingly space limited landfills and as a source of two valuable renewable byproducts - “green” energy and a soil amendment.

R. W. Beck retained two sub-consultants, DSM Environmental Services Inc. (“DSM”) and R.S. Lynch and Co. (“R.S. Lynch”) to perform specific portions of the Study. DSM, the consultant that previously performed the Organics Recovery Feasibility Study, was responsible for the tasks related to waste quantification, waste characterization and the disposal market. R.S. Lynch was responsible for identifying and analyzing various financing structures.

Section 2
WASTE STREAM IDENTIFICATION AND CHARACTERIZATION

The Organics Recovery Feasibility Study found that the quantity of waste available for the AD Facility was one of the key variables in determining the potential feasibility of the AD Facility, and that there are an estimated 27,400 tons of waste generated at the Fish Market and Produce Market each year that are suitable for disposal at the AD Facility. The first task in this Study was to identify and characterize additional sources of organic wastes that might be available for processing at the AD Facility.

In essence, there are four potential additional sources of organic wastes on the Hunts Point peninsula:

- Increases in generation at the Produce Market or the Fish Market subsequent to 2005;
- Additional organic waste from sources on FDC Drive that were not involved in the 2005 study;
- Additional organic waste from the growing number of smaller, independent, food distribution companies located outside of, but adjacent to FDC Drive; and,
- Organic wastes transported to the Hunts Point peninsula from other areas of NYC.

Each of these potential sources of additional organic waste is discussed below.

Fish Market and Produce Market

Meetings were held with J.R. McIntyre, Market Manager at the Produce Market and George Maroulis, Market Manager at the Fish Market in December, 2008. The meetings were held to attempt to determine if there had been any significant changes in generation and/or composition subsequent to the analysis conducted for the Organics Recovery Feasibility Study.

Fish Market

George Maroulis reported that waste generation has declined since 2005 due to: a reduction in wholesalers (from 45 at the old market to 34 at the new market); the lack of availability of fish in general; and, because of better refrigeration and storage at the new facility, reducing waste.

At the time of the Organics Recovery Feasibility Study, Action Carting collected the waste from the wholesalers, and reported collecting an average of 19 tons per day ("TPD") over 250 open days resulting in an estimated annual generation of roughly

4,750 TPY. Subsequent to the move to Hunts Point, Sanitation Salvage has taken over the account. According to Sanitation Salvage, they collect roughly 50 tons per week of wholesalers' waste.[1] This is equivalent to 2,600 TPY of waste – a significant drop since 2005.

Since waste from the Fish Market was characterized during the Organics Recovery Feasibility Study, it was not sorted and characterized as part of this Study. For the purposes of this Study, the assumption was made that the composition of the waste generated by the wholesalers has not changed significantly since 2005.

George Maroulis speculated that if the Fish Market were to be able to move forward with their plans for development of a dock and fish processing capabilities that the quantity of waste would increase again to levels similar to what was observed at the old Fish Market.

In addition to the waste generated at the Fish Market, George Maroulis estimates that 7 TPD of fish waste (bones, heads and tails – primarily from filleting) are sent out for other uses. Depending on the economics of the AD Facility, this material might be available, but without a tipping fee.

Produce Market

Two meetings were held with J.R. McIntyre, and with one of the largest wholesalers, Mathew D'Arrigo of D'Arrigo Brothers Company, during the second meeting. Both J.R. McIntyre and Mathew D'Arrigo reported that there has been essentially no significant change in wholesalers, or in waste generation or composition since 2005.

One load each of the wet waste (dock waste) and common area waste from the Produce Market was sorted as a check against the composition of these materials from 2005. Figures 2-1 and 2-2 compare the 2005 composition with the 2008 sorts. As illustrated, the dock waste remains essentially unchanged. However, wood waste (primarily broken pallets) appears to have more than doubled in the common area waste with a corresponding drop in food waste, while the percent of old corrugated cardboard ("OCC") and plastics remains roughly the same.

[1] Telephone conversation with Andrew Squitieri, Sanitation Salvage, June 18, 2009.

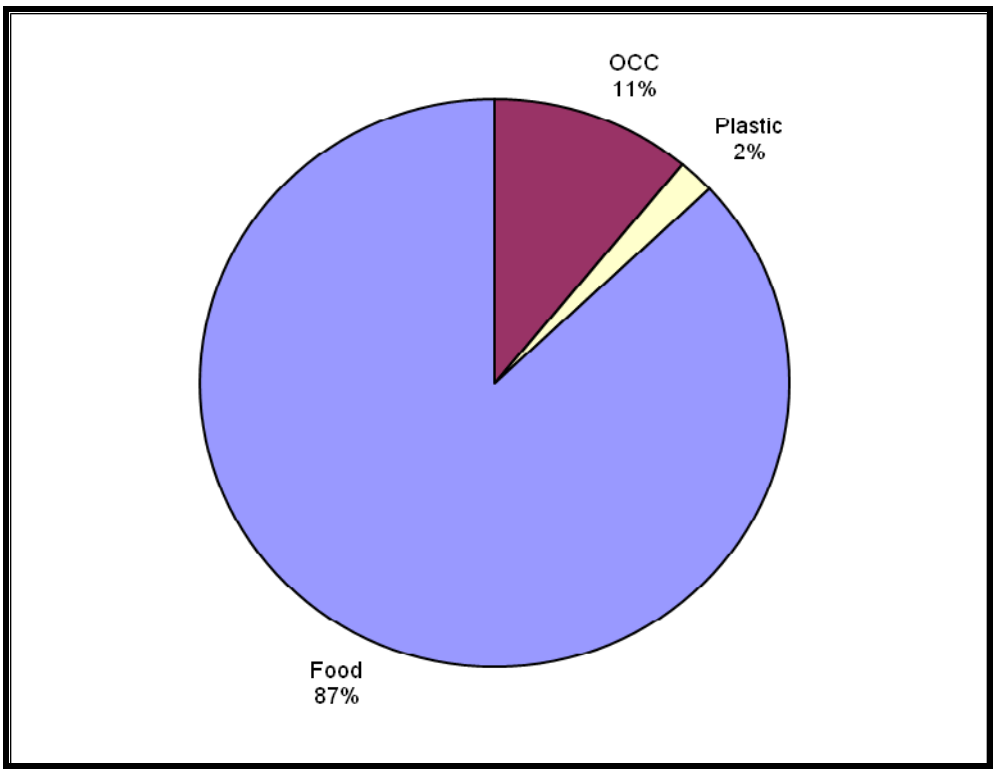

Figure 2-1. Produce Market, Dock Waste Composition, C. 2005

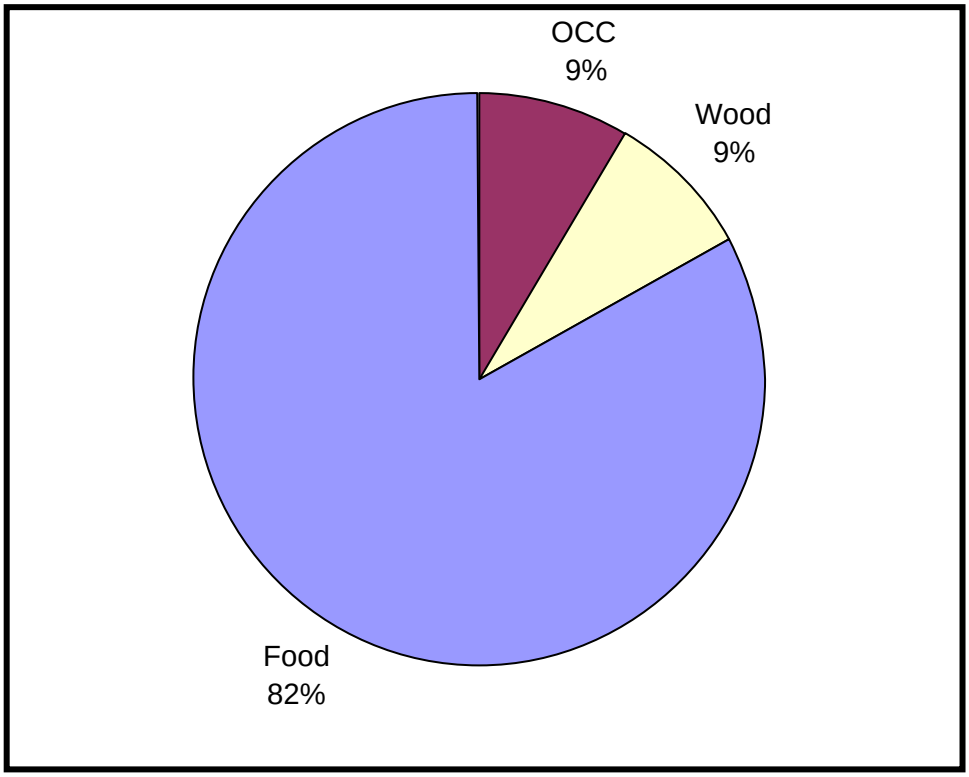

Figure 2-2. Produce Market, Dock Waste Composition, June 11, 2009

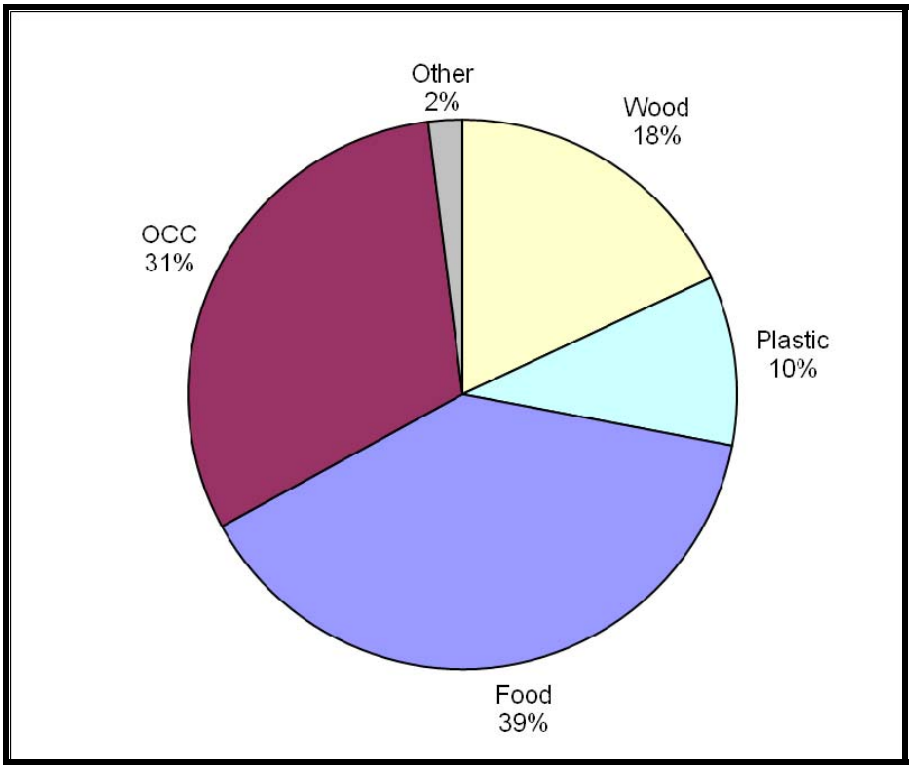

Figure 2-3. Produce Market, Common Area Waste, C. 2005

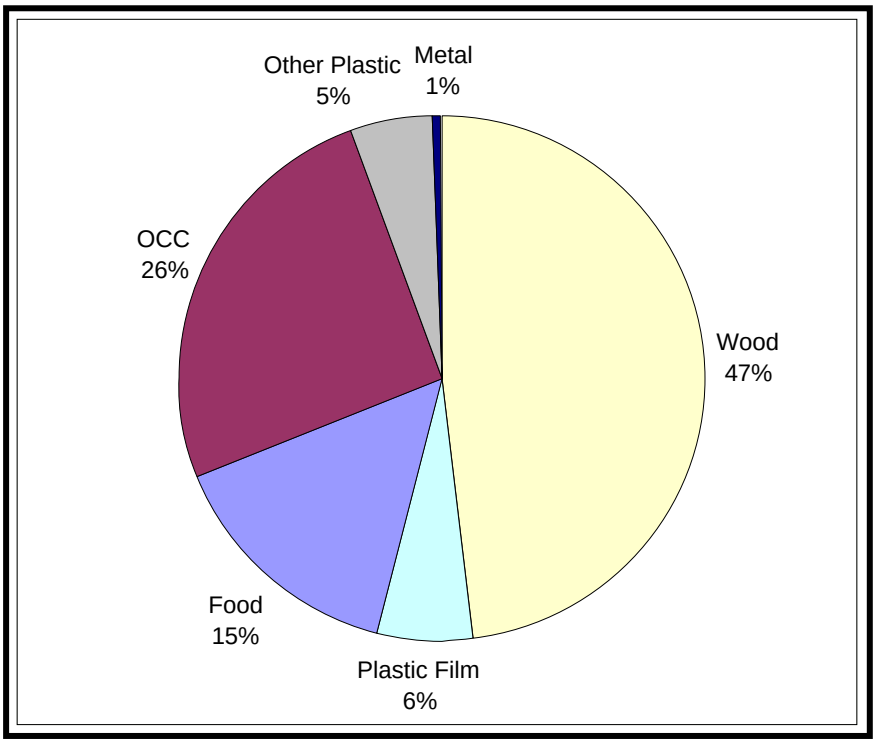

Figure 2-4. Produce Market, Common Area Waste, June 18, 2009

Produce Market Redevelopment

The Produce Market is located on the Hunts Point Peninsula, a thriving industrial area in the South Bronx with 670 businesses which collectively employ over 13,000 people. Opened in 1967, the Produce Market occupies 105 acres within the FDC, and consists of four primary warehouse structures (Buildings A – D) and two adjunct warehouses, making it the largest terminal produce market of its kind in the country.

The Produce Market is currently operating beyond capacity in sub-optimal facilities. Due to warehouse space constraints, roughly 50 percent of the market's produce is stored temporarily in refrigerated diesel trailers. This "flex storage" arrangement requires additional handling, to transfer produce from the trailers to the warehouses when space becomes available, which increases the rate of spoilage.

NYCEDC is working with the Produce Market Cooperative to design a new market that will eliminate the flex storage, by providing significantly more warehousing capacity, while also increasing energy efficiency and future rail service. The new market will also be fully enclosed to maintain the produce in a temperature and humidity-controlled environment. Together, the elimination of flex storage and construction of enclosed warehouse facilities could reduce the amount of spoilage in a new market.

Initial estimates from NYCEDC's market consultant, ACDS, Inc., indicate that spoilage could be reduced by up to 0.5 percent of aggregate sales (the current market generates approximately $2 billion in aggregate sales). However, this reduction in spoilage would most likely be offset by the more than 0.5 percent increase in capacity expected from a redesigned market. The future redevelopment of the Produce Market and its potential implications on the waste stream are not reflected in this Report as plans have not been finalized. It is advised that any developer investigating the feasibility of siting an AD Facility take the future redevelopment of the Produce Market and its potential implications on the waste stream into consideration.

Additional Food Distribution Center Drive Tenants

All of the other tenants on FDC Drive were contacted and with the exception of R. Best Produce and Dairyland, who would not return the telephone calls, on-site interviews were conducted with management at each facility. Based on the interviews, it appears that Baldor Specialty Foods, Inc. and the Meat Market are the only two additional facilities on FDC Drive that represent potentially significant quantities of additional organic material.

Baldor Specialty Foods, Inc.

According to Manny Lopes, Director of Facilities, Baldor generates roughly 5 TPD of ground, clean produce waste generated from their cutting and packaging operations. A load of this material was sorted and it was essentially 100 percent produce waste. Manny Lopes also reports that Baldor generates roughly 1.5 TPD of mixed produce

waste similar in composition to the Produce Market Dock (wet) waste, and 1 TPD of waxed OCC.

Meat Market

Meetings were held with Bruce Reingold, General Manager of the Meat Market, and the individual wholesalers' dumpsters were observed, as well as the Darling Company rendering truck collecting meat and bone waste.

As with the Produce Market and the Fish Market, there are in essence three distinct waste streams:

- Common area waste managed by the Meat Market Cooperative;
- Vendor waste managed by the individual wholesalers under contract to private carters; and,
- Meat/bone/fat waste collected by rendering companies.

The common area waste is collected by Action Carting and is currently delivered to the Harlem River Yard Transfer Station. The majority of wholesaler waste is also collected by Action Carting. Darling collects the majority of meat waste.

Despite several attempts to arrange for the sorting of the wholesaler waste, only a load of common area waste was obtained and sorted.

As illustrated by Figure 2-5, the common area waste is marginal, at best, for disposal at the AD Facility, with meat and fish waste comprising roughly 13 percent of the waste, and other organics comprising another 8 percent. Wood waste (35 percent) is a relatively high component of this waste, as it is of the Produce Market common area waste. The Meat Market estimates, based on invoices from Action Carting, that they generate roughly two roll-off containers tons per month of common area waste. Assuming an average weight of 6 tons, this is equivalent to roughly 12 tons per month, or 144 TPY.

Wholesaler waste probably represents another 7 to 10 TPD. In lieu of sorting, observations of the wholesaler area waste were performed. The general conclusion is that the wholesaler area waste is very low in organic material, consisting primarily of plastic and corrugated containers.

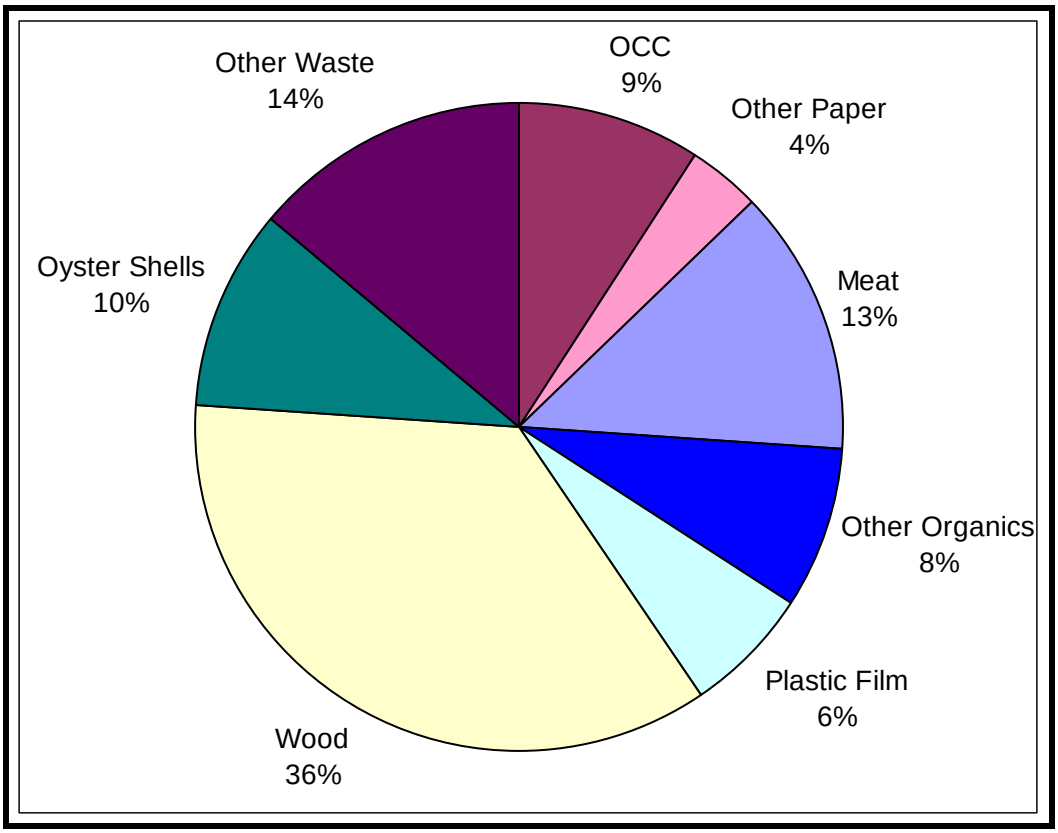

Figure 2-5. Meat Market Common Area Waste

The Meat Market waste most suitable for disposal at the AD Facility (meat, fat and bone waste) is currently going to rendering companies. According to an informal survey of the wholesalers carried out by Bruce Reingold, and based on observations made at the Meat Market, rendering waste generation could be as much as 15 TPD. While in the past the wholesalers were paid for this material, they are currently paying up to $25 per pickup or receiving collection at no cost. If this waste stream is identified as a target waste for the AD Facility a more accurate estimate of the quantity should be obtained.

All Other Food Distribution Center Businesses

Other food processing/distribution businesses interviewed on FDC Drive (A.L. Bazini Co., Krasdale, Citarella, Sultana Distribution, and Anheuser-Busch) reported that they generate very little organic waste, with the bulk of their waste being dry OCC, wood waste, and plastics. Brief telephone calls with facility managers at R. Best Produce and Dairyland indicate that they are also not large generators of organic wastes.

Additional Organic Waste Generated on Hunts Point Peninsula

Information was obtained on potential organic waste generation and composition from food production and distribution businesses on the Hunts Point peninsula but not located on FDC Drive. The information was gathered using three different approaches. First, a list was obtained of 113 companies (with company contact names) from the Hunts Point Economic Development Corporation that were believed to be engaged in food distribution on the Hunts Point peninsula, but that were not located on FDC Drive. Telephone surveys were conducted with a sub-set of these companies.

Second, Sanitation Salvage was requested to collect waste from a representative sample of these food distribution companies that were Sanitation Salvage customers. A sample of this waste was sorted to obtain composition data. It was also requested that Sanitation Salvage estimate the quantity of waste collected from these businesses.

Finally, Sanitation Salvage was requested to provide their best estimate of the quantities of similar waste generated on the Hunts Point peninsula based on Sanitation Salvage understanding of the waste market on the Hunts Point peninsula.[2]

Telephone Surveys of Potential Organic Waste Generators on the Hunts Point Peninsula

Hunts Point Economic Development Corporation worked with us to prioritize the 113 companies believed to be in the food distribution business based on size (number of employees), the likelihood they would generate food waste and the type of company.

Twenty-four companies were eliminated because they were beverage distribution companies (and, therefore, unlikely to generate organic wastes) or conducted their primary business outside of the Hunts Point peninsula (even though they had an address on the Hunts Point peninsula). This left 89 companies that potentially generated food waste.

Contact was attempted with 47 of these 89 companies, concentrating on the largest companies. Five of the contacts (out of the 47) had disconnected telephone lines. Telephone surveys of many of the companies proved difficult as English was not typically their primary language, or in some cases, an English speaking person at the company was not able to be located. Ultimately, 18 of the 47 companies were interviewed. Of the 18 companies, 15 reported that they generated some food waste, and we estimate that roughly 6 tons of food waste is produced weekly by these 15 companies.

These 15 companies typically operate either 5 or 6 days per week. Their annual generation was estimated based on the very rough data they were able to provide. It

[2] Sanitation Salvage believes that they are either the largest, or second largest carter on Hunts Point, and that they collect from roughly 50 percent of the potential organic generators on Hunts Point (Telephone conversation with Andrew Squitieri, June 18, 2009).

was impossible to obtain good data on seasonality, although it can be assumed that many of the produce distributors experience the same type of seasonal changes as the Produce Market, while the seafood distributors experience the same type of seasonal changes as the Fish Market. Waste generation seasonality at the Produce and Fish Markets is addressed elsewhere in this report.

Sanitation Salvage Estimate of Organic Waste Generation from Hunts Point Food Distribution Companies Beyond FDC Drive

Because of the difficulty of obtaining accurate data from the telephone surveys, it was also requested that Sanitation Salvage provide their best estimate of weekly generation of food rich loads from food production and distribution businesses on the Hunts Point peninsula, but outside of FDC Drive. Sanitation Salvage estimates that they collect roughly 10 tons per week of food rich loads from these businesses. Assuming that Sanitation Salvage collects from roughly 50 percent of these businesses on the Hunts Point peninsula,[3] it can be roughly estimated that 20 tons per week are generated and could potentially be available to an AD Facility located on the Hunts Point peninsula.

Composition of Organic Rich Loads from Food Production and Distribution Companies Beyond FDC Drive

Sanitation Salvage collected waste from a sample of their customers likely to generate organic rich loads and provided it for sorting on June 11, 2009. Table 2-1 lists the companies and contact information (when known). Figure 2-6 presents the composition of the waste.

[3] Based on telephone conversation with Andrew Squitieri, Sanitation Salvage.

Table 2-1
Food Distribution Waste Generated Beyond FDC Drive

Company Name	Company Contact	Address	Telephone
Agro Sun, Inc	Magali Campoverde	700 Whittier Street	718-991-8895
Bimbo Bakeries - NY & NJ Division	George Sandoval	324 A Casanova Street	(718) 860-0640
Caraveo Papayas	Eden Caraveo	1267 Randall Ave	1-718-617-2213/14
Pronto Produce		590 Wales Ave #584-590	718-292-9251
Reyes Produce	Julio Reyes	1280 Randall Ave	718-328-3500
Ridge Produce Inc.		531 Tiffany Street	718-861-7555
Tropical Products			
Uncle Vinnie Produce			
Uray Fish and Meat Market		1200 E Bay Ave	718-328-1300
Valencia Bakery		801 Edgewater Road	718-991-6400 or 6402

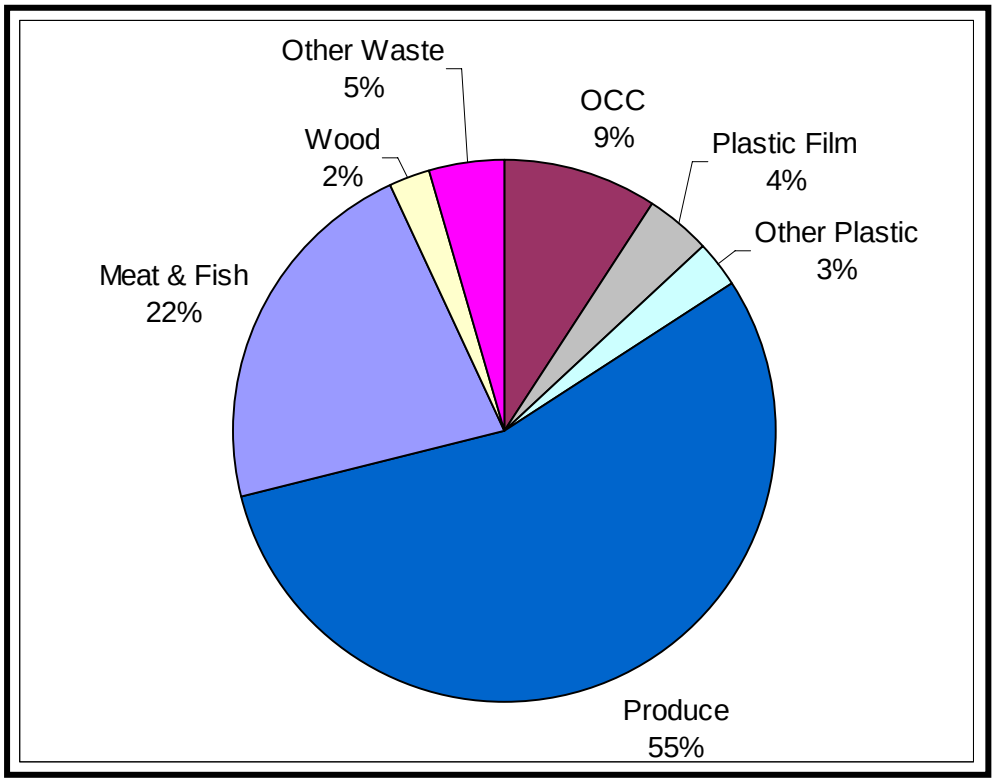

Figure 2-6. Composition of Food Distribution Waste Generated Beyond FDC Drive

Variations in Generation

The organic rich waste generated at the Hunts Point Terminal Produce Market and the Fish Market is generated over the course of 250 operating days per year. There are

considerable variations in tonnage of waste generated, corresponding with variations in sales on a seasonal, as well as a daily, basis.[4] According to vendors, and the Fish Market Manager, waste is greatest during the summer months and winter holidays. During the week, waste volumes on the busiest day (Thursday) are a third more than on the slowest day (Tuesday). In addition, weather patterns at sea directly affect the quantity of fish caught and sold and, thus, waste generated. Therefore, the waste volumes are likely to vary by 20 percent, plus or minus, in any given week.

Like the Fish Market, waste volumes at the Produce Market vary considerably, primarily as a function of sales, but also due to weather conditions at both the point of production and at the market, and to spoilage resulting from refrigeration problems in transport vehicles. According to NYC's records, there was a total of 13,007 tons of common area waste disposed in 2004, with a monthly average of 1,084 tons. The highest tonnage month was July, with 1,579 tons, nearly twice that of October, the lowest tonnage month, in which 821 tons were disposed.

Organic Rich Loads from the Metropolitan Transfer Station

Observations at the Metropolitan Transfer Station (December, 2008) and conversations with Sanitation Salvage (a part owner of the Metropolitan Transfer Station) indicated that an AD Facility should be able to attract around 100 TPD (six days per week) of organic rich waste from the Metropolitan Transfer Station. These loads consist primarily of restaurant and produce stand waste currently being collected in the Bronx and Manhattan and trucked to the Metropolitan Transfer Station on the Hunts Point peninsula. While this waste is not generated on the Hunts Point peninsula, it is currently being brought onto the Hunts Point peninsula for transfer at the Metropolitan Transfer Station. Therefore, the truck traffic impact of processing this material at the AD Facility would be insignificant.

Unfortunately it was not possible to obtain a sample of the organic rich waste from the Metropolitan Transfer Station for sorting. However, a sample was obtained from a collection vehicle reported to be delivering waste from a restaurant route. Figure 2-7, below presents the composition of this material. While this sort represents a single load of restaurant waste as reported by the driver at the time of delivery to Harlem River Yards, the data are consistent with multiple sort data reported for restaurant waste in California data from a waste composition study conducted for the State of Vermont.[5]

As illustrated by Figure 2-7, roughly 67 percent of the waste sorted was digestible produce and meat/fish waste, with another 20 percent being potentially digestible corrugated cartons and other paper, leaving 13 percent non-digestible waste.

[4] This section is excerpted from the 2005 report.

[5] See for example, *Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups, June 2006*, Cascadia Consulting Group and *Final Report, Vermont Waste Composition Study, June 2006*, DSM Environmental Services, Inc.

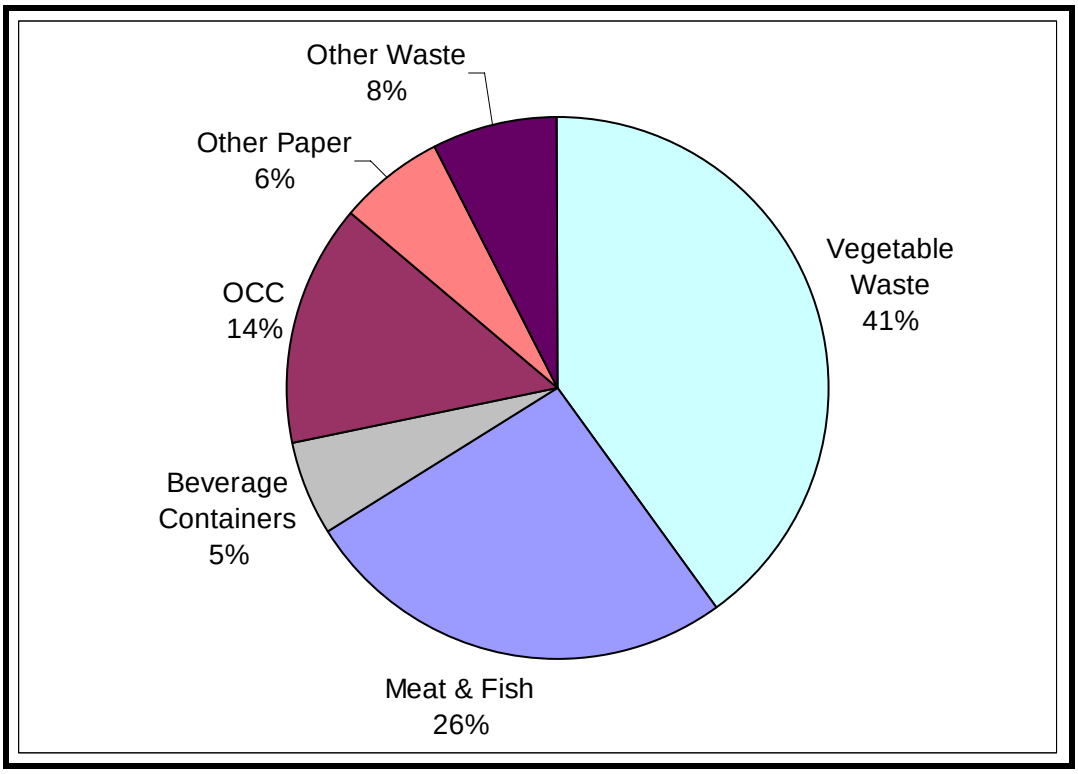

Figure 2-7. Organic Rich Restaurant Load, June 10, 2009

Summary of Organic Rich Waste Generation on the Hunts Point Peninsula

Table 2-2 summarizes the estimate of organic rich waste quantity and composition on the Hunts Point peninsula based on our 2005 study, and the results of our investigations in 2008 – 2009. The total quantity of organic rich waste generated in the FDC is estimated to be approximately 32,500 TPY. The total quantity of organic rich waste from other sources on the Hunts Point peninsula is estimated to be approximately 32,500 TPY with the total estimated organic rich waste potentially available on the Hunts Point peninsula being approximately 65,000 TPY.

Included in this total are at least three significant sources of organic waste that are currently generated on the Hunts Point peninsula, but not disposed of as waste. These are meat, bone and fat from the Meat Market, fish waste from the Fish Market, and bagel and dough waste from Just Bagels. Together, these three waste streams represent an estimated 5,775 TPY. In each case the generators do not pay a tipping fee to dispose of this material because it is already going for beneficial uses; however, in the case of the meat and bagel waste, the generators do pay a collection fee. Depending on the economics of an AD Facility, this material also might be available.

Table 2-2
Summary of Organic Rich Waste on the Hunts Point Peninsula

Source	Generation	Composition (%)						
	(tons/yr.)	Food/ Produce	Meat/ Fish	OCC/ Paper	Plastic	Film Plastic	Wood	Other
Hunts Point Terminal Produce Mkt. (1)								
Common Area	13,000	27%		28%	5%	6%	33%	1%
Dock Waste	9,600	84%		10%	1%		5%	
New Fulton Fish Market								
Vendor Waste (2)	2,600		36%	25%		17%	12%	10%
Fish Waste Sold (3)	1,750		100%					
Baldor								
Ground Vegetables	1,250	100%						
Other Waste (4)	375	82%		9%			9%	
Hunts Point Cooperative Market								
Common Area	144		21%	13%		6%	36%	24%
Meat Waste to Rendering (5)	3,750		100%					
Sub-Total, Food Distribution Center	***32,469***							
Other Food Distribution Waste	1,040	55%	22%	9%	4%	3%	2%	5%
Just Bagels Dough/Bagels (6)	275	100%						
Organic Rich Commercial Waste Loads (7)	31,200	26%	41%	20%				13%
Sub-Total, Additonal Hunts Point Waste	***32,515***							
Total (8)	***64,984***							

Notes:
(1) Composition based on an average of the 2009 and 2005 sort.
(2) 2009 quantity estimate, 2005 sort for composition.
(3) Estimated by George Maroulis, Market Manager.
(4) Quantities provided by Baldor, composition based on DSM visual observation.
(5) Estimated by DSM based on observations, waiting for confirmation from Cooperative.
(6) Just Bagels pays a pull charge but no tip fee; material is currently beneficially used.
(7) Organic rich waste commecial waste loads on the Hunts Point Peninsula.
(8) Waste generation and composition will vary daily and seasonally.

Based upon the limited data that was obtained, as shown in Table 2-2, an estimated waste stream quantity and composition was established for the purpose of performing an economic analysis. It was assumed that the AD Facility would process 60,000 TPY of organic rich waste with the following composition:

Meat and Fish Waste:	20%
Other Food Waste (mostly vegetative):	40%
Corrugated Cardboard and Other Paper:	20%
Wood:	10%
Plastic and other Non-digestible Waste:	10%

The waste composition information in this report does not include upper and lower confidence intervals for the various material categories typically included in the results for comprehensive waste characterizations studies. The composition percentages are estimates based on several sources of data and analysis including previous studies, limited field sort data, and generator survey information. More detailed analysis may be needed to refine the composition should the project proceed further.

Biogas Generation

The AD of organic material results in the generation of biogas and digestate. Digestate is the nutrient-rich material (a fibrous byproduct and water) that remains following the digestion process. Both the biogas and the digestate are typically refined in post-digestion processes which depend upon their intended use. Biogas contains primarily methane, CO_2, water vapor. It also contains compounds such as H_2S, siloxane and ammonia, which need to be removed from the biogas. Digestate is the material remaining at the conclusion of the digestion process. The relative quantities of biogas and digestate depend upon two primary factors -- the characteristics of the feedstock and the type of digestion process employed. In order to evaluate the energy production potential of the AD Facility an estimate of the biogas generation rate was made using the results of waste identification and characterization task.

Since the biogas generation rate is dependent upon the type of digestion process employed, a number of digestion system suppliers were requested to provide estimates of biogas generation. Published literature was also reviewed. As an additional reference point data from an operating AD plant in Toronto, Canada was reviewed.

Since the biogas generated at a specific AD plant is dependent upon the quantity of feedstock processed the biogas production is typically reported as a generation rate in ncm/metric ton. The estimates received for AD system suppliers ranged from 100 to 180 ncm/metric ton received. Data from the operating AD plant in Toronto indicates that 115 ncm/metric received ton is generated.

For the purpose of estimating the energy production of the AD Facility, it was assumed that biogas would be produced at a rate of 120 ncm per metric ton of waste received. Assuming the AD Facility receives 60,000 TPY of waste, the digestion process will produce approximately 230 million standard cubic feet of biogas per year.

The rate of biogas production will vary from day-to-day as a result of variations in waste flow and characteristics. For purposes of energy production, it is assumed that the daily average rate of biogas production is plus or minus 30 percent of the annual average rate. The annual average biogas production rate is estimated at 440 scfm and with a maximum rate of 572 scfm.

The AD Facility will require electric power throughout the plant and heat for the digestion process. These energy uses are considered parasitic loads. The method of parasitic power production will depend upon the energy production option that is selected. If the energy production option is to produce and sell electricity then all the biogas would be burned to produce electricity and the waste heat from the engine

would be used to produce steam for the AD process. If the sale of biomethane is the energy production option, then a smaller reciprocating engine generating set ("genset") would be used to produce the parasitic power and the remaining biogas would be available to upgrade to pipeline quality biomethane.

The amount of parasitic power usage will vary significantly depending upon the type of digestion process. For the purposes of the energy production analysis, parasitic load of the AD Facility was estimated to be 3,000,000 kilowatt hours per year ("kWh/yr") and 1.4 million British thermal units per hour ("MMBtu/hr") of low pressure steam. The assumed method of parasitic power generation is outlined in each of the following energy production and use option analyses.

Energy Production and Use Options

R. W. Beck performed a high level evaluation (screening analysis) of the following eight potential energy production and use scenarios in order to select three scenarios for a more detailed evaluation:

1. Biogas treatment and use within FDC
2. Biogas treatment and injection into an existing natural gas pipeline
3. Steam production for use within the FDC
4. Electricity production for use within the FDC using reciprocating engines
5. Electricity production for export to the power grid using reciprocating engines
6. Electricity production for use within the FDC using gas turbines
7. Electricity production for export to the power grid using gas turbines
8. Biofuel production and sale as a vehicle fuel

Issues and constraints related to these eight scenarios are outlined in the following sections.

Biogas within the FDC

The Energy Strategy Plan documented natural gas use at the FDC. Almost all natural gas usage at the FDC is for heating needs and, therefore, the natural gas usage varies widely by season and does not represent a consistent market for biogas. According to the Energy Strategy Plan 179,067 MMBtu of natural gas is used at the FDC each year. This compares to approximately 100,000 MMBtu of biogas that could be produced from 60,000 TPY of food waste. During the coldest months, the AD Facility would not produce enough biogas to satisfy the needs of the FDC and during the warmer months the FDC would not have a need for the biogas. A potential option would be to sell biogas within the FDC during the winter and sell it to the natural gas network (the second scenario) when the biogas supply exceeded the FDC demand. This would essentially be a hybrid of this scenario and the second scenario.

The issue of gas distribution within the FDC would also have to be addressed. There are various gas users within the FDC and Consolidated Edison ("Con Ed") owns the

distribution system. As a result, it is likely that a parallel distribution system would need to be constructed.

According to the Energy Strategy Plan, an alternative biogas use within the FDC could be created if the Meat Market retrofitted its refrigeration system with a boiler and steam turbine drive in lieu of the current electric motor drives. This potential retrofit is described in the Energy Strategy Plan. The refrigeration system energy demand is relatively constant throughout the year and is considerably greater than the energy content of the biogas that the AD Facility would produce. As a result, if the Meat Market were willing to retrofit the refrigeration system a consistent biogas market would be created at the FDC. The Meat Market would have to buy additional natural gas to supplement the upgraded biogas that would be supplied by the AD Facility.

The biogas generated by an AD system from food waste will consist of methane, CO_2, moisture, ammonia, H_2S, siloxane and other gases that would need to be removed if the biogas were to be upgraded for sale as a natural gas replacement fuel. As compared to natural gas, biogas has less methane and more CO_2. Therefore, if the biogas is being used to displace natural gas, the biogas will most likely be treated to remove the CO_2, moisture and other contaminants. The upgrade technologies for biogas exist and are commercially proven. Some energy production systems, such as boilers and reciprocating engines do not require the biogas to be treated.

Con Ed has the franchise for the local distribution of natural gas. The transport of biogas across a public right-of-way ("ROW") to sale to a third party might be inconsistent with Con Ed's franchise rights. Con Ed was contacted regarding this issue and their representative (Margarett Jolly, the Distributed Generation Ombudsman) stated that the AD Facility would only need NYC's approval for the gas line and that Con Ed did not consider such an arrangement a conflict with their franchise. She also suggested that Public Service Law 66-g and 66(13) may apply since they deal with exemptions to Public Service Law regulation. R. W. Beck has not reviewed the validity of the these laws or the required approval process for this scenario and we recommend a more detailed review if this option is further considered.

Biogas Sale into an Existing Natural Gas Pipeline

The potential exists for biogas to be upgraded and sold into either the local Con Ed natural gas distribution system or the interstate pipeline that transects the FDC site. The interstate pipeline is required under Federal Energy Regulatory Commission ("FERC") regulations to accept the gas. There is an example of this scenario in NYC; the landfill gas generated at the closed Fresh Kills Landfill is cleaned and sold to National Grid, the natural gas supplier on Staten Island.

Con Ed was contacted regarding their potential purchase of cleaned biogas, Margarett Jolly, the Distributed Generation Ombudsman, informed us that staff has expressed concern that the biogas would contain micro-organisms that would degrade their system. They do not believe that proven cleaning systems exist to remove the micro-organisms. Suppliers of AD systems were contacted regarding this issue and believe that experience in Europe can be successfully used to address Con Ed's concern. If it

becomes necessary, United States experience with AD of sewage sludge or animal manure might be persuasive on this issue.

Steam for Use within the FDC

According to the Energy Strategy Plan, steam is not currently used at the FDC in any significant quantity. Steam could be used as the energy source for the winter heating load if the boilers were replaced with heat exchangers. The more likely potential use of steam, as previously discussed, would be by steam turbines used to drive the compressors for the refrigeration load. Alternatively, if the Meat Market were to install adsorption chillers they would be a potential use of steam. As discussed previously, the refrigeration energy needs of the Meat Market exceed the energy that would be available from the biogas. As a result, if the Meat Market converted to steam turbines, the boiler that provided the steam would need to burn natural gas in addition to the biogas. The key question that would need to be addressed is whether the boiler should be located at the AD Facility or at the Meat Market.

The decision on where to locate the boiler is likely to be influenced by two key factors. First, whether there are regulatory restrictions to the sale of the biogas by a third party to the Meat Market across a public right-of-way. Second, whether the Meat Market preferred to have control of the steam generation or was willing to rely on a steam purchase contract.

Electricity within the FDC Using Reciprocating Engines

According to the Energy Strategy Study, although the FDC uses much more electricity than the AD Facility could produce, sale of the electricity throughout the FDC is problematic because many of the various tenants and subtenants have their own meters to directly purchase electricity from Con Ed. The Meat Market represents the largest single purchaser of electricity and, due to the large refrigeration load, purchases more electricity than the AD Facility is able to produce.

According to the Energy Strategy Study, a number of large electricity users within the FDC currently purchase electricity at lower than market rates. If these users can continue to obtain this discounted rate, it would make this option less likely to be economically viable.

A potential regulatory fatal flaw exists with this option if the electricity is produced at a site separated from the electricity producer by a public ROW. Such a situation could be inconsistent with Con Ed's franchise rights. This potential fatal flaw could be overcome by locating the generating equipment at the Meat Market and piping the biogas across the public ROW.

Producing electricity from biogas in a reciprocating engine generator set is a commercially proven approach. Biogas from an AD facility is similar to landfill gas and there are many reciprocating engines in operation, which utilize landfill gas. Many reciprocating engines utilize untreated landfill gas, while some operators of landfill gas to energy systems prefer to clean the gas to reduce engine operating costs. Whether or not the AD biogas is cleaned in this scenario will not have a significant

economic impact. We have assumed that it would not be economically justified to install a cleaning system.

Electricity to the Grid Using Reciprocating Engines

From a regulatory and institutional perspective, selling to the electric power grid is likely to be the scenario with the least unknowns. As pointed out in the Energy Strategy Study, there is a well defined Con Ed procedure that must be followed in order to connect to the grid through the Con Ed system. Con Ed is required to convey the electricity to the grid as long as such transmission is not detrimental to the stability of their distribution system. Given the relatively small size of the generation unit, it is unlikely that Con Ed could deny access to the grid.

The only significant difference in facility design between selling within the FDC and to the grid is that sale to the grid is likely to be at a higher voltage, therefore, requiring a step-up transformer.

The two largest financial differences between this option and the other options are: (1) that the costs may be higher since the equipment to convert biogas to electricity must be purchased; and (2) the electricity will likely be sold at wholesale as opposed to retail rates.

Electricity within the FDC Using Gas Turbines

Two types of gas turbines could be used to produce electricity from the biogas – conventional combustion turbines and micro turbines. Although the suppliers of both of these types of turbines offer turbines in the 1 megawatt ("MW") size range, this is not the size range in which either of these turbines historically have proven to be economically viable compared to reciprocating engines. Combustion turbines are typically used in much larger applications and are likely to be more costly and less efficient in this application. Micro turbines are typically used in much smaller applications and are also likely to be more costly. Both types of turbines typically require extensive cleanup of the biogas.

Issues related to the sale of electricity within the FDC are no different under this option than the reciprocating engine scenario.

Electricity to the Grid Using Gas Turbines

Facility design issues in this scenario are the same as the most previously discussed scenario.

Issues related to the sale of electricity to the grid are similar to the reciprocating engine scenario.

Biofuel Production and Sale as a Vehicle Fuel

Theoretically the biogas produced by an AD facility could be converted to ethanol or treated and sold as a vehicle fuel. It is not commercially feasible to produce ethanol from natural gas, so that option was not considered in this analysis.

In order to produce a vehicle fuel, the biogas would need to be upgraded to pipeline quality, just as it would if it were to be sold into the natural gas network. It would then need to be condensed (or liquefied) and stored. If the vehicle filling station were not co-located with the AD Facility, then pipeline or transportation issues would become a factor.

A local market for CNG appears to be developing. The cost of this option will be similar to the other scenarios involving the sale of cleaned biogas displacing natural gas. In this scenario, the costs for developing a fueling station are included, however, connection to the natural gas network is unnecessary.

Scenario Screening

The screening criteria established in order to evaluate the various energy production and use options were:

- Viability and strength of the associated energy market
- Environmental impacts
- Regulatory and institutional hurdles
- Technical complexity and degree of commercialization
- Likelihood of being the low cost option

These criteria were applied on a relative basis to compare the eight scenarios. The eight scenarios were compared and a score from one to five was assigned with a score of five being the high score.

During the screening analysis, R. W. Beck attempted to identify potential fatal flaws in the various scenarios.

In all of the scenarios, it is assumed that the biogas would be produced by an AD system that included the following process steps: waste receipt and storage, pre-digestion processing to remove non-processible materials, size reduction and AD. These processes and ancillary systems are common to all the biogas usage scenarios and, therefore, were not considered in the screening analysis.

Viability and Strength of the Associated Energy Market

The Organics Recovery Feasibility Study clearly established that the AD Facility would not be economically feasible without the revenue from the use and sale of the biogas. This criteria addresses the markets for the various energy products represented in the eight energy production and use scenarios.

The following three scenarios received the highest score (5) because they all represent established and reliable energy markets.

- Biogas Sale into an Existing Natural Gas Pipeline
- Electricity to the Grid using Reciprocating Engines
- Electricity to the Grid using Gas Turbines

The two scenarios that included the sale of electricity within the FDC received a score of four because FDC is not considered as stable a market as the electrical grid.

The Biofuel Production and Sale as a Vehicle Fuel scenario received a score of three because CNG or LNG is an emerging market.

The Biogas Sale within FDC scenario received a score of one because the natural gas within the FDC has a high seasonal variation.

The Steam for Use within the FDC scenario received a score of one because there is no current need for steam within the FDC.

Potential Environmental Impacts

The feasibility of successfully developing an AD Facility on the Hunts Point peninsula is likely to depend upon its environmental impacts. Both the positive and negative environmental impacts were considered with a higher number score reflecting either a greater positive environmental impact or a lesser negative impact of a scenario as compared to the other scenarios. Since all of the scenarios are the same from the perspective of waste diversion and reuse this screening element related only to the environmental impacts of energy use or production.

The following three scenarios received the highest score of five primarily because they had the positive environmental impact of replacing fossil fuel use with renewable fuel use:

- Biogas Sale within FDC
- Biogas Sale into an Existing Natural Gas Pipeline
- Biofuel sale as a Vehicle Fuel

The Steam for Use with the FDC scenario received a score of four because although electricity use is replaced by a renewable fuel, a new local emissions source results.

The remaining four scenarios involving the production of electricity received a score of three because they represent a new local emissions source and are likely to involve a more onerous environmental permitting effort.

Regulatory and Institutional Hurdles

The feasibility of successfully developing an AD Facility on the Hunts Point peninsula is likely to depend upon the severity of the regulatory and institutional hurdles that must be overcome. For example, some scenarios might require approvals

from regulatory bodies such as the Public Service Commission. Additionally some of the scenarios may require more complicated contractual structures.

The following scenarios received a score of five because the regulatory process is well defined and significant hurdles are not anticipated.

- Biogas Sale into an Existing Natural Gas Pipeline
- Electricity to the Grid using Reciprocating Engines
- Electricity to the Grid using Gas Turbines

The Biofuel Sale as a Vehicle Fuel scenario received a score of four because an institutional hurdle is anticipated in that a purchaser for the fuel must be identified that will make a strong guarantee to purchase the fuel. The limited demand presently for such fuel results in obtaining such a guarantee as being challenging.

The scenarios including the sale of either biogas or steam within the FDC received a score of three for the institutional reason that contracts with the purchaser will likely need to contain a well-defined purchase guarantee and the FDC tenants may not find such a clause acceptable.

The scenarios including the sale of electricity within the FDC received a score of two for the regulatory reason that franchise issues are anticipated and for the institutional reason that the contracts with the power purchaser will likely need to contain a well-defined purchase guarantee and the FDC tenants may not find such a clause acceptable.

Technical Complexity and Degree of Commercialization

Although an AD Project might seem feasible at the outset, some project developments fail because the degree of technical complexity is high and technical issues predominate that cannot be overcome. Projects based upon technologies with strong, proven commercial operating histories are likely to succeed.

The Steam for Use within the FDC scenario received the highest score of five because steam boilers are low tech and commercially proven.

The following five scenarios all received a score of four because they are more complex as compared to the production of steam. All five are proven in commercial operation.

- Biogas Sale within FDC
- Biogas Sale into an Existing Natural Gas Pipeline
- Electricity within the FDC using Reciprocating Engines
- Electricity to the Grid using Reciprocating Engines
- Biofuel sale as a Vehicle Fuel

The two scenarios involving gas turbines received a score of three because a facility using turbines is judged to be more complex.

Likelihood of Being the Low Cost Option

The higher the cost of a facility, considering both capital and operational costs, the lower the likelihood that a project will be economically feasible. An assessment for this criterion was based primarily on the scope and relative costs for the needed equipment to either upgrade the biogas or produce energy [6].

The Steam for Use within the FDC scenario received a score of five because only minimal biogas treatment will be required.

The scenarios using reciprocating engines received a score of four because they require less biogas treatment as compared to the other options (except for steam sales).

The scenarios involving either the sale of biogas or biogas-based vehicle fuel received a score of three because they require extensive biogas treatment.

The scenarios with turbines are likely to have the highest cost of equipment and systems and, therefore, received a score of two.

Screening Analysis Summary

Table 3-1 contains a summary of the screening analysis. Based upon the screening analysis, the following three scenarios were selected for more detailed technical and financial evaluation because they received the highest scores.

- Biogas Sale into an Existing Natural Gas Pipeline
- Electricity to the Grid using Reciprocating Engines
- Biofuel sale as a Vehicle Fuel

6 This portion was of the screening analysis was updated after the detailed analysis was completed. The relative ranking of the options did not change.

Table 3-1 – Screening Analysis Summary
(Numerical Scores from 1 to 5 with 5 representing the highest level of feasibility)

	Viability and Strength of the Associated Energy Market	**Environmental and Social Impacts**	**Regulatory and Institutional Hurdles**	**Technical Complexity and Degree of Commercialization**	**Likelihood of being the Low Cost Option**	
1. Biogas for FDC	1	5	3	4	3	16
Major Issue	Heating load seasonal.	No local emission impacts. Replacement of NG with a renewable resouce is positive.	May involve franchise issues. Likely to require long-term contract with FDC tenents.	Proven technology.	Requires extensive biogas cleaning.	
2. Biogas to Pipeline	5	5	5	4	3	22
Major Issue	An interstate gas transmission pipeline that intersects the FDC is required to accept "pipeline quality" methane. Con Ed may also purchase the gas.	No local emission impacts. Replacement of NG with a renewable resouce is positive.	No significant issues	Proven technology.	Requires extensive biogas cleaning.	
3. Steam for FDC	1	4	3	5	5	18
Major Issue	No significant quantity of steam is used at the FDC.	Local use of renewal energy is positive. New local air pollution source.	Likely to require long-term contract with FDC tenents.	Proven technology, widely understood equipment.	Level of biogas treatment lower that other options.	
4. Power to FDC – Recip	4	3	2	4	4	17
Major Issue	Meat Market refrigeration load is constant and large enough. Low rates from NYPA.	New local air pollution source.	May involve franchise issues. Likely to require long-term contract with FDC tenents.	Proven technology.	Larger electricity generation system compared to the non-export electricity options.	

Table 3-1 – Screening Analysis Summary (continued)
(Numerical Scores from 1 to 5 with 5 representing the highest level of feasibility)

	Viability and Strength of the Associated Energy Market	**Environmental and Social Impacts**	**Regulatory and Institutional Hurdles**	**Technical Complexity and Degree of Commercialization**	**Likelihood of being the Low Cost Option**	
5. Power to Grid - Recip	5	3	5	4	4	21
Major Issue	Established market will accept all produced power.	New local air pollution source.	No significant issues.	Proven technology.	Larger electricity generation system compared to the non-export electricity options.	
6. Power to FDC – Turbine	4	3	2	3	2	14
Major Issue	Meat Market refrigeration load is constant and large enough. Low rates from NYPA.	New local air pollution source.	May involve franchise issues. Likely to require long-term contract with FDC tenents.	ProventTechnology, more complex compared to engines.	Requires greater biogas treatment compared to the recip engine. Higher cost per kW produced.	
7. Power to Grid - Turbine	5	3	5	3	2	18
Major Issue	Established market will accept all produced power.	New local air pollution source.	No significant issues.	Proven technology, more complex compared to engines.	Requires greater biogas treatment compared to the recip engine. Higher cost per kW produced.	
8. Bio-Fuel for Vehicles	3	5	4	4	3	19
Major Issue	The local CNG market is developing.	Using renewable fuels to power vehicles is a public policy priority.	Hurdles anticipated to be low.	CNG and LNG from NG commercially proven.	Requires extensive biogas cleaning. Requires vehicle fueling station.	

Biogas Sale into an Existing Natural Gas Pipeline

While natural gas is primarily methane, it also contains other hydrocarbons such as ethane and propane. Natural gas has a heating value of approximately 1,030 MMBtu/scf. The biogas from an AD Facility is expected to have the following characteristics:

Methane	40-70 percent
Carbon Dioxide	30-60 percent
Oxygen	less than 1 percent
Nitrogen	less than 1 percent
Hydrogen Sulfide	less than 500 parts per million
Ammonia	less than 400 parts per million
Heating Value	600 Btu/scf (higher heating value)

These percentages are on a dry basis and the biogas will be saturated with water vapor.

In order to sell the biogas as pipeline quality biomethane, it is necessary to dry the gas and remove the non-methane gases to achieve a methane percentage of at least 97 percent and a heating value of at least 975 Btu/scf.

AD system suppliers have experience in Europe upgrading biogas to pipeline quality biomethane. In the United States, companies have successfully upgraded biogas from landfills to pipeline quality biomethane. The landfill gas generated in the closed Fresh Kills Landfill on Staten Island is being upgraded and sold to the local gas utility. We estimate that there are at least 35 landfill gas and AD projects in the United States that are supplying biogas into natural gas systems. In addition, a number of projects have been announced that will upgrade landfill gas to vehicle fuel.

A number of proprietary technologies are commercially available to upgrade biogas. Representatives of these technologies were contacted to obtain cost and performance information.

As previously discussed, the AD Facility will have parasitic power needs that can be supplied by the energy in the biogas. In a scenario where the primary use of the biogas is sale of methane into an existing natural gas pipeline, a portion of the biogas would be used to produce the parasitic power and the remaining biogas would be upgraded to pipeline quality biomethane. The system used to upgrade the biogas also requires parasitic power. In order to estimate the cost to upgrade the biogas to pipeline quality biomethane, the quantity of biogas remaining after the production of parasitic power must be estimated.

The annual parasitic electricity requirements of the biogas upgrading process are estimated to be 3,000,000 kWh per year based upon discussions with system suppliers. This electrical load, when added to the electric load of the waste processing and digestion portion of the AD Facility, results in an average total parasitic load of approximately 570 kW. This power generation will require approximately 110 scfm of biogas. Subtracting 110 scfm of biogas for parasitic power from the projected total biogas, results in 370 scfm available for upgrading to pipeline quality biomethane.

Electricity to the Grid Using Reciprocating Engines

With limited clean-up, the energy in the biogas can be converted to electricity by using the biogas as fuel for a reciprocating engine electrical generating set ("genset"). Gensets have been used in Europe to produce electricity from AD biogas. Gensets are used extensively in the United States to burn landfill gas and produce electricity. One of the advantages of using a genset is that it can be configured in a combined heat and power ("CHP") arrangement where the waste heat is converted to steam for use in the digestion process.

The major components of a genset-based CHP selling electricity to the local utility are:

- Biogas drying and compression
- Reciprocating engine and electric generator
- Heat recovery equipment
- Controls, switchgear, a transformer and interconnection equipment
- Prefabricated building with sound attenuation
- Auxiliary flare (to burn the biogas when the genset is not in service)

One of the disadvantages of this option is the emissions that are generated. Although biogas is a comparatively clean burning fuel, the emission of nitrogen oxides ("NO_X") cannot be avoided and NYC is a non-attainment zone for NO_X. The implications of the emission potential of a reciprocating engine are further discussed in a section later in this report.

Biofuel Sale as a Vehicle Fuel

In recent years, there has been growing interest in using CNG as a vehicle fuel. There are a number of CNG filling stations located in the New York Metro area. This option is simply taking the pipeline quality biomethane as described in the previous option, treating it more extensively, then using it in lieu of natural gas to create and dispense the biofuel equivalent of CNG. The primary components required are a cleaning system to remove contaminants that are potentially harmful to vehicle engines, a compressor station, storage tanks and a filling station.

Systems that convert landfill gas to CNG or LNG have been developed in the United States and are gaining popularity. These existing systems were used as the basis for the estimates in this memo.

The economic advantage of this option is the ability to sell the energy value from the biogas directly to the final user. This results essentially in the ability to sell biomethane at the retail level as opposed to the wholesale level offering potentially greater revenue generation. It also presents the opportunity for NYC to directly use the energy in its fleet and, thereby, support the AD Project. The financial feasibility of this option will hinge on the incremental value of the energy as a vehicle fuel as compared to the cost of delivering the biofuel.

Planning Level Cost Estimates

Planning level capital and operating cost estimates were developed for these three energy use scenarios based upon information obtained from equipment suppliers. The cost estimates were used in the economic analysis and are presented in Section 7 of this report.

Section 4
SITE PREPARATION

Three potential sites were evaluated as part of this Study. These sites are Site D, Site AOU2, and the Marine Transfer Station ("MTS") Site, as shown on Figure 4-1. The evaluation focused on determining the extraordinary site preparation costs associated with developing the AD Facility.

All three evaluated sites share some important attributes which will impact site development costs. The sites are within or immediately adjacent to areas subject to tidal action and flooding. Each of the sites includes disturbed soil strata and each will be either (1) remediated or (2) cleared of existing vegetation and structures before the AD Facility can be constructed. These particular site characteristics, for the most part, can and should be accounted for in the normal site development costs associated with any site. The following narrative summarizes the special features of the sites and the costs associated with the adaptation of such features to the AD Facility.

As described in Section 2, NYCEDC anticipates redeveloping the Produce Market in order to improve material handling and increase warehousing capacity. It is expected that the redevelopment of the site could provide the opportunity to reclaim the two warehouse buildings located on the western portion of the existing property (Buildings A and B); thereby creating approximately 35 acres of undeveloped area adjacent to the new Produce Market (comprised of new warehouse facilities and the retention of Buildings C and D). It has been suggested that this reclaimed area be considered as a potential location for siting an AD Facility. Aside from the obvious synergies that would be created by siting an organics recovery facility next to the Produce Market, the facility would have access to a lead rail track that allows boxcars to be transported between the Oak Point Rail Yard and the Produce Market.

If the two existing Produce Market structures (Buildings A and B) need to be demolished to clear the reclaimed area for an AD Facility, the reclaimed area may require some level of remediation. Remediation costs for the portion of the Produce Market being redeveloped are estimated to be approximately $4 million. Since the reclaimed area is about 1/3 the size of the area being redeveloped, it is possible that the remediation costs could be approximately $1.33 million. The site is not in the FEMA flood zone and is located outside the Con Ed remediation area. The evaluation of this potential location for the AD Facility was beyond the scope of this Report.

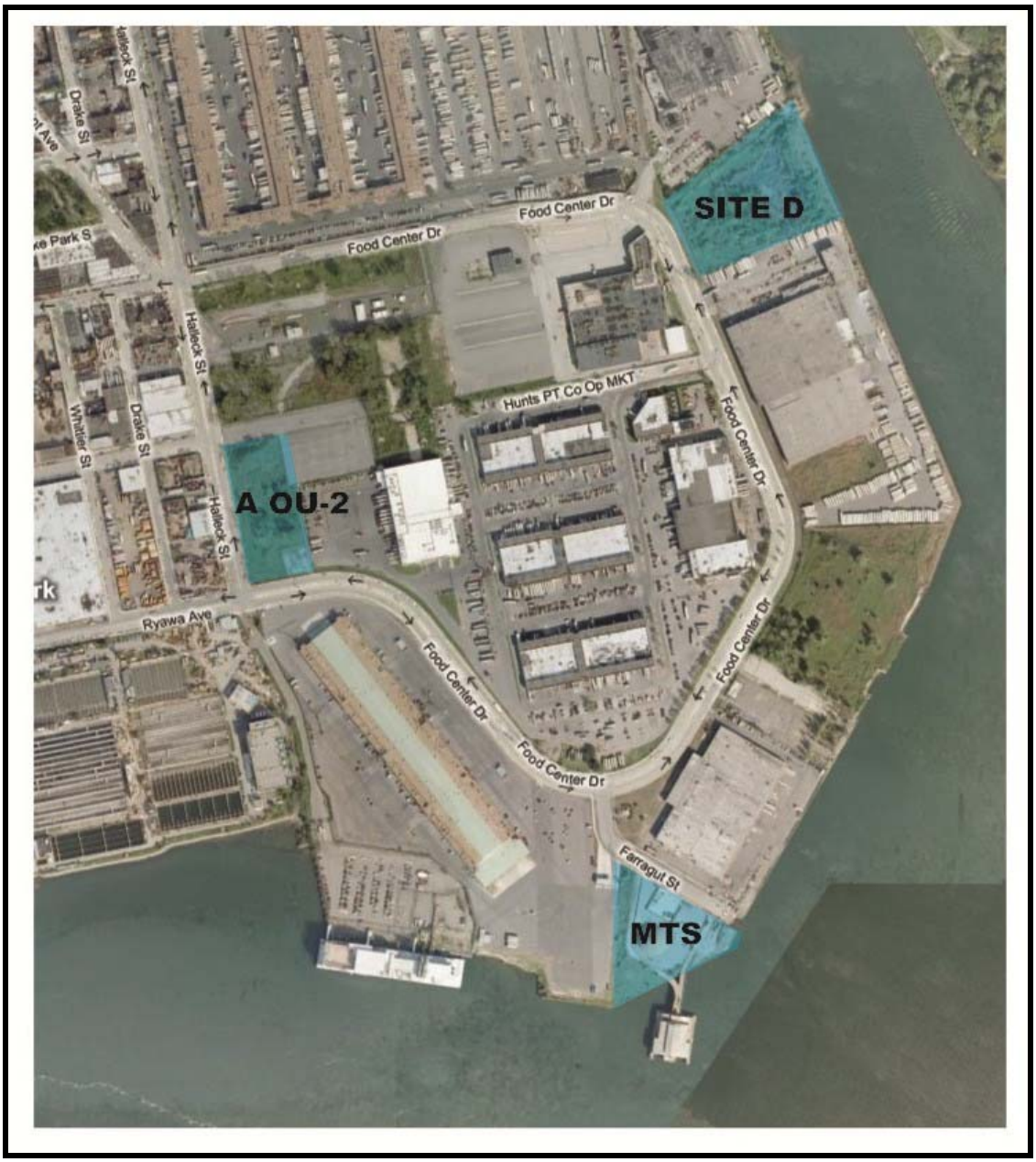

Figure 4-1. Hunts Point Site Map

Interconnections and Site Appropriateness

Site D is trapezoidal in shape and covers approximately 7.23 acres. The site is bounded on the west by Food Center Drive and an active railroad spur, on the east by the Bronx River, on the north by a produce distribution warehouse, and the south by a food distribution warehouse.

The AOU-2 site is a rectangular piece of property that covers approximately 3.2 acres. The site is located at the northeast corner of the intersection of Ryawa Avenue and Halleck Street. A sewer easement intersects a small portion of the northeast corner of the site. The Meat Market is located adjacent, and to the east, of site AOU-2.

Both Site D and AOU-2 will require remediation as a result of a Con Ed coal gasification plant that was initially constructed between 1924 and 1932 and operated until the early 1960s. The plant was constructed to manufacture both oven gas and carbureted water gas as major products with coke, ammonium sulphate, coal tar, water gas tar, and light oil as byproducts. Both sites contain coal tar that requires remediation.

The MTS Site is triangular in shape, covers approximately 3.9 acres and is located on Hunts Point Avenue and the East River. A bulkhead consisting of a steel sheet pile cofferdam exists along the East River. A dormant marine transfer facility located in the waters of East River is accessed from the site. An environmental assessment would need to be performed to determine if the site will require remediation.

Site D is the largest of the sites and the AD Facility will fit on Site D. Site AOU-2 appears (the site dimensions are in question and a survey is not available) to be the smallest of the sites. The potential may exist to acquire land to the east of Site AOU-2 from the Meat Market. If Site AOU-2 cannot be expanded, most AD Developers will likely consider the site too small. Although the MTS Site is larger than Site AOU-2, it is triangular and, therefore, there will be more unusable land. The MTS Site is marginal for a site size perspective. The de-watered digestate that remains following the digestion process has greater value if it is cured or composted. Curing or composting will take a significant space and choosing to transport uncured digestate to an off-site location for further processing could result in all the potential sites being large enough.

All of the sites are located either on Food Center Drive or within close proximity. As a result, they all have good access to utility services such as water, sewer, electric, gas and telephone. The electricity sale option will require an interconnection to the Con Ed distribution network. The Energy Strategy Plan for the Hunts Point Food Distribution Center prepared for NYCEDC by AECOM addresses interconnections with Con Ed. It states in part:

> *Con Edison's official policy is to allow any customer to operate electric generating equipment in parallel with their electric system "provided there is no adverse effect on the company's other customers, equipment, or personnel, or the quality of service." However, this determination of "adverse effect" leaves a large amount of uncertainty as to the outcome of any effort to interconnect to Con Edison's system. To be equitable, Con*

Edison's system was not designed to accommodate distributed generation. Rather, it was developed around the large scale centralized generation model that evolved in the early 20th century. Consequently, connecting DG to Con Edison's distribution system involves the introduction of a new source of power to the utility's distribution system at a point in the grid that was not initially designed to accept this power.

As with any other utility, connecting a DG facility to Con Edison's electrical system entails adherence to its standards. This requires that the necessary protection requirements are met and the appropriate approvals are obtained. These protection requirements are project and site specific and are determined by Con Edison on a case by case basis.

The Energy Strategy Plan should be consulted for additional information on the interconnection process and requirements.

Con Ed was contacted regarding the interconnection with either the electrical grid or the natural gas distribution system. They advised that it might be more advantageous to connect with their network at a location that uses a large quantity of electricity. The Meat Market is one such site and Site AOU-2 is contiguous to the Meat Market site. If Site AOU-2 is selected, the Meat Market might be alternative purchaser of the electricity, since they have an electrical load for their refrigeration system that exceeds the estimated electrical production potential of the AD Facility.

The biomethane sale option would require an interconnection to either the interstate pipeline or the Con Ed distribution network. Interstate pipeline operators are required by law to transport gas so the biogas could theoretically be sold to a distant purchaser and injected into the interstate pipeline. Gas in the interstate pipeline is at a much higher pressure as compared to the gas in the Con Ed distribution system. This increases the cost to sell the gas. The capital cost to connect with the interstate pipeline is also expected to be higher than the capital cost to interconnect with the Con Ed system. As a result of discussions with Con Ed, we have assumed that selling to Con Ed is more financially advantageous than selling on the open market in injecting into the interstate pipeline.

There is a natural gas compression station within the block that contains Site AOU-2 and, therefore, that site may be more advantageous if the sale of biomethane into the natural gas distribution system is the selected biogas use option.

Site Development Issues

Site D

This site is situated on the waterfront and is underlain by a saturated soil, whose specific geotechnical characteristics are currently unknown. It is highly likely that the vertical structures on the site will require driven piles for its foundations. Piles will need to be protected from corrosion by purifier waste. The site elevation is such that the waterfront structure will need to be modified and additional fill brought to the site.

Site D contains residual waste related to activities from the manufactured gas plant that previously existed in the vicinity of the site. These wastes include coal tar wastes and purifier type waste. The site will require remediation prior to the development of the AD Facility.

Site MTS

This site is much like Site D given its location on the waterfront. It too will require modification of the waterfront structure, importation of select fill to raise a portion of the site, and the use of driven piles to support vertical structures. An environmental site investigation has not been performed to determine the potential need for remediation. For purpose of this Study we have assumed that the site does not require remediation.

Site AOU-2

Site AOU-2 is not located on the waterfront and will not require any sort of perimeter structure or modification to an existing pile system. It will require importation of select fill to raise the elevation of portions of the site. It is highly likely that the saturated soils of Sites D and MTS extend underneath the site and, therefore, driven piles will also be required for the foundations of the vertical structures. Piles will need to be protected from corrosion by the purifier waste. A portion of this site has a sewer easement which could impact the site layout and might require obtaining some additional adjacent property.

Site AOU-2 contains residual waste related to the activities from the manufactured gas plant that previously existed in the vicinity of the site. These wastes include coal tar wastes purifier type waste and incinerator ash. The site will require remediation prior to the development of the AD Facility.

Foundation Piles

Each of the three sites will require special foundations for the vertical structures due to the saturated soil conditions. Given the proximity of the sites to each other, there is no meaningful distinction among the sites in their subsurface conditions from a load bearing perspective. That is, the cost of the special foundations, whatever they are, would be virtually the same for all three sites.

Extraordinary Costs

The extraordinary or special costs which we have identified as being beyond or in addition to ordinary development costs include:

- Waterfront protection structures for Sites D and MTS which would eliminate or mitigate storm surges or wave action along the site boundaries.
- Imported select fill to raise the ground elevation in the occupied portions of the three sites in order to mitigate flooding.

- The addition of fly ash for the treatment of surficial soils necessary for soil improvements under and near building foundations, driveways and parking.
- Limited adaptations or modifications to normal drainage and piping structures (such as headwalls, manholes, utility lines, and bedding) where the size of such structures might need to be enlarged to account for poor soil conditions.
- Costs associated with paving and parking, reflected in the additional quantities for additional asphalt and concrete pavement sections.
- Engineering, field inspection, and materials testing due to the additional time and effort required to design and construct the waterfront system, manage and test imported fill, and apply the fly ash amendment.

With the exception of the waterfront protection system for Sites MTS and D, all of the additional site development work can be accomplished as a part of, and under the same contract or contracts, one would normally let for site and utility work. Nevertheless, additional allowance has been made for certain items common to both routine and special work. These items include:

- Mobilization
- Construction Staking
- Environmental protection measures (taken during construction)
- Additional engineering and inspection

While it is somewhat difficult to differentiate in the field between surveying necessary to construct the normal development features and those additional features enumerated here, the extra work is almost always reflected in additional engineering and surveying costs as well. In these instances, we estimated additional staffing requirements based on our experience.

Waterfront Protection and Flood Mitigation

All of the considered sites are situated in areas which are subject to either storm surge or flooding. There are measures which can be incorporated in both the site design and the AD Facility design to eliminate or mitigate these threats. The exact configuration and extent of such structures will be determined by the facility designer.

For Sites D and MTS, we envisioned the construction of a 24-inch vertical extension of the sheet-piling along the waterfront. Behind the extension imported soil would be placed to form a berm of approximately 15 feet in width, to reinforce the wall. An alternative solution would be to place a berm parallel to the existing sheet-piling whose toe is parallel to the sheet-piling and simply forego the sheet-piling extension.

For all sites, we proposed the importation of select fill to raise the critical parts of the sites so as to eliminate or minimize flooding on the site around the critical structures. The site layout sketches we developed were used to arrive at a quantity for such works. If, as is most likely, the site layout is changed, the quantity of imported fill and the associated costs would be expected to change materially. One of the main efforts

in engineering of the AD Facility must be to integrate the facility layout with the site in such a way as to minimize these additional costs.

Effects of Planned Remediation Upon Site Development Costs

A properly planned and executed site remediation program should theoretically restore any given site to a usable and marketable, if not pristine, condition. Therefore, again theoretically, there should be no meaningful costs embedded in the site development budget for remediation tasks, work or systems. There are, however, certain costs which might be assumed, if not actually estimated, which may be considered as a part of the development costs.

Additional Soils Testing

Remediated sites invariably include a large volume of disturbed soils, therefore, traditional subsurface investigations (such as simple soils borings, standard penetration tests and soils profiling) often must be supplemented with other testing. Such testing might include test piles and flat-plate load testing. An allowance for this additional work has been provided in the site development cost spreadsheets and is designed to cover the costs of soils testing one would not otherwise undertake for a virgin site.

Lack of Significant Cost Differentials

Previous reports indicate that the remediation costs would be the greatest at Site D while Site MTS may require no remediation at all. Some allowance to accommodate previous remediation work, therefore, should be provided for Site D; there is no specific information upon which an estimate can be made at this time. Despite the site differences and the likely cost differentials due to the history of remediation, the costs are not considered to be of such a magnitude as to present a significant differentiating factor in site selection.

Cost Estimates

For each of the three sites, we estimate the following planning level extraordinary site preparation costs as:

- Site D $4.0 million
- Site MTS $3.6 million
- Site AOU2 $2.2 million

The accuracy of these estimates are plus 25 percent, minus 15 percent.

Section 5
REGULATORY FRAMEWORK AND PERMITTING

Introduction

This section identifies the regulatory framework and permitting requirements for the proposed AD Facility, with focus on the solid waste and AD aspects of the AD Project. The major local, state and federal regulations and permits are identified which may be applicable to the AD Facility. The AD Developer should anticipate pre-application meetings with the appropriate regulatory agencies to discuss project objectives and to identify specific permitting requirements.

City Level Environmental Permits

City Environmental Quality Review

In 1975, New York State enacted SEQRA that required all state and local government agencies to assess the environmental effects of discretionary actions before undertaking, funding, or approving the actions. SEQRA regulations allow a local government to promulgate its own environmental review procedures, provided that they are no less protective of the environment than state procedures. As a response to SEQRA, NYC established CEQR in 1977 and substantially modified the CEQR in 1991. CEQR is NYC's process for implementing the SEQRA. CEQR differs from the State Environmental Quality Review ("SEQR") in that its procedures pertain to proposed discretionary actions specifically taking place within the boundaries of NYC. It also adapts and refines the state rules to take into account the special circumstances of NYC. In addition, CEQR gives guidance on selection of a lead agency, adds scoping requirements, and outlines the environmental review responsibilities within NYC.

Under the 1991 Rules of Procedure for CEQR, each City agency acts as "lead agency" for projects that it approves, funds, and/or directly implements. The Office of Environmental Coordination ("NYC OEC") was set up as a policy office to complement and support the "lead agency" to ensure that they are applying consistent approaches and to provide expertise, as required, to agency staff who conduct environmental reviews.

Actions subject to CEQR are discretionary actions: (1) directly undertaken by a City agency; (2) funded by a City agency; or (3) approved by a City agency. They may be actions initiated by the City or actions proposed by private applicants for approval by City agencies. Ministerial actions, such as the routine issuance of building permits, are not subject to CEQR. As a result, the Hunts Point AD Facility will likely require a CEQR since the AD Project will be approved by the NYCEDC. The following

comprise a preliminary list of substantive impact areas for environmental review under CEQR:

- Land Use, Zoning, and Public Policy
- Socioeconomic Conditions
- Community Facilities and Services
- Open Space
- Shadows
- Historic Resources
- Urban Design/Visual Resources
- Neighborhood Character
- Natural Resources
- Hazardous Materials
- Waterfront Revitalization Program
- Infrastructure
- Solid Waste and Sanitation Services
- Energy
- Traffic and Parking
- Transit and Pedestrians
- Air Quality
- Noise
- Construction Impacts
- Public Health

The initial step of the CEQR is to perform an Environmental Assessment Statement ("EAS"). An EAS is a form to describe the proposed action and its location. The EAS presents a first level of analysis of the environmental review impact areas to determine potential effects on the environment. It is used by the lead agency to inform the determination of significance.

If the AD Project is to be developed by a private developer, the EAS report should be prepared by the developer. NYCEDC may act as a facilitator and review the CEQR. If the AD Facility site is not subject to brownfield cleanup requirements, the developer may not need to coordinate the CEQR with the NYC OEC, and can work with the Office of Environmental Remediation ("NYC OER") directly for the CEQR with NYCEDC as a facilitator. If, after preparation of the EAS, the lead agency determines that the AD Project will not have a significant adverse impact on the environment, it issues a negative declaration, which ends the environmental review process.

If actions of environmental significance are necessary (a positive declaration) based on the findings of the EAS, an Environmental Impact Statement ("EIS") is required to be completed by the lead agency for a discretionary action that has been determined to have the likelihood of having one or more significant adverse impacts on the environment. An EIS is a disclosure document that provides a complete analysis of all appropriate impact areas and provides a means for agencies, project sponsors, and the public to consider an action's significant adverse environmental impacts, alternatives, and mitigations. A draft EIS ("DEIS") is the initial statement that is circulated for review and comment and which is often combined with comments and responses to produce a final EIS ("FEIS"). The FEIS is the disclosure document upon which the lead and involved agencies set forth their decisions in a Statement of Findings. Public notice and/or hearing will be required as part of the EIS review process.

The approvals of the CEQR and SEQR are essential for the AD Project since they provide the overall environmental framework for other regulatory agencies to proceed with their review and approval of their environmental permits required for the AD Project.

City Level Solid Waste Permit

NYC regulates transfer stations and does not regulate waste processing facilities. The New York State Department of Environmental Conservation ("DEC") issues solid waste permits for various types of solid waste facilities including processing facilities and transfer stations. It is expected that a Part 360 solid waste permit will be required and that NYC will not consider the AD Facility a transfer station for its regulatory purposes. Please refer to the State Level Solid Waste Permit section for more details.

City Level Air Permit

Although NYC has its own Air Pollution Control Code ("Air Code"), the Air Code is mainly for NYC to regulate air emissions from certain industrial process equipment. The overall administration of the Federal Clean Air Act ("FCAA") is under the purview of the DEC. For the AD Facility, air emissions and permitting issues will be led by the DEC. Please refer to the State level Air Permit section for more details.

City Level Noise Permit

Noise complaints are one of the most common life quality issues for NYC residents. The current NYC Noise Code went into effect in July 2007 and was a major overhaul to NYC's Noise Code in 30 years. The Noise Code establishes rules, guidelines and standards for governing noise in NYC. The NYC DEP is responsible for implementing the Noise Code. Non-compliance with the Noise Code may result in penalty and/or remedial requirements from the NYC Environmental Control Board ("NYC ECB").

The main source of noise for the AD Project is likely to occur during construction of the Facility. To limit construction noise, the Noise Code requires that all construction be conducted in accordance with individual noise mitigation plans. Contractors

engaged in construction work have to develop a noise mitigation plan ("NMP") prior to the start of work. The construction NMP covers areas such as type of construction equipment and activities, work hours, perimeter noise barriers, and measures to reduce noise impacts in surrounding residences and businesses. In general, the construction NMP will be subject to the following procedures:

- Every construction site must have a NMP on location.
- If noise complaints are received, an inspector from NYC DEP will ensure the NMP is posted and being followed and determine whether it needs modification.
- When construction activity is planned near "sensitive receptors," such as schools, hospitals and houses of worship, the party responsible for construction is expected to design the NMP to be responsive to these receptors.

Depending on the final location of the AD Facility, the daily truck traffic to and from the AD Facility may have noise impact on the surrounding areas during operations. Although the current Noise Code does not have specific standards on AD Facility traffic, the current Noise Code standard on refuse collection vehicles may serve as a reference. The Noise Code requires that the maximum sound levels may not exceed 80 decibels when measured at a distance of 35 feet or more from the compacting unit of the vehicle when it is not engaged in compacting a load of refuse.

In addition, industrial air conditioners and rooftop circulation devices may generate noise impact due to their cooling size and location on rooftops near residential buildings. The Noise Code restricts the decibel levels created by air conditioners and other types of circulation devices with the following requirements:

- A single circulating device may not produce noise levels in excess of 42 decibels, as measured 3 feet from the noise source at an open door or window of a nearby residence.
- To account for the cooling needs of new construction or shifting building populations, the Noise Code limits buildings with multiple devices to a cumulative noise level of 45 decibels, as measured per the above standard.

City Level Wastewater Permit

Wastewater will be generated as part of the AD process at the Facility. The wastewater can either be discharged to NYC's sewer system or treated at the AD Facility as an optional module added to the AD Facility. The Hunts Point Water Pollution Control Plant ("WPCP") will be the wastewater treatment plant receiving the wastewater effluent from the AD Facility.

A Site Connection Application will be required by the NYC's DEP Bureau of Water and Sewer Operations for a new service connection for water and sewer services. Depending on the quantity and quality of the wastewater, NYC DEP may require some pre-treatment prior to discharge into NYC's sewer system.

If the AD Facility includes an optional on-site wastewater treatment plant ("WWTP"), the on-site WWTP will need approval from the NYC DEP Bureau of Wastewater Treatment ("Bureau").

State Level Environmental Permits

Uniform Procedures Act

The Uniform Procedures Act ("UPA") of Article 70 of the Environmental Conservation Law ("ECL") standardizes the procedures for administering the key regulatory permits issued by DEC. The Act provides time frames and procedures for:

- Filing and reviewing applications
- Providing public notice
- Holding public hearings
- Reaching final decisions

DEC implements the UPA through 6 NYCRR Part 621 – Uniform Procedures Regulations. For the AD Facility, Part 621 requires that a complete application, which includes a completed DEC application form and supporting documentation required by Part 621 and information required by specific program implementing regulations pertaining to the specific permit(s) sought for the AD Project. The combined applications should be filed with the Permit Administrator for DEC Region 2 which has the jurisdictions over Bronx County. The Region 2 staff will have the primary responsibility of review and approval of the permit applications for the AD Project.

State Environmental Quality Review

New York's SEQRA requires all state and local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision-making. The review process used by the DEC of these environmental impacts is called the SEQR.

SEQR is "triggered" if an agency has a discretionary decision to approve, fund, or directly undertake an action or project that may have an impact on the environment. Once SEQR is triggered, a sequential review process unfolds. Depending upon the complexity of a project, that review may be relatively brief or extensive. To determine whether SEQR applies to an action or project, the action must be classified as Type I, Type II, or Unlisted. A Type II classification requires completion of the SEQR process. For Type I and many Unlisted actions, a lead agency will administer the SEQR review. For the AD Project, it is likely that it will be classified as a Type I or Unlisted.

The lead agency (NYCEDC or NYC DEP) will determine whether the potential impacts of the proposed action require further study via an EIS. If no EIS is required, the SEQR process concludes with issuance of "Negative Declaration" by the lead agency. If an EIS is required with "Positive Declaration", the SEQR process must continue through acceptance of draft and final EISs by the lead agency, followed by issuance of SEQR. Findings by each involved agency which must make a decision regarding the action. Findings are a rationale for the agency's decisions and also certify that the action as approved will avoid or minimize adverse environmental

impacts to the maximum extent practicable. When an EIS is required, SEQR concludes with the issuance of findings. Once SEQR has been concluded, other DEC agencies may then make their final decisions based upon their underlying jurisdictions.

In general, the NYC's CEQR has more specific and stringent requirements than the SEQR since it is customized to NYC. Most of the environmental areas of consideration, documentation, and review process required by the CEQR and SEQR are similar and can be shared. However, DEC has the authority to use a different methodology to evaluate a particular area of environmental concern, or DEC may choose to adopt the information presented in the CEQR. Again, the approvals of the CEQR and SEQR are essential since they provide the overall environmental framework for other regulatory agencies to proceed with their review and approval of their environmental permits required for the AD Project.

State Part 360 Solid Waste Permit

The New York State Solid Waste Management Program is administered as a regionalized program. All Part 360 permits, registrations, variances and other permit-related determinations regarding the construction and operation of solid waste management facilities are issued on a regional basis. For the AD Project, DEC Region 2 will administer the Part 360 solid waste permit application and approval.

It is expected that the AD Facility will need to comply with the follow minimum requirements under Part 360-1.9:

- Complete applications for initial permits to construct and operate a solid waste management facility not specifically addressed in a subpart of this part must include and address the following (as minimum requirements), in addition to the requirements described elsewhere in the Part 360 Rules;
- Submit an engineering report, plans and specifications that must comprehensively describe and address the project in its environmental setting and the project's design, construction, operation, closure and post-closure monitoring;
- Prepare an operation and maintenance plan; and
- Provide a waste control plan.

State Air Permits

The overall administration of the FCAA is under the purview of the DEC. Specifically, the DEC Region 2 office will administer the air permits for the AD Project. For the AD Project, the main sources of air emissions are likely come from the following:

- Air emissions from the biofilter used to control odors: trace amounts of ammonia and H_2S.

- Air emissions from beneficial use of the biogas such as emissions from an internal combustion engine: NO_X, carbon monoxide ("CO")
- Occasionally flaring of biogas: NO_X and CO
- Minor air emissions from the aerobic composting operations: ammonia
- Wastewater treatment (if on-site treatment option is selected): trace amount of ammonia, H_2S and volatile organic compounds ("VOC").

Since NYC (and the site) is located in a "Severe Ozone Nonattainment Area", lower air emission thresholds will apply for the AD Project. Pre-construction and operating air permits from DEC are required for the air emission sources, and all air emissions within the same facility can be included as one air permit for the facility. Under the current 6 NYCRR Subpart 201 Rules, the AD Project will fall under one of the following three air permits:

- Title V Facility Permit
- State Facility Permit
- Minor Facility Registration

Any facility that has the potential to emit ("PTE") more than 25 tons TPY of NO_X and VOC, 100 TPY of fine particulate (PM-2.5), or 10 TPY of any hazardous air pollutants ("HAPs") or 25 TPY combined is considered a "Major Source" and will need to apply for a Title V Facility Permit. A facility which has the PTE less than the Major Source threshold but more than 50 percent of the thresholds can apply for a State Facility Permit. A Minor Facility Registration applies to those facilities which have a PTE less than 50 percent of the Major Source thresholds. PTE is the maximum capacity of the specified air pollutants that would be emitted if the source were operated full time (8,760 hours per year).

State Environmental Justice and Permitting

DEC issued Commissioner Policy-29 Environmental Justice and Permitting ("CP-29") in 2003 to address environmental justice concerns and ensure community participation in the DEC environmental permit review process. CP-29 amends the DEC environmental permit review process by identifying potential environmental justice areas and establishing requirements for proposed projects affecting those communities. CP-29 requires applicants for permits covered by CP-29 to actively seek public participation throughout the environmental permit review process. Public participation in the NYS DEC environmental permit review process means a program of activities that provides opportunities for stakeholders to be informed about and involved in the review of a proposed action.

According to a 2005 NYS DEC map of the State Environmental Justice ("EJ") Preliminary Screen for Bronx County, the AD Project site is listed as a Potential EJ Area. Specifically, CP-29 states that where a potential environmental justice area is identified by the preliminary screen, the applicant should submit a written "Public Participation Plan" as part of its complete application. At a minimum, the plan should demonstrate that the applicant will:

- Identify stakeholders to the proposed action;
- Distribute and post written information on the proposed action and the environmental permit review process;
- Hold a public information meeting or meetings to keep the public informed about the proposed action and the permit review process;
- Establish an easily accessible document repository or repositories in or near the potential environmental justice area;
- Provide a report or reports which summarize all progress to-date in implementing the plan, all substantive concerns raised to-date, all resolved and outstanding issues, the components of the plan yet to be implemented and an expected time line for completion of the plan; and
- Upon completion of the plan, submit written certification that the applicant has complied with the plan and submit a final report detailing the activities that occurred pursuant to the plan.

State Pollution Discharge Elimination System Permit

The Federal Clean Water Act provides that stormwater discharges associated with industrial activity from a point source (including discharges through a municipal separate storm sewer system) to waters of the United States are unlawful, unless authorized by a National Pollutant Discharge Elimination System ("NPDES") permit. In New York, US Environmental Protection Agency ("EPA") has approved the state program which is enacted through the administration of the State Pollutant Discharge Elimination System ("SPDES") program. There are three SPDES general permits required for activities associated stormwater discharges related to the AD Project:

- The Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activities ("MSGP")
- The General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems ("MS4s")
- General Permit for Stormwater Discharges from Construction Activities

Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activities

Industrial facilities must obtain permit coverage through either an individual industrial SPDES permit which address the stormwater discharges, obtain coverage under the SPDES MSGP for Stormwater Discharges Associated with Industrial Activity or provide certification using the "No Exposure Exclusion" that industrial activities are not exposed to stormwater.

The DEC administers the SPDES MSGP Permit for stormwater discharges associated with industrial activity. The SPDES MSGP is a five-year permit that covers new and

existing discharges of stormwater to waters of the United States from industrial activities as defined in 40 CFR Part 122.26.

The MSGP addresses stormwater runoff from certain industrial activities. This permit requires facilities to develop Stormwater Pollution Prevention Plans ("SWPPPs") and report the results of industry-specific monitoring to the DEC on an annual basis.

General Permit for Stormwater Discharges from Municipal Separate Storm Sewer Systems

According to the federal law commonly known as Stormwater Phase II, permits are required for stormwater discharges from MS4s in urbanized areas. Permittees are required to develop Stormwater Management Program ("SWMP") and submit annual reports to the DEC. The SPDES General Permit for Stormwater Discharges from MS4s is a two-year permit that covers new and existing discharges of stormwater to waters of the United States from MS4s as defined in the federal rules 40 CFR 122.26(b)(16).

"Municipal Separate Storm Sewer System" is specifically defined in 40 CFR Part 122.2. "Separate storm sewer system" includes ditches, curbs, gutters, storm sewers, and similar means of collecting or conveying runoff that do not connect with a wastewater collection system or treatment plant. And to be a "Municipal Separate Storm Sewer System," the system must be owned or operated by a public agency for example:

- A city or town
- A municipal utility district, flood control district, or other special district
- A county
- A state or federal agency

Under the Federal Clean Water Act, operators of MS4s are required to develop and implement SWMPs to reduce pollutant loadings to the maximum extent practicable. Typical SWMPs for MS4s are required to incorporate the following six elements:

- Public education and outreach
- Public participation and involvement
- Illicit discharge detection and elimination
- Construction site runoff control
- Post-construction stormwater management in new development and redevelopment
- Pollution prevention and good housekeeping for municipal operations and maintenance

General Permit for Stormwater Discharges from Construction Activities

Construction activities disturbing one or more acres of soil must be authorized under the General Permit for Stormwater Discharges from Construction Activities. Permittees are required to develop a SWPPP to prevent discharges of construction-related pollutants to surface waters. Prior to and during the construction of the AD Project, the following steps may be required to comply with the requirements of the General Permit for Stormwater Discharges from Construction Activity:

- Develop a SWPPP in accordance with the requirements in the General Permit for Stormwater Discharges from Construction Activity prior to construction.
- Complete the Notice of Intent ("NOI") form which is a request for coverage under the General Construction Stormwater Permit.
- Complete the MS4s SWPPP Acceptance Form prior to construction. This form is used by a regulated, traditional land use control MS4 (e.g., town, city or village) to indicate acceptance of the SWPPP it has reviewed. Projects subject to MS4s regulation must submit a signed SWPPP Acceptance Form along with their NOI. With some exceptions, an owner or operator of a construction project within the boundaries of an MS4 is required to have their SWPPP reviewed and accepted by the MS4 prior to submitting their NOI to the Department.
- When the construction project is complete and has met the requirements of the construction permit, a Notice of Termination ("NOT") form should be completed and submitted to the DEC.

Federal Level Environmental Permits

National Environmental Policy Act

Using the National Environmental Policy Act ("NEPA") process, federal agencies are required to determine if their proposed actions have significant environmental effects and to consider the environmental and related social and economic effects of their proposed actions. NEPA's procedural requirements apply to a federal agency's decisions for actions, including financing, assisting, conducting, or approving projects or programs; agency rules, regulations, plans, policies, or procedures; and legislative proposals.

Usually, private individuals, companies or local governments become involved in the NEPA process when they use federal funding for their projects or need a non-routine permit issued by a federal agency. NEPA is not likely to apply to the AD Project unless federal funds are considered. Moreover, no non-routine Federal permits are anticipated to be required.

Federal Air Permits

Federal air permits are administered through the DEC since NYS is an approved state to manage its own air programs under the FCAA.

National Pollutant Discharge Elimination System Permit

The Federal Clean Water Act states that stormwater discharges associated with industrial activity from a point source (including discharges through a municipal separate storm sewer system) to waters of the United States are unlawful, unless authorized by a NPDES permit. In New York, US EPA has approved the state program which is enacted through the administration of the State SPDES program. Consequently, the NPDES permit requirements are covered under the State's SPDES permit for the AD Project.

Section 6
ENVIRONMENTAL BENEFITS

Introduction

AD is a natural microbiological process in which bacteria decompose organic material in the absence of oxygen. The AD process produces a biogas that consists primarily of methane, carbon dioxide and water vapor. The nutrient-rich material that remains is called digestate (a fibrous byproduct and water). The digestate can be used as a fertilizer or soil amendment. AD facilities control and enhance the decomposition process to maximize efficiency and manage byproducts.

AD is best suited for the treatment of moisture-rich organic waste such as waste from wholesale food markets, restaurant waste and food processing waste. Within a controlled and managed facility, AD can be utilized to both divert waste from increasingly space limited landfills and as a source of two valuable renewable byproducts - “green” energy and a soil amendment. AD facilities provide a variety of environmental benefits which, given the proper design and a steady organics supply, offer a sustainable approach to waste management for the organic fraction of the waste stream.

Reduced Truck Traffic

The organic waste on the Hunts Point peninsula is currently trucked away for disposal at distant facilities. The AD Facility would reduce the number of trucks transporting waste on the Hunts Point peninsula because the AD Facility will convert waste that is currently trucked to distant disposal facilities into biogas, soil amendment and recovered materials. It is estimated that the AD Facility will process approximately 60,000 tons of waste annually and produce approximately 18,000 tons of product annually – a net reduction of approximately 42,000 TPY in materials needing to be transported off the peninsula. If the average truck holds 15 tons then 2,800 less trucks per year will be needed for waste management purposes. Reducing the number of truck loads reduces traffic volume and air pollution from moving and idling diesel trucks.

Produces Renewable Energy

The AD process generates biogas that contains methane, a combustible gas which is the primary gas in natural gas. The biogas can be treated and used as a replacement for natural gas in power generation or heating applications. It can also be converted to a vehicle fuel and used as a diesel fuel replacement in trucks. Using biofuel as a replacement for diesel fuel replacement in trucks reduces air pollution.

The AD Facility will produce renewable energy, meaning the energy is generated from natural resources and readily replenished. When methane goes uncollected, such as methane flared from a landfill, there is a loss of useful energy potential. Contrastingly, when renewable energy sources are tapped and used efficiently, the reliance on fossil fuels is offset. Reducing the use of fossil fuels decreases dependence on foreign oil and reduces air pollution, as burning renewable resources compared to fossil fuels results in fewer air emissions.

Reduced Air Emissions

Greenhouse gases ("GHGs"), gases that EPA has identified as contributing to climate change and global warming, may be reduced if the AD Facility is developed. Biogas is composed of about 60 percent methane and the remainder primarily carbon dioxide. Methane and carbon dioxide are both GHGs. Methane is considered to be 20 times more powerful a GHG than carbon dioxide. It is important to control the biogas that waste disposal operations create and, thereby, reduce the release of GHGs into the environment. Most organic waste in NYC is disposed of in landfills and landfills generally do not capture all of the GHGs that are generated as the waste decomposes. AD facilities divert organics from landfills and capture the GHGs reducing the overall waste management carbon footprint.

By harnessing biogas for energy, our reliance on fossil fuels is reduced. According to the EPA, burning methane is cleaner than burning coal or oil. Compared to the average air emissions from coal-fired power generation, methane produces half the carbon dioxide, less than a third of nitrogen oxides, and 1 percent of the sulfur oxides.

Conserve Landfill Space

Disposing of organic waste in landfills can be considered an inefficient use of landfill space. Organics are high in moisture content and can be transformed into a reusable materials. Although AD occurs naturally within landfills, the process is much slower in a landfill. The use of AD facilities for organic waste management diverts waste from landfills, conserves landfill space and reduces the demand for new landfills thereby reducing the overall environmental impacts of landfill disposal.

Produces Soil Amendment

The soil amendment which can be produced at the AD Facility is a renewable resource. Its use has the potential to offset the use of virgin soil; thereby avoiding the environmental impacts of removing virgin soil. In addition, a reliable supply of soil amendment can reduce the demand for peat, a soil additive found in wetlands, thereby preserving these natural areas.

Background

The management of commercial waste in NYC is a private activity undertaken by private collection companies often referred to in NYC as "carters." BIC (Business Integrity Commission) is a regulatory and law enforcement agency that oversees the private sanitation industry and the public wholesale markets in NYC. Every commercial establishment in NYC is required by law to have its waste removed by a private carting company. BIC sets the maximum rates that private carters can charge for waste removal services.

The maximum rates that carters are permitted to charge are based either by volume or by weight are $15.89 per cubic yard of loose refuse (volume), or $10.42 per 100 pounds of refuse (weight). While the customer and carter can negotiate whether the customer will be charged by volume or by weight, the customer has the right to choose by which method to be charged. If a commercial establishment does not want private carter service and wishes to remove its own waste and dispose it at private transfer stations, it must apply for a self-hauler registration.

It is unlikely that the AD Facility can be developed without one or more creditworthy entities guaranteeing the delivery of waste to the AD Facility at specified disposal fees. A number of AD Developers were contacted during this Study and they all indicated that waste delivery guarantees would be required. Although the quantity of waste under guarantee may not have to be the full capacity of the AD Facility, it will have to be a sufficient quantity of waste to assure the financial community that there will be sufficient project revenues to pay the debt service and provide the expected return on equity. The guarantees could be provided by waste generators, waste haulers or a government entity. The waste-to-energy ("WTE") facilities developed in the 1980s and 1990s typically required waste delivery guarantees and serve as a good example of the concept. The vast majority of the WTE facility financings were structured with a governmental entity guaranteeing the waste disposal revenues. There is no "rule of thumb" that provides guidance with regard to the percentage of the anticipated waste revenues that must be guaranteed. The specific financing arrangements, outlined later in this report, have historically been supported by waste delivery guarantees when applied to waste disposal facilities.

Interviews with Potential Waste Suppliers

The Organics Recovery Feasibility Study identified the need to secure a waste stream as a key element of project feasibility. Potential waste suppliers were interviewed on November 18 and 19, 2009 to discuss this issue. Meetings were held at the Produce

Market, the Meat Market and the Fish Market in an effort to better understand the potential for waste guarantees as one of the key components for any long-term financing. A meeting was also held with Sanitation Salvage, partial owner of the Metropolitan Transfer Station, and the contract hauler for the Fish Market.

Produce Market

Approximately half of the waste generated at the Produce Market is collected from common areas of the market and cannot be attributed to a specific wholesaler. NYC, as the lessor of the property, has financial responsibility for disposal of all common area waste. While there have been discussions between NYC and the Produce Market about whether this agreement will remain in force in the future; as long as it remains in force, then the AD Developer can assume that the common area waste would be delivered to the AD Facility, if NYC determines that it is in their best interest to do so. The other half of the waste generated at the Produce Market is currently the responsibility of the individual wholesalers.

Approximately 45 wholesalers ("Cooperators") are members of the Hunts Point Terminal Produce Cooperative Association, Inc. ("Cooperative Association") and have operations at the Produce Market. Gaining control of the wet waste from the docks could conceivably be as difficult as contracting with 45 separate Cooperators. According to Matt D'Arrigo, the Cooperative Association President, the Cooperators tend to be very independent, making it difficult to conceive of a process whereby an AD Developer could successfully negotiate individual, long-term contracts. However, four Cooperators currently generate roughly 50 percent of the dock waste, so even if the AD Developer had to enter into separate contracts, four major players would be responsible for the majority of the remaining wet dock waste, and could set the stage for acquiring more than 50 percent of the additional dock waste.

While it may be possible to find an AD Developer willing to take on this project development task together with all of the other project development tasks associated with successfully financing the AD Facility, it is likely that NYCEDC would need to take a more active role for waste supply negotiations to be successful.

Because the NYCEDC holds the master lease for all three of the markets, the NYCEDC could make it a condition of their master lease that all organic waste generated at the Produce Market (and the Meat and Fish Markets) be delivered to the AD Facility as a means to secure waste. Each of the three cooperative markets could then decide how it would achieve this requirement.

One way for the Produce Market to meet a master lease obligation imposed by NYCEDC, or to assure delivery without a master lease obligation, would be for the Cooperative Association to take over the collection and transport of the wet waste using its own trucks and equipment. According to J.R. McIntyre, Produce Market Manager, the Cooperative Association has discussed taking over collection of common area and dock waste in the past, and is willing to consider it going forward.

Alternatively, the Cooperative Association could agree to require that all wet waste be delivered to the AD Facility over a fixed time period. In this case, each Cooperator

could continue to contract for collection with a carter, but the carter would be required to deliver the material to the AD Facility. This approach would essentially allow each Cooperator to continue to pay for waste as they do now, with no change in the collection process. This approach also has the benefit of allowing each Cooperator to negotiate its best deal with a hauler, while assuring that all the waste is delivered to the AD Facility. However, based on discussions with Matt D'Arrigo and the Produce Market Manager, it could be difficult to assure an agreement from all of the Cooperators even if the economics were favorable, and the long-term risks are low, because they are reluctant to make long-term financial commitments.

The Produce Market pays Royal Waste roughly $1 million per year, under a three-year contract, to remove the common area waste and deliver it to the Waste Management Inc. transfer station at Harlem River Yards. NYC pays for disposal by issuing disposal vouchers/tickets to the Produce Market. The current tipping fee is $90.97 per ton. The annual common area waste quantity is estimated at 13,000 TPY resulting in a $1,182,610 annual estimated disposal cost for NYC.

Royal Waste also collects almost all of the dock waste – although there is currently no prohibition against one or more of the Cooperators contracting with a different carter. Royal Waste charges $20 per cubic yard for the "dry waste" (back of the dock) and $25 per cubic yard for wet waste (front of the dock). These rates are greater than NYC's rate caps. We understand based upon information provided by BIC staff that a Memorandum of Agreement exempts Produce Market waste from the rate cap.

Current rates for collection and disposal of dock wastes can be compared against the rates reported to DSM in 2004 (at the beginning of the previous study). At that time, Circle Waste was charging $16.50 per cubic yard for "dock" waste. Circle Waste did not report a separate rate for wet and dry dock waste. Assuming that the $16.50 was used for all dock waste, it can be compared against an average of the two reported rates charged today, or $22.50 per cubic yard. This represents an increase of 73 percent over 5 years or an average annual increase of approximately 10 percent. This increase compares to an annual average tip fee increase of 4 percent to 5 percent at NYC transfer stations between 1997 and 2007, according to David Biderman, of the National Solid Waste Management Association.

Assuming that the wet waste generated at the Produce Market has a density ranging from 400 to 500 pounds per cubic yard, then 4 to 5 yards equals one ton. At $25 per cubic yard, Royal is charging each Cooperator roughly $100 to $125 per ton to collect and dispose of the wet waste.

Meat Market

The Meat Market is primarily a distribution and storage facility with limited processing. As a result, the Meat Market is not a significant generator of waste suitable for AD. The only exception is meat, fat and bone, which is currently collected for rendering. At the time of the December 2008 meeting with the Meat Market management, the individual wholesalers were paying up to $25 per collection for the meat, fat and bone. This material is stored in either 55-gallon drums or in

small dumpsters. Each wholesaler generates different amounts of meat, fat and bone and the cost per ton varies from one wholesaler to another.

As of the follow-up interview on November 18, 2009, the rendering companies were collecting the meat, fat and bone at no cost, making it less likely that the AD Facility could compete for this material.

Fish Market

The Fish Market Manager negotiates an agreement with a single carter to collect the waste requiring disposal. Unlike the Produce Market, which disposes of all of their organic waste, the Fish Market wholesalers sell a portion of their fish waste for uses such as bait, fertilizer and pet food production. As a result, it is likely that the density of the waste collected for disposal at the Fish Market is less than the density of the Produce Market dock waste. Sanitation Salvage holds the current contract with the Fish Market. Individual wholesalers then deliver their waste to the collection truck and pay the negotiated rate per cubic yard of $19.75/cubic yard. Assuming a density of 250 pounds per cubic yard, this is equivalent to $158 per ton for collection and disposal. The waste is currently tipped at the Metropolitan Transfer Station – which is partially owned by Sanitation Salvage.

The issue of a guarantee of waste delivery to the AD Facility was raised with the Fish Market Manager during a telephone interview. While the negotiated arrangement with a single carter should make it easier to guarantee waste to the AD Facility, the Fish Market Manager was hesitant to commit to the concept of a guarantee at this time. The meeting was useful, however, in that the Fish Market Manager now has a better understanding of why a guarantee may be necessary, and is willing to have further discussions on this issue as the project develops.

Current and Projected Tipping Fees

A key in determining the feasibility of the AD Facility will be the ability to charge relatively stable tipping fees at the AD Facility that are competitive with tipping fees at alternative transfer stations. Projections of future tipping fees are difficult to make, especially at this time of such economic uncertainty.

According to David Biderman, of the National Solid Waste Management Association, tipping fees increased between 50 and 60 percent at NYC transfer stations between 1997 and 2007. This is roughly double the official rate of inflation reported for this same time period. However, the economic recession has reduced waste generation and exerted significant downward pressure on rates throughout the United States (including the NYC metro area) in 2008 and 2009.

NYC currently pays $90.97 per ton for waste disposal at the Harlem River Yards transfer station under NYC's long-term contract with Waste Management. The waste delivered to the Harlem River Yards transfer station under NYC's long-term contract is primarily residential waste generated in the Bronx; a limited amount is institutional or commercial waste for which NYC has disposal responsibility. By comparison, the reported rate for disposal of Fish Market waste at the Metropolitan Transfer Station

was roughly $78 per ton in December of 2009. An additional point of reference are transfer stations in northern New Jersey. The statewide average for New Jersey is currently $81 per ton (October 2009) based on tipping fees reported to New Jersey Department of Environmental Protection. Based upon this information, a tip fee at the AD Facility of $80 per ton (escalated from 2009) was assumed.

Projected Future Tipping Fees

As stated above, projecting tipping fees over the expected 20-year financing of an AD facility is inherently difficult because of the challenges associated with predicting future economic and regulatory conditions. The three largest variables impacting future tipping fees are likely to be:

- Changes in economic growth over the next ten years;
- The price of fuel; and
- Elimination or modification of the rate cap by NYC.

Changes in Economic Growth

Waste disposal quantities have fallen in the northeast between 10 and 15 percent over the past two years, reflecting the economic recession. This drop in waste disposal has forced landfills, and especially WTE facilities, to lower their tipping fees (especially spot market tip fees) to attract sufficient refuse.

During past economic downturns, it has been common to assume that as the economy improved, waste disposal would increase with economic growth. However, it is not clear that waste generation will automatically climb back to pre-recession levels after this economic downturn, if and when economic growth resumes. This is because there is some evidence that structural changes in production and consumption of goods are also occurring, reducing per capita generation going forward. If this is the case, then existing landfill and WTE capacity will remain relatively readily available even as the economy improves implying relatively stable tipping fees over the intermediate term (five years).

When the uncertainty associated with future waste generation is combined with the large amount of low cost landfill capacity available in up-state New York, Ohio, Pennsylvania and Virginia, it is difficult to predict large increases in landfill (and, therefore, competing WTE) tipping fees going forward. Thus, it is unlikely that increasing disposal fees at landfills and WTE facilities will be the driving factor with respect to potential increased disposal fees faced by waste generators.

Fuel Prices

More important to the long-term trend for NYC area tipping fees may be the future price of fuel used to transfer waste to distant disposal facilities. While fuel prices are also related to economic recovery in the United States, they are much more dependent on worldwide demand. Because a significant amount of NYC waste is transported long distances, significant increases in fuel prices could have large impacts on tipping fees at transfer stations.

The impact on tipping fees in the Bronx will be somewhat mitigated by the amount of waste shipped by rail, which is significantly more fuel efficient than truck transfer. However, not all waste can be shipped by rail, and as the cost of truck transfer increases, rail transfer stations will be able to charge higher prices on the spot market for commercial waste.

Future legislation regarding the control of greenhouse gas emissions are likely to further increase fuel prices over and above the increases due to increased worldwide demand.

Elimination of the Rate Cap

Private carters have argued for some time now that the rate cap is unnecessary in today's competitive market, and that it has been set too low, especially for the types of wet waste that the AD Facility will receive. If NYC were to remove the rate cap, it is possible that tipping fees would rise at transfer stations once the carters have more ability to charge higher rates and pay increased tipping fees.

Tipping Fees for the Financial Feasibility Analysis

Given the uncertainties in projected future tipping fees, DSM recommended that the financial feasibility analysis use a range of tipping fees, as follows:

- Most conservative: Assume that tipping fees will only increase at the assumed inflation rate of 3 percent;
- Most reasonable: Assume that tipping fees will increase at an annual average rate of 4 percent; and
- Optimistic: Assume that tipping fees will increase at an annual average rate of 5 percent.

The base case financial analysis assumes a tipping fee of $80 escalated from 2009 at the assumed inflation rate of 3 percent. The sensitivity analysis evaluated the impact of tip fees escalating at both 4 percent and 5 percent. The sensitivity analysis also evaluated the impact of the tipping fee being $70 and $90.

Assuring a Waste Stream to the AD Facility

It is reasonable to expect that NYCEDC will have to take an active role in the development of the AD Facility to assure the timely development of the project. Important actions that NYCEDC could take include:

- A requirement in the master site leases that all organic rich loads be shipped to the AD Facility – Based on discussions with representatives of the three cooperative markets, it appears that it will be difficult for the cooperative markets to agree to require their members to deliver all waste to the AD Facility unless NYCEDC either requires, or proposes to require, such a commitment under the master site lease. The Cooperators at all three markets are, by nature, independent and are also adverse to long-term contractual obligations given the nature of their business. While they would undoubtedly object to such a

requirement by NYCEDC, the real impact on their bottom line would be relatively small in most cases because waste disposal costs are, in general, a small part of their total cost of doing business.

- Elimination of free tipping for Produce Market common area waste with substitution of free rejects disposal for the AD Facility – As described elsewhere in this report, NYC is responsible for the disposal of Produce Market common area waste. This arrangement provides an incentive for the Cooperators to push waste off the docks and into the common area. While there is an historical precedent for the decision to provide free tipping of common area waste, the Produce Market recognizes that this is unlikely to continue indefinitely with some limitations, or without strings attached to its continuance. NYC might be better served by using the funds it expends on disposal of Produce Market common area waste to support the AD Facility by taking responsibility for the disposal of rejects from the AD Facility. NYC's current cost to dispose of the Produce Market common area waste is approximately $1 million per year. If NYC took responsibility for the disposal of rejects from the AD Facility, its cost of disposal would be approximately $350,000. This approach would need to be coupled with a requirement that all organic rich waste generated at the Produce Market be disposed of at the AD Facility.
- Encouragement of a joint venture between the AD Developer and a private carter with wet waste routes – The waste supply risk can be substantially reduced by development of the AD Facility in conjunction with an existing carter that is currently tipping organic rich waste on the Hunts Point peninsula. The NYCEDC should consider this type of arrangement during the procurement of an AD Developer for the project.
- NYC might also consider delivering organic rich loads of waste that is currently tipped at the Harlem River Yards transfer station if that can be done without a net increase of truck traffic on the Hunts Point peninsula. To the extent that NYC route collection vehicles currently garaged on the Hunts Point peninsula can deliver organic rich loads to the AD Facility when returning to the garage for the day this would not represent an increase in truck traffic entering and leaving the Hunts Point peninsula.

Infrastructure Costs

AD Facility Cost Estimates

AD Facility cost estimates were developed using a combination of engineer's estimates and inquiries to system suppliers and equipment vendors. Costs were developed in three general categories – extraordinary site development costs, the AD system, and energy production. Extraordinary site development costs were developed based upon site information provided by NYCEDC and engineering estimates presented in Section 4 of this report. Costs related to the receipt, processing and digestion of waste were estimated based upon information received from various system suppliers and project developers. The costs related to three biogas use

scenarios were developed based upon a combination of information supplied by system suppliers, equipment vendors and our experience with similar systems on other projects.

Development Costs

The AD Developer will expend considerable effort advancing the project to the point at which all approvals are obtained and the AD Facility can be financed. For purposes of the financial analysis, an allowance of $2 million was included in the capital cost estimate for these development costs. The allowance was established based upon information received from various AD Developers and our general experience with renewable energy projects.

Extraordinary Site Costs

The NYCEDC has identified three potential sites for the AD Facility. Two of the sites are waterfront properties and are in a flood zone. One of those two also requires remediation. The third site requires remediation but is not a waterfront property. Although the AD Developer is not expected to absorb the remediation costs, the extraordinary costs of constructing the AD Facility on a previously remediated site are assumed to be the responsibility of the AD Developer. An analysis was performed to determine the nature and cost of extraordinary development work which would be required to construct the AD Facility on these specific sites. A description of the analysis and cost estimates is contained in Section 4 of this report. As described in Section 4 of this report, the estimated cost for additional or extraordinary development work on the sites ranged from $2.2 to $4 million. The base case analysis includes an allowance of $3 million and the sensitivity analysis evaluated the impact of a variation of this amount.

Waste Processing Area and Digestion System Cost

The AD Facility is likely to consist of a number of different buildings, processes and systems including the following:

- Waste Receiving Building and Storage Area
- Waste Processing and Preparation
- Digestion
- Digestate Dewatering and Curing
- Biogas Treatment
- Wastewater Treatment
- Energy Production
- Odor Control

During the development phase of the project, a preliminary design for the project site and each of the facility buildings and systems will be developed. There are numerous

proven AD technologies to an AD Developer. Different AD Developers are likely to take different approaches to the facility design and use different technologies. Some of the differences will be driven by the AD process that is chosen. Some will be driven by the anticipated markets for the digestion byproducts.

The material resulting from the digestion process is often called digestate. The digestate is rich with nutrients and can be used as a fertilizer or soil amendment. In some locations, the digestate can be directly land applied – this is unlikely to be an option for the AD Facility. Alternatively, the digestate can be dewatered with the liquid being disposed and solids being cured in an aerobic composting process. The aerobic composting can be performed either at the AD Facility or at another site. An alternative to composting the digestate solids would be a thermal drying system to produce either a soil amendment or fertilizer pellets. On-site composting will require a larger facility site as compared to the other digestate management options. The AD Developer will determine the best method of managing the digestate based upon the site characteristics and the product markets. The financial analysis is based upon an on-site composting approach assuming a conservatively low soil amendment price.

The cost estimate includes an odor control system that collects potentially odorous air from various areas of the AD Facility such as the waste receiving and processing areas. The odor control system would also include a biofilter to remove odorous components.

In order to develop an estimated range of capital costs for the AD Facility, AD system suppliers were contacted and requested to submit cost information on a confidential basis. The submitted cost estimates were reviewed, adjusted as appropriate to account for project specifics and used on an aggregated basis. The adjusted estimates ranged from $20 to $45 million. These were planning level estimates and the actual cost of the AD Facility could vary significantly from these estimates. An AD system cost of $40 million was assumed in the base case to evaluate project feasibility. The sensitivity analysis that was conducted included evaluating the impact of capital costs on the overall project economics.

Electricity Production

Electricity is produced for on-site use, as well as for, export in one of the biogas use scenarios. Cost estimates for two sizes of electric generation systems were developed. The larger system would use all of the biogas generated by the AD system to produce power for both on-site use and for export. The smaller system would use only the biogas necessary to produce the electricity used by the AD Facility with the balance of the biogas upgraded to pipeline quality gas. The potential sites are all located in a Severe Ozone Non-attainment Area and the cost estimates are based upon systems that can be permitted in such an area.

Interconnect with Consolidated Edison

An interconnection is required with the local electric utility, Con Ed, which enables the AD Facility to both sell power to the electrical grid and to purchase standby power when the on-site power generation system is not in operation. The estimated cost for the interconnection was provided by Con Ed.

NYSERDA Grant

On December 16, 2009 the Public Service Commission announced that up to $30 million of new funding would be available for "large-scale downstate solar photovoltaic ("PV"), anaerobic digester and fuel cell projects". It is unknown how much of this funding could be obtained for the AD Facility. NYSERDA currently has an Anaerobic Digester Gas-to-Electricity Program that provides incentives related to the production of electricity from AD generated biogas. In the current program, the maximum support to a project is $1 million dollars. There is a capacity incentive that can be used to support the purchase and installation of equipment and a performance incentive to support operating costs. The maximum allowed capacity incentive of $350,000 was used to reduce the capital cost requiring financing.

The project support amount can have a significant impact on project economics. If, for example, the $1 million maximum support limit were increased to $5 million, it would have the same impact on the project feasibility as a $5 per ton decease in the tip fee.

Biogas Upgrading AD Facility

In order to sell the biogas as pipeline quality gas, or biomethane, it is necessary to dry the gas and remove the non-methane gases to achieve a methane percentage in the range of 97 percent and a heating value of at least 975 Btu/standard cubic feet ("Btu/scf"). A number of proprietary technologies are commercially available to upgrade biogas. Representatives of these technologies were contacted to obtain cost and performance information. Based upon information obtained from equipment suppliers, we developed a planning level cost estimate for the biogas upgrading system of $2,600,000.

Biogas Export Infrastructure

In order to sell upgraded biogas, it must be piped to either the Con Ed distribution system or the interstate pipeline that transects the FDC site. Based upon discussions with Con Ed, it has been determined that a gas interconnection with the Con Ed distribution system would be more economically feasible as compared to interconnecting directly with the interstate pipeline. Based on discussions with Con Ed, an allowance of $600,000 was included in the capital cost for the piping and the interconnection costs.

Vehicle Fuel Filling Station

In this third biogas use scenario, the upgraded biogas is sold as vehicle fuel at a filling station co-located with the AD Facility. The equipment necessary is the same equipment that is currently in use at filling stations that compress natural gas from distribution networks. It is unlikely that a filling station that only uses biogas would be feasible since the quantity of biogas produced is relatively small and the production will not necessarily be consistent with the need. It is more likely that the filling station will use natural gas to supplement the biogas. The portion of the filling station that would be allocated to the sale of biogas is estimated to be $2,000,000.

Start-up and Testing

An allowance of $2,000,000 was included for the start-up and testing activities that will occur after the completion of construction and prior to the commercial operation. This allowance was established based upon the operating cost estimates obtained from various AD Developers.

Capital Cost Estimates

The capital costs shown in Table 7-1 and described herein formed the basis of the project financing options and economic feasibility analyses.

Table 7-1
Capital Costs

Capital Costs (in 2009$)	Electricity	Biogas	Biofuel
Development Costs	$ 2,000,000	$ 2,000,000	$ 2,000,000
Extraordinary Site Costs	3,000,000	3,000,000	3,000,000
AD Facility	40,000,000	40,000,000	40,000,000
Electricity Production Facility	2,900,000	2,000,000	2,100,000
Electrical Interconnection	1,000,000	500,000	500,000
NYSERDA Grant	(350,000)	--	--
Biogas Upgrading Facility	--	2,600,000	2,600,000
Biogas Export Infrastructure	--	600,000	--
Vehicle Fuel Filling Station	--	--	2,000,000
Start-up and Testing	2,000,000	2,000,000	2,000,000
Total Capital Cost	$50,550,000	$52,700,000	$54,200,000

Environmental Attributes and Tax Credits

The following environmental attributes and tax credits as listed below were considered in the economic analysis.

- Carbon Credits
- RECs
- Section 45 Renewable Energy Tax Credits and new Accelerated Depreciation options

Tax Credits that are established in the Emergency Economic Stabilization Act include both ITCs and PTCs. While revenue from the sale of Carbon Credits and RECs can be realized by both public and private project owners, the financial value of the project's Tax Credits can only be realized by a private, taxable entity. The Tax Credits can only be fully maximized by a private owner who has other, non-project related taxable income against which it can apply tax losses in excess of project-generated taxable income. Furthermore, Section 45 Federal Tax Credits are only available to electric generation facilities.

Table 7-2 summarizes the applicability of these financing features under the three evaluated biogas use scenarios.

Table 7-2
Applicability of Financing Features

Project Configuration	Carbon Credits	RECs	Section 45 Tax Credits
Electricity Production	Yes	Yes	Yes (1)
Biomethane Production	Yes	No	No
Vehicle Fuel Production	Yes	No	No

(1) For purposes of this memo, we have assumed that the Project would qualify under Federal Tax Regulations for Section 45 Tax Credits either as an "open loop biomass facility" or as a "municipal solid waste" facility or both. Final determination of such qualification will depend upon the exact nature and source of the organic material to be process and a detailed review by qualified Tax Counsel. Of course we can make no representation or warranty regarding the outcome of that review.

Revenue and Expense Projections

Revenues and expenses were estimated for the AD Facility based on the three difference biogas use scenarios – electricity production, biomethane production and vehicle fuel production. The revenues and expenses related to waste processing and digestion are the same in all three scenarios. In addition to evaluating the overall financial feasibility of the project, the economic analysis enabled the comparison of the three biogas use scenarios under differing assumptions for key variables such as capital cost, operating cost, tip fee and energy prices.

Assumptions

In order to project revenues and expenses, a number of assumptions were made as shown on Table 7-3 and described herein. The values shown in Table 7-3 are held constant over the 20-year analysis period.

Table 7-3
General Assumptions

Variable	Value	Explanation
Base Year	2009	Cost estimates were made in current 2009 dollars and escalated as appropriate by either the assumed general inflation rate or a specific escalation factor identified herein.
Waste Received (TPY)	60,000	Approximately 60,000 TPY of organic rich municipal solid waste ("ORMSW") is available for disposal at the AD Facility.
Produce Market Common Area Waste (TPY)	13,000	As described previously in this memo, the disposal cost of the common area waste at the Produce Market is the responsibility of NYC. This waste volume is currently delivered to the Harlem River Yard Transfer Station. If it were delivered to the AD Facility, NYC would realize a disposal fee savings at the Harlem River Yard Transfer Station. The estimated quantity of common area waste at the Produce Market is 13,000 TPY.
Digestable Content	80%	The digestible content of the ORMSW was assumed to be 80 percent. The

Variable	Value	Explanation
		digestible content impacts the quantity of biogas and digestate generated.
Wood Content	10%	Wood will not digest in the type of AD systems likely to be proposed for the AD Facility. The pre-processing system should enable the removal and recycling of the wood. The wood content of the ORMSW was assumed to be 10 percent.
Other Non-Digestable Content	10%	Other non-digestible materials should be removed by a pre-processing system. A portion of the plastic and the metals should be recyclable. This portion the ORMSW was assumed to be 10 percent.
Biogas Production Rate (ncm/ton) (1)	109	For the purpose of estimating the energy production of the AD Facility, it was assumed that biogas would be produced at a rate of 120 ncm per metric ton of waste received. This translates to 109 ncm per short ton.
Percent Methane	60%	The methane content of the biogas produced by the digestion process will vary depending upon the composition of the waste digested and the facility design. The AD Facility designer will perform tests on the waste that is expected to be received before designing the digestion system. Based upon information received from AD system suppliers a methane content of 60 percent was assumed.
Methane Heating Value (Btu/scf)	1,000	1,000 Btu/scf is the generally accepted value.
Electricity Genset Availability	92%	A conservative estimate of 92 percent was assumed based upon historical performance of similar systems.
Biogas Use System Availability	92%	A conservative estimate of 92 percent was assumed base upon discussions with system suppliers.
Material Recovery Percent	80%	The wood and a portion of the other non-digestible material received can be recycled thereby reducing the quantity of waste requiring disposal. Based upon discussions with AD Developers it has been assumed that 80 percent of the non-digestible material received will be recovered and not require disposal.
Soil Amendment Production	30%	The combined liquid and solid material resulting from the digestion process is often called digestate. This material can be dewatered and cured to produce a soil amendment. Based upon the characteristics of the ORMSW and information provided by AD Developers, it was assumed that the quantity of soil amendment produced will be 30 percent by weight of the waste received.
General Inflation Rate – Annual	3%	Assumed 3 percent based upon NYCEDC guidance for consistency with current DSNY assumptions.
Commercial Tip Fee Escalation Rate	3%	Assume 3 percent for consistency with the general inflation rate.
Operating Cost Factor	0%	This factor is used in the sensitivity analysis to add the specified percentage increase to the operating cost.
NYSERDA Assistance	1	The input in this cell s used in the sensitivity analysis to switch between assuming a NYSERDA Grant will be available or not (yes=1, no=0).
Electric Power Price Factor	1.00	This factor is used in the sensitivity analysis to adjust the assumed electric power prices above the prices assumed for the base case.
Gas Price Factor	1.00	This factor is used in the sensitivity analysis to adjust the assumed biogas prices above the prices assumed for the base case.

(1) Normal cubic meters per ton ("ncm/ton").

Assumptions were also made for various costs and unit prices that increase over the analysis period. These assumptions are listed in Table 7-4 in 2009. Table 7-5 indicates how these assumptions are escalated for the first, tenth and twentieth years of

operations. The Year 2015 was assumed as the first year of operations to allow for the development and construction of the AD Facility.

Table 7-4
Cost and Price Assumptions in 2009

Variable	2009 (1)	Explanation
Tip Fee ($/ton)	$80.00	For the base case analysis, a tip fee of $80 was assumed and that rate was escalated yearly at the assumed commercial tip fee escalation rate.
Rejects Disposal Cost ($/ton)	$130.00	A portion of the received ORMSW is neither digestible or recyclable and will need to be transferred to a disposal facility. Based upon discussions with carters the cost to haul and dispose of the waste is assumed to be the commercial tip fee plus $50 per ton.
Electrical Energy Price ($/kWh) (2)	$0.094	The assumed sale price of electrical energy was based upon wholesale price projections provided by NYCEDC multiplied by Electric Power Price Factor in some of the sensitivity cases.
Electrical Capacity – Summer ($kW-month) (2)	$14.50	The assumed sale price of electrical capacity was based upon projections provided by NYCEDC multiplied by the Electric Power Price Factor in some of the sensitivity cases.
Electrical Capacity – Winter ($kW-month) (3)	$7.92	The assumed sale price of electrical capacity was based upon projections provided by NYCEDC multiplied by the Electric Power Price Factor in some of the sensitivity cases.
REC Price ($kWh)	$0.025	Assumed $0.025 based upon recent market prices. To be conservative, the price was not escalated and it was assumed that the credits were only available for 10 years.
Carbon Credit ($ per ton)	$6.00	Assumed $6 based upon recent market prices. To be conservative, the price was not escalated and it was assumed that the credits were only available for 10 years.
Biogas Sale Price ($/MMBtu) (2)	$9.69	The assumed sale price of biogas was based upon wholesale price projections for natural gas provided by NYCEDC and multiplied by Gas Price Factor in some of the sensitivity cases.
CNG Price ($/diesel gal eq) (3)	$2.00	The assumed sale price of $2 is based upon recent market prices and is escalated at the same rate as the projected natural gas prices.
Electricity Purchase Price ($/kWh)	$0.16	Based in the prices currently being paid to Con Ed by similar customers.
Recovered Materials Price	-	Since the recovered materials markets can vary substantially with local supply and demand a conservative assumption that they could be given away but not sold.
Soil Amendment Price ($/cy) (4)	$5.00	A $5 to $10 dollar range is conservative based upon discussions with a leading company in the organics management business. Five dollars was used in the base case and a sensitivity analysis was performed.
Water Cost ($/1,000 gal)	$3.49	Based on published rates.
Sewer Cost ($1,000 gal)	$5.55	Based on published rates.

(1) 2009 is the Base Year.
(2) In 2015 dollars.
(3) Gallon equivalent ("gal eq").
(4) Cubic yard ("cy").

Table 7-5
Future Year Cost and Price Assumptions

Cost and Price Assumptions	2009 (1)	2015	2024	2034
Tip Fee ($/ton)	$80.00	$95.52	$124.64	$167.50
Rejects Haul and Disposal Cost ($/ton)	$130.00	$155.23	$202.54	$272.19
Electrical Energy Price ($/kWh)	-	$0.094	$0.136	$0.166
Electrical Capacity – Summer (kW-month)	-	$14.50	$17.41	$21.11
Electrical Capacity – Winter (kW-month)	-	$7.92	$9.54	$11.34
REC Price ($kWh)	$0.025	$0.025	$0.025	$0
Carbon Credit ($ per ton)	$6.00	$6.00	$6.00	$0
Biogas Sale Price ($/MMBtu)	-	$9.69	$14.19	$22.76
Vehicle Fuel Price ($/diesel gal eq)	$2.50	$2.16	$3.17	$5.08
Electricity Purchase Price ($/kWh)	$0.16	$0.19	$0.28	$0.34
Recovered Materials Price	$0	$0	$0	$0
Soil Amendment Price ($/cy)	$5.00	$5.97	$7.79	$10.47
Water Cost ($/1,000 gal)	$3.49	$6.18	$8.07	$10.84
Sewer Cost ($1,000 gal)	$5.55	$9.83	$12.82	$17.23

(1) 2009 is the base year for cost estimation purposes.

Operating Parameters

A number of operating parameters for the various AD Facility processes were estimated that impact revenue and expense estimates. These operating parameters are listed in Tables 7-6 through 7-9.

Table 7-6
AD Operating Parameters

Variable	Value	Explanation
Biogas Produced (scfm)	439	This parameter is calculated based upon the assumed biogas generation rate and the assumed waste processing rate.
Materials Recovered (TPY)	9,600	This parameter is calculated as the Materials Recovery Percentage multiplied by the Waste Received quantity.
Rejects (TPY)	2,400	Calculated based upon the assumed Digestible Content, the Materials Recovery Percentage and Waste Received quantity.
Soil Amendment Produced (TPY)	14,400	This parameter is calculated as the Compost/Digestate Production multiplied by the Waste Received quantity and multiplied by the Digestable Content percentage.
Electrical Usage (kWh/yr)	2,600,000	Based on information provided by AD Developers. Electrical usage can vary greatly depending upon the facility design. The financial feasibility is not significantly impacted by this factor.
Water Usage (1,000 gal/yr)	200	Estimated from information provided by AD Developers. Water use can vary greatly depending upon the facility design. The financial feasibility is not significantly impacted by this factor.
Wastewater Produced (1,000 gal/yr)	36,000	Estimated from information provided by AD Developers. Wastewater generation can vary greatly depending upon the facility design. Designs that result in high generation rates might also included wastewater treatment systems to minimize this disposal expense. The financial feasibility is not significantly impacted by this factor.
Carbon Credits Generated	42,000	Estimated based upon the Climate Action Reserve Organic Waste Digestion Project Protocol and recent carbon credit sales. Credits decrease from 42,000 to 6,600 in the fourth year.

Table 7-7
Electricity Production Operating Parameters

Variable	Value	Explanation
Electricity Generated (kWh/yr)	11,400,000	Calculated based information provided by power system vendors and the assumed availability. The estimate is net of power system auxiliary power, but not other AD Facility power uses.
Electricity Usage (kWh/yr)	2,400,000	Calculated based on the AD system electrical power usage multiplied by the assumed power system availability factor.
Electricity Sold (kWh/yr)	9,000,000	Calculated as the difference between the Electricity Generated and the Electricity Usage.

Table 7-8
Biomethane Production Operating Parameters

Variable	Value	Explanation
Biogas Use for On-Site Power (scfm)	110	The biogas upgrade system uses electricity which is assumed to be produced by an on-site power generation system. This parameter represents that amount of biogas the will be used by the power generation system to upgrade the biogas and is based upon estimated on-site power usage and the estimated efficiency of the electricity production system.
Biogas Available for Upgrade (scfm)	329	This parameter is calculated as the difference between the Biogas Produced and the Biogas Use for On-Site Power.
Methane Recovery Rate (percent)	95%	The biogas upgrading system can not recover 100 percent of the methane contained in the raw biogas. Based upon information obtained from upgrade system suppliers a methane recovery rate of 95 percent was assumed.
Upgraded Biogas Produced (scfm)	173	Calculated based upon previously described parameters.
Upgraded Biogas Produced (scf/yr)	83,000,000	Calculated based upon previously described parameters.
Upgraded Biogas Energy Produced (MMBtu/yr)	83,000	Calculated based upon previously described parameters.
Electricity Usage (kWh/yr)	3,000,000	Calculated based upon previously described parameters.
Auxiliary Power Production (kWh/yr)	5,600,000	Calculated as the sum of electricity usage by the AD system and the biogas upgrading system.

Table 7-9
Vehicle Fuel Production Operating Parameters

Variable	Value	Explanation
Electricity Usage (kWh/yr)	700,000	The CNG filling station, primarily the compressors, will use a significant quantity of electricity. The amount was estimated based upon information obtained from system suppliers.
Energy Use (MMBtu/yr)	8,000	The electricity used by the CNG filling station is assumed to be produced by an on-site power generation system. This parameter represents that amount of biogas the will be used by the power generation system to supply the filling station electric load and is calculated based upon the estimated electricity usage at the filling station and the assumed efficiency of the power generation system.
Energy Sold (MMBtu/yr)	75,000	Calculated as the difference between the upgraded biogas energy produced and the energy used at the filling station.
Diesel Gal. Equivalents Sold (gal/yr)	550,000	Calculated from the energy sold and the heating value of diesel fuel.

Revenue Estimates

Based upon the previously described assumptions and operating parameters, the revenues associated with the AD Facility operation were estimated for the three biogas use scenarios. Revenues were projected over a 20-year period and used in a life cycle financial analysis. The projected revenues for the first, tenth, and final years are shown in Tables 7-10 through 7-12.

Tip Fees - Commercial – Approximately 80 percent of the waste that would be receive at the AD Facility is currently being tipped at local transfer stations. This revenue stream is calculated as the Tip Fee multiplied by the difference between the Tons Received and the Common Area Waste Tonnage.

Tip Fees - Common Area Waste – As described previously in this memo, the disposal cost of the common area waste at the Produce Market is the responsibility of NYC. This waste is currently delivered to the Harlem River Yard Transfer Station. This revenue stream is calculated as the Tip Fee multiplied by the Common Area Waste Tonnage.

Recovered Materials Sales – Recovered materials included wood, metal and plastics. The quality of these materials is not likely to result in any significant revenue. It is assumed that the materials will be removed from the site at no cost to the AD Facility.

Soil Amendment Sales – Calculated as the assumed soil amendment sale price multiplied by the soil amendment quantity.

Power Sales - Capacity – Calculated as the assumed value of electricity production capacity, based upon projections provided by NYCEDC, multiplied by the export capacity of the AD Facility.

Power Sales - Energy – Calculated as the Electricity Export Sales Price multiplied by the quantity of electricity sold.

Biogas Sales – Calculated as the Biogas Sale Price multiplied by the Biogas energy produced.

Vehicle Fuel Sales – Calculated as the CNG Sale Price multiplied by the Diesel Gallon Equivalents sold.

REC Sales – Calculated as the REC Price multiplied by the quantity of electricity sold.

Carbon Credits – Calculated as the Carbon Credit Price multiplied by the Carbon Credits generated.

NYSERDA Incentive Payment – NYSERDA currently has an AD Gas-to-Electricity Program that provides incentives related to the production of electricity from AD generated biogas. In the current program, the maximum support to a project is $1 million dollars. There is a capacity incentive that can be used to support the purchase and installation of equipment and a performance incentive to support operating costs. The performance incentive is $0.10 per kWh. Subtracting the $350,000 capacity incentive which is used to purchase equipment from the $1 million project maximum leaves $650,000.

Expense Estimates

Based upon the assumptions and operating parameters, expenses were estimated for the three biogas use scenarios. Expenses were projected over a 20-year period and used in a life cycle financial analysis. The projected expenses for the first, tenth, and final years are shown in Tables 7-10 through 7-12.

General Expense – This expense category covers overhead costs such as insurance that are not associated with the operation of one of the processes or systems at the AD Facility. A $500,000 per year allowance (in 2009$) has been assumed for these expenses. The amount is escalated at the assumed inflation rate.

AD Facility Operation and Maintenance ("O&M") – This expense category includes the labor and materials necessary to receive and process the waste, digest the waste, cure the digestate and control odor. The estimate is based upon information obtained from AD Developers. The amount is escalated at the assumed inflation rate.

Power Production O&M – This expense category includes the labor and materials necessary to operate the electrical generation system. The estimate is based upon information obtained from system suppliers. The amount is escalated at the assumed inflation rate.

Biogas Upgrading O&M – This expense category includes the labor and materials necessary to operate the biogas upgrading system. The estimate is based upon information obtained from system suppliers. The amount is escalated at the assumed inflation rate.

Vehicle Fuel Production O&M – This expense category includes the labor and materials necessary to operate a compressed gas filling station. The estimate is based upon information obtained from equipment suppliers. The amount is appropriate for the quantity of fuel that is assumed to be produced from biogas. Should a filling station be selected as the biogas use option, it is likely that fuel will also be produced from natural gas obtained from the local utility since the demand for fuel is likely to be greater than the quantity of fuel that can be produced from biogas. The amount is escalated at the assumed inflation rate.

Gas Sale Connection Fee – This is a fee that Con Ed will charge to maintain the connection to their natural gas distribution system so that the AD Project can sell biogas to either Con Ed or a third party. The fee estimate is based upon discussions with Con Ed.

Capital Repair and Replacement – Major capital repair and replacement costs were assumed to be 1 percent of the initial capital cost of the AD Facility. The amount is escalated at the assumed inflation rate.

Waste Disposal – Calculated as the Rejects quantity multiplied by the Rejects Disposal Cost.

Water and Sewer – Calculated as the quantity multiplied by the unit cost.

Debt Service – For purposes of the economic analysis of the three biogas use scenarios, the public ownership financing option was used since it is the only financing arrangement that is common to all three biogas use scenarios.

Net Cash Flow

Revenues and expenses were projected over a 20-year operating period and the net cash flow was calculated. The 20-year net present value ("NPV") of net cash flows was used to compare the three biogas use scenarios and as the metric used in the sensitivity analysis.

Table 7-10
Electricity Production – Pro Forma Summary

	2015	2024	2034
Revenues			
Tip Fees Commercial	$4,490,000	$5,860,000	$7,870,000
Tip Fees - Common Area Revenues	$1,240,000	$1,620,000	$2,180,000
Recovered Materials Sales	$0	$0	$0
Soil Amendment Sales	$190,000	$250,000	$340,000
Power Sales – Capacity	$110,000	$130,000	$160,000
Power Sales – Energy	$850,000	$1,230,000	$1,500,000
REC Sales	$230,000	$230,000	$0
Carbon Credits	$250,000	$40,000	$0
NYSERDA Incentive Payment	$650,000	$0	$0
Total Revenues	$8,010,000	$9,350,000	$12,040,000
Operating Expenses			
General Expense	$600,000	$780,000	$1,050,000
AD Facility O&M	$1,470,000	$1,930,000	$2,580,000
Power Production O&M	$110,000	$140,000	$190,000
Capital Repair and Replacement	$510,000	$670,000	$900,000
Waste Disposal	$370,000	$490,000	$650,000
Water and Sewer	$360,000	$460,000	$620,000
Total Operating Expenses	$3,420,000	$4,460,000	$5,990,000
Net Revenues (1)	$4,590,000	$4,890,000	$6,050,000
Debt Service	$4,260,000	$4,260,000	$4,260,000
Net Cash Flow	$330,000	$630,000	$1,790,000
Net Present Value	$8,300,000	$0	$0

(1) Available for Debt Service and Return on Equity.

Table 7-11
Biomethane Production - Pro Forma Summary

	2015	2024	2034
Revenues			
Tip Fees - Commercial	$4,490,000	$5,860,000	$7,870,000
Tip Fees - Common Area Waste	$1,240,000	$1,620,000	$2,180,000
Recovered Materials Sales	$0	$0	$0
Soil Amendment Sales	$190,000	$250,000	$340,000
Biogas Sales	$800,000	$1,180,000	$1,890,000
REC Sales	$0	$0	$0
Carbon Credits	$250,000	$40,000	$0
NYSERDA Incentive Payment	$0	$0	$0
Total Revenues	$6,980,000	$8,940,000	$12,270,000
Operating Expenses			
General Expense	$600,000	$780,000	$1,050,000
AD Facility O&M	$1,470,000	$1,930,000	$2,580,000
Biogas Upgrading O&M	$220,000	$300,000	$400,000
Gas Sale Connection Fee	$60,000	$80,000	$100,000
Capital Repair and Replacement	$530,000	$690,000	$930,000
Waste Disposal	$370,000	$490,000	$650,000
Water and Sewer	$360,000	$460,000	$620,000
Total Expenses	$3,610,000	$4,870,000	$6,340,000
Net Revenues (1)	$3,360,000	$4,220,000	$5,930,000
Debt Service	$4,440,000	$4,440,000	$4,440,000
Net Cash Flow	$(1,080,000)	$(230,000)	$1,490,000
Net Present Value	$(2,300,000)	$0	$0

(1) Available for Debt Service and Return on Equity.

Table 7-12
Vehicle Fuel Production - Pro Forma Summary

	2015	2024	2034
Revenues			
Tip Fees - Commercial	$4,490,000	$5,860,000	$7,870,000
Tip Fees - Common Area Waste	$1,240,000	$1,620,000	$2,180,000
Recovered Materials Sales	$0	$0	$0
Soil Amendment Sales	$190,000	$250,000	$340,000
Vehicle Fuel Sales	$1,190,000	$1,740,000	$2,790,000
REC Sales	$0	$0	$0
Carbon Credits	$250,000	$40,000	$0
NYSERDA Incentive Payment	$0	$0	$0
Total Revenues	$7,360,000	$9,510,000	$13,180,000
Operating Expenses			
General Expense	$600,000	$780,000	$1,050,000
AD Facility O&M	$1,470,000	$1,930,000	$2,580,000
Biogas Upgrading O&M	$220,000	$300,000	$400,000
Vehicle Fuel Production O&M	$130,000	$170,000	$230,000
Capital Repair and Replacement	$530,000	$700,000	$940,000
Waste Disposal	$370,000	$490,000	$650,000
Water and Sewer	$360,000	$460,000	$620,000
Total Expenses	$3,690,000	$4,820,000	$6,470,000
Net Revenues (1)	$3,680,000	$4,690,000	$6,710,000
Debt Service	$4,570,000	$4,570,000	$4,570,000
Net Cash Flow	$(890,000)	$120,000	$2,150,000
Net Present Value	$3,100,000	$0	$0

(1) Available for Debt Service and Return on Equity.

Economic Analysis Results

The economic analysis indicates that electricity production is the most feasible biogas use scenario. This result is primarily driven by the following factors:

- The electricity production scenario had the lowest estimated capital cost.
- The electricity production scenario had higher energy revenues than the biomethane production scenario and essentially the same energy revenues compared to the vehicle fuel production scenario.
- RECs and NYSERDA grants only apply to electric generating facilities and, therefore, do not benefit either the biomethane production or vehicle fuel production scenarios.

Under the base case assumptions and cost estimates, the biomethane production scenario also appears to be feasible. The vehicle fuel production scenario appears only to be feasible using a non-traditional financing structure such as grants or the advanced purchase of energy or disposal services by NYC. The vehicle fuel sale scenario appears to be more feasible than the biomethane production scenario due to the relatively low current cost of natural gas.

Other Potential Options

The economic analyses for the electricity production and biomethane sale scenarios assumed sales at the wholesale level. The project economics could be improved by selling energy directly to energy users. An example being the sale of electricity to the Meat Market. The project economics would be improved if energy were sold at higher prices due to the elimination of an intermediary such as Con Ed. The economic analysis for the vehicle fuel production scenario did not include potential Tax Credits or other federal government incentives. Government incentives to encourage CNG use by vehicles are being considered and could improve the feasibility of this option.

Specific Financing Arrangements

Five alternative project financing structures were identified and evaluated.

Numerous combinations of these financing features may be considered by an AD Developer. In addition to a public ownership structure, four private ownership project finance structures were analyzed to demonstrate the impact of the various financing features on the economic feasibility of the project. The five project finance structures analyzed were:

- Public Ownership / General Obligation Bonds
- Third-Party Tax Equity Investor Utilizing the ITC
- Third-Party Tax Equity Investor Utilizing the ITC with Prepaid Revenue
- 80/20 Private Debt/Equity and PTC
- 80/20 Tax Exempt Solid Waste Revenue Bonds/Equity, and Grant or Prepaid Revenue

While all five of these financing structures are applicable to the electricity production scenario, ITCs are not applicable to either the biomethane production or vehicle fuel production scenarios. The resulting 11 combinations of biogas use scenarios and project financing structures were analyzed using a 20-year life cycle analysis. The input variables to the analysis were capital cost and net cash flow available for debt service and investor return on equity.

It is important to note that these financial models are not intended to represent detailed project financing plans, the development of which is beyond the scope of this study. For example, the use of any one of these financing options would require detailed negotiations of final terms among the debt lender, tax investor and/or AD Developer to allocate total project return in a mutually acceptable manner and to structure the

term and payment schedule of any project debt to more closely match the pattern of annual project net revenues, among other details.

The purpose of the model development was simply to indicate which financial structures should be further examined by evaluating the impact of the various financing features on the financial feasibility of the project. Generally, where a General Obligation Debt ("G.O. Debt") project financing option results in an average debt coverage ratio of 1 or greater or where a private financing option results in a return of 20 percent or more, we have characterized the option as "Feasible" and, thus, worthy of further examination. It is important to note, that the characterization of whether or not a structure is feasible is based upon the base case assumptions and costs. The financial structure feasibility could change under differing assumptions and costs. An economic analysis was performed which included a sensitivity analysis of the key assumptions and costs.

The results of the financing structure analysis are summarized in Table 7-13. The analysis shows that when using the base case assumptions a number of the financial structures result in a feasible project.

An important next step which NYC should undertake in anticipation of any public procurement of the project on a private financing basis would be to engage the services of a firm or individual with the specific legal expertise to review the applicability of the various financing mechanisms examined herein in order to determine and verify that they can be used in the project financing as assumed. Upon completion of this review, one or more of the "Feasible" financing options can be expanded into a more detailed project financing plan and offered as part of NYC's potential project RFP. Other financial, economic and business aspects of any future RFP would also need to be developed.

Table 7-13
Summary of Results

Assumed Financial Structure	Metric	Conclusion
Electricity Production		
Pubic Ownership/G.O. Debt	1.15 (1)	Feasible
Third-Party Tax Equity Investor Utilizing the ITC	18% IRR (2)	Not Feasible
Third-Party Tax Equity Investor Utilizing the ITC with Prepaid Revenue	23% IRR (2)	Feasible
Traditional 80/20 Debt/Equity with PTC	6% IRR (2)	Not Feasible
Traditional 80/20 Debt/Equity with Grant	49% IRR (2)	Feasible
Biomethane Production		
Public Ownership/G.O. Debt	0.99 (1)	Borderline
Traditional 80/20 Debt/Equity	Negative IRR (2)	Not Feasible
Traditional 80/20 Debt/Equity with Prepaid Revenue	24% IRR (2)	Feasible
Vehicle Fuel Production		
Public Ownership/G.O. Debt	1.08 (1)	Feasible
Traditional 80/20 Debt/Equity	Negative IRR (2)	Not Feasible
Traditional 80/20 Debt/Equity with Prepaid Revenue	26% IRR (2)	Feasible

(1) Average Debt Coverage Ratio.
(2) Internal Rate of Return ("IRR").

Sensitivity Analysis

In order to understand the impact that various key assumptions have on project feasibility, a sensitivity analysis was performed by varying the inputs for the following parameters:

- AD System Capital Cost
- Operating Cost
- Tip Fee
- Tip Fee Escalation
- Extraordinary Site Development Costs
- Electric Power Price Factor
- Natural Gas Price Factor
- NYSERDA Assistance
- Soil Amendment Price
- Recovered Materials Price

For purposes of the sensitivity analysis, the public debt financing structure was used since it was the only financing structure common to all biogas use scenarios. The net cash flow after debt service was calculated for each year in the 20-year analysis period

and the net present value of those cash flows was used to evaluate the impact of a change in the variable being evaluated. The results are shown in Tables 7-14 to 7-23.

Table 7-14
Sensitivity Analysis – AD System Capital Cost

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV – Vehicle Fuel
Base	$40,000,000	$8,300,000	$(2,300,000)	$3,100,000
Lower	$30,000,000	$25,500,000	$12,500,000	$17,900,000
Higher	$50,000,000	$(8,800,000)	$(17,200,000)	$(11,800,000)

Note: The AD system capital cost is both the largest and the most variable of the various capital components that contribute to the total capital cost.

Table 7-15
Sensitivity Analysis – Operating Cost Factor

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	0%	$8,300,000	$(2,300,000)	$3,100,000
Higher	10%	$1,700,000	$(9,400,000)	$(4,100,000)
Lower	-10%	$15,000,000	$4,700,000	$10,200,000

Table 7-16
Sensitivity Analysis – Tip Fee

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	$80	$8,300,000	$(2,300,000)	$3,100,000
Lower	$70	$(2,000,000)	$(12,700,000)	$(7,300,000)
Higher	$90	$18,700,000	$8,000,000	$13,400,000

Table 7-17
Sensitivity Analysis – Tip Fee Escalation

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	3%	$8,300,000	$(2,300,000)	$3,100,000
Higher	4%	$22,600,000	$11,900,000	$17,300,000
Higher	5%	$39,300,000	$28,700,000	$34,100,000

Table 7-18
Sensitivity Analysis – Extraordinary Site Development Costs

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	$3,000,000	$8,300,000	$(2,300,000)	$3,100,000
Lower	$0	$12,100,000	$1,400,000	$6,800,000
Higher	$6,000,000	$4,600,000	$(6,100,000)	$(700,000)

Table 7-19
Sensitivity Analysis – Electric Power Price Factor

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	1.0	$8,300,000	$(2,300,000)	$3,100,000
Lower	0.8	$4,800,000	$(2,300,000)	$3,100,000
Higher	1.2	$11,800,000	$(2,300,000)	$3,100,000

Table 7-20
Sensitivity Analysis – Natural Gas Price Factor

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	1.0	$8,300,000	$(2,300,000)	$3,100,000
Lower	0.8	$8,300,000	$(6,000,000)	$(2,300,000)
Higher	1.2	$8,300,000	$1,300,000	$8,400,000

Table 7-21
Sensitivity Analysis – NYSERDA Assistance

Case	Input Assumption (1)	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	1	$8,300,000	$(2,300,000)	$3,100,000
None	0	$7,300,000	$(2,300,000)	$3,100,000

(1) Note: 1 = Yes, 0 = No.

Table 7-22
Sensitivity Analysis – Soil Amendment Price

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	$5	$8,300,000	$(2,300,000)	$3,100,000
Lower	$0	$4,600,000	$(6,000,000)	$(600,000)
Higher	$10	$12,000,000	$1,400,000	$6,800,000

Table 7-23
Sensitivity Analysis – Recovered Materials Price

Case	Input Assumption	NPV - Electricity	NPV - Biomethane	NPV - Vehicle Fuel
Base	$0	$8,300,000	$(2,300,000)	$(600,000)
Higher	$5	$9,400,000	$(1,200,000)	$3,100,000
Higher	$10	$10,600,000	$(100,000)	$6,800,000

The sensitivity analysis reveals that most important factors effecting financial feasibility are:

- AD Facility Capital Cost
- Operating Cost
- Tip Fee and the Tip Fee Escalation Assumption
- Grant Funding Availability
- Willingness of NYC to Prepay for Disposal Services or Energy

The amortization of the AD Facility capital cost in the base case economic projections is larger than the total operating expense and is roughly 50 percent of the total revenues. The planning level cost estimates for the AD system portion of the capital cost obtained from AD Developers ranged from $20 to $45 million and $40 million was used in the base case economic projections. If this cost were $30 million, all of the biogas use scenarios would be feasible.

A variation in the operating costs can significantly impact project feasibility since the base case results show that the net cash flow is relatively low as a percentage of revenue.

Tipping fee revenues represent approximately 60 percent of the total revenues in the base case economic projections and are a major factor in the feasibility analysis. The base case included an assumed tip fee of $80 escalated from 2009. At a $70 tip fee the AD Facility does not appear to be feasible unless one of the other factors changed in a positive manner.

Although tip fees have declined recently, they have historically increased at a rate greater than the general inflation rate. The base case economic projections assume

that both the general inflation rate and tipping fee escalation rate are 3 percent per year over the 20-year analysis period. If tipping fees were to escalate at a rate of 4 percent or more, the project would be feasible for all biogas use scenarios.

The sensitivity analysis for extraordinary site development costs indicates that these costs are not as significant to the project feasibility as other factors.

The sensitivity analysis for both the electric power price and natural gas price indicates that a variation in theses prices is not as significant to the project feasibility as other factors, such as tip fee.

Grant funding can have a significant positive impact on the feasibility of the project since the grants would be used to reduce the capital cost and the resultant debt service. The assumed maximum NYSERDA assistance of $1 million per project is not large enough to have a major impact on economic feasibility. Larger grants, such as the grants currently available for projects as a result of the American Recovery and Reinvestment Act of 2009, would greatly improve the feasibility. The AD Facility would only be eligible for these larger grants if new legislation extended the current deadline for construction initiation.

The sensitivity analysis for the soil amendment price indicates that a variation in this price, while not as significant to the project feasibility as other factors, could impact project feasibility.

The sensitivity analysis for the recovered materials price indicates that a variation in this price is not very significant to the project feasibility.

7.2 Financial Feasibility

The financial feasibility analysis identified a variety of scenarios and assumptions which result in the AD Facility being feasible on the Hunts Point peninsula.

Electricity production is the biogas use scenario most likely to be financially feasible. This scenario generates larger net cash flows for an AD Developer due to factors that include:

- Tax Credits
- Environmental Attribute Sales
- Lower Relative Capital Costs
- Higher Relative Energy Revenues

The vehicle fuel sale scenario also appears to be feasible, especially if NYC made a commitment to purchase the fuel. The biomethane production scenario would only be feasible if one or more of the base case assumptions changed in a positive manner.

A relatively new financing structure, one in which NYC makes a prepayment for either waste disposal services or energy at the time of the financial closing, would benefit the project by effectively reducing the cost of capital and making the project more financially feasible.

Section 8
CONCLUSIONS

The Hunts Point Anaerobic Digestion Feasibility Study was conducted by the R. W. Beck Project Team in support of NYC's ongoing efforts to develop an AD Facility to process the organic-rich waste generated on the Hunts Point peninsula. The primary findings are as follows:

- The previously performed Organics Recovery Feasibility Study determined that the Produce Market and the Fish Market generated approximately 27,400 TPY of organic-rich waste that could be processed at the AD Facility. This Study identified approximately 37,600 TPY of additional organic-rich waste as being potentially available for processing at the AD Facility. It should be noted that these waste flows may vary considerably on both a daily and seasonal basis. For the purposes of the economic analysis, 60,000 TPY of waste was assumed to be processed at the AD Facility and 80 percent of that waste was considered to be digestible. The potentially available waste is currently either generated on the Hunts Point peninsula or delivered by carters to the Metropolitan Transfer Station, which is directly adjacent to the FDC.
- It is unlikely that the AD Facility can be developed without one or more creditworthy entities guaranteeing the delivery of waste to the AD Facility at specified disposal fees. A number of AD Developers were contacted during this Study and they all indicated that waste delivery guarantees would be required. Although the amount of the waste supply that must be guaranteed cannot be determined until the project is further developed, it is likely that most of the capacity of the AD Facility will need to be subject to the delivery guarantees. Waste delivery guarantees could be provided by waste generators, waste haulers or a government entity.
- The AD Facility is projected to generate biogas at the rate of 440 scfm with an energy content of approximately 600 Btu/scf. The energy value in the biogas produced is equal to approximately one million gallons of diesel fuel. An AD Facility using the biogas to produce electricity is estimated to have the capability of generating, net of on site use, an average of 1,500 kW.
- The biogas, a renewable energy source, can be used in a variety of different ways. Eight energy use scenarios were subjected to a screening analysis to determine which three were most likely to result in a feasible project. The screening analysis ranked each of the scenarios in the following five areas:
    - Viability and strength of the associated energy market;
    - Environmental impacts;
    - Regulatory and institutional hurdles;
    - Technical complexity and degree of commercialization; and
    - Likelihood of being the low cost option.

The energy use scenarios selected for detailed evaluation were:

- Electricity production for export to the power grid;
- Pipeline quality methane production for introduction into the natural gas distribution system; and
- Biofuel production for vehicle use

- Three potential sites were identified by the NYCEDC as possible locations for the AD Facility. All three are either: (1) located in a FEMA flood zone, (2) require remediation or (3) both. For purposes of this Study it was assumed that site remediation costs would not be the responsibility of the AD Developer. The three sites were evaluated to determine the extent to which an AD Developer would experience extraordinary site development costs due to either the remediation impacts or their flood zone location. Extraordinary costs that were identified included:
    - Modification of waterfront structures to protect the AD Facility from erosion during storms;
    - Importation of fill to raise the base elevation of the site;
    - Soil stabilization additives; and
    - Corrosion resistant piles for foundation support.

  The planning level estimates of the extraordinary costs ranged from $2.2 to $4.0 million depending upon the specific site analyzed. While these costs are significant, they are not of the magnitude that would, in and of themselves, render the AD Facility development at these sites infeasible.

- The financial feasibility of the AD Facility was evaluated by developing an economic model of revenues and expenses over a 20-year time horizon. A base case scenario was established and a sensitivity analysis was performed by varying the most critical model inputs. The financial feasibility of the various scenarios was compared by calculating the net present value of the net cash flows over the 20-year period. The economic analysis revealed that under multiple scenarios the AD Facility would generate net cash flows with a positive net present value.

- Under the base case assumptions electricity production for sale to the power grid generates greater net cash flow than the other biogas use scenarios analyzed. The economic analysis also revealed that:
    - Tipping fees are the largest revenue source and the tip fee escalation rate is a critical assumption in the analysis,
    - AD Facility capital cost is a critical factor in the analysis, and the resulting debt service was the largest expense and,
    - Grants, tax treatment and other financial incentives have a significant impact on economic feasibility.

- Several financing structures were identified and analyzed. The sale of environmental attributes, such as RECs and Carbon Credits, has become a key element in the financing of renewable energy projects. In addition, favorable tax treatment and grant programs have the potential to improve the feasibility of the project. The prepayment for either disposal services or energy by NYC represents

a relatively new financing structure that could contribute to the feasibility of the project.

In order to foster the development of the AD Facility project, R. W. Beck recommends that NYCEDC take the following steps:

- Identify a specific site and develop a plan to remediate (or otherwise prepare) the site for leasing to an AD Developer. The site preparation plan should: (1) specify the expected responsibilities of the AD Developer and NYCEDC and (2) establish a timeframe for the remediation.

- Determine the actions that NYCEDC, and/or NYC, will take to facilitate the establishment of the waste flow or tip fee revenue guarantees an AD Developer will need in order to finance the construction of the AD Facility.

- Assess NYC's willingness to enter a long-term energy purchase contract with the AD Developer. Such a contract could be for electricity, biomethane or biofuel for vehicle use.

- Assess NYC's willingness to pre-purchase disposal services (and/or energy) to reduce the AD Developer's need to raise capital for the construction of the AD Facility.

- Prepare a Request for Expressions of Interest that describes the potential project, expresses NYC's commitment to the project's development and elicits information from potential AD Developers. The receipt of Expressions of Interest offers the following benefits:
    - Provides an indication of the level of interest in the project,
    - Generates information regarding the relevant experience of the potential AD Developers,
    - Provides an understanding of the various development approaches and project structures for consideration,
    - Serves as a vehicle to solicit critical project development information from the AD Developers, and
    - Generates a list of AD Developers willing to provide additional information as project development proceeds.