5.0 OTHER PLANNING INITIATIVES

5.1 Waste Characterization

5.1.1 Introduction

Section 27-0107 of the New York State Conservation Law requires New York State planning units (counties and municipalities) to draft, and update at least decennially, a local SWMP. Among the requirements of such local SWMPs is one to "characterize the solid waste stream to be managed in the planning period." (New York State Environmental Conservation Law, Section 27-0107, Subsection 1.b.i.) In response to this, in April of 2004, the Bureau of Waste Prevention, Reuse and Recycling (BWPRR) of the DSNY contracted with a consulting firm to conduct a Citywide WCS.

The WCS is being coordinated through the BWPRR and involves the participation of several other bureaus within DSNY, including the Bureau of Cleaning and Collections, the Bureau of Waste Disposal, and the Bureau of Planning and Budget's Operations Management Division. The preliminary phase of the WCS has been completed. Follow-up phases to the WCS will provide more in-depth information on the DSNY-managed Waste stream.

The last Citywide WCS was conducted in the City in 1989-1990. Over the past 12 years, the DSNY has conducted four smaller-scale waste composition studies of DSNY-managed refuse and recycling.[1] The results of these studies varied considerably because they examine different groups of waste generators served by DSNY. The results of the 1989-1990 study have been utilized in the preparation of the Draft New SWMP, while the results of the new WCS currently underway and outlined below will further inform the DSNY's solid waste management planning over the proposed planning period.

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[1] For the DSNY's 1990 Waste Composition Study, see DSNY, A Comprehensive Solid Waste Management Plan for New York City and Final Generic Environmental Impact Statement, Appendix Volume 1.1, Waste Stream Data, August 1992; and DSNY Operations Planning Evaluation and Control, New York City Waste Composition Study 1989-1990 (four volumes). For the DSNY's Staten Island Waste Composition Study, see HDR Engineering, Inc., Report on Staten Island District 3 Waste Composition Analysis (June 1997). For the DSNY's Low-Diversion Districts Waste Composition Study, see DSNY, Mixed Waste Processing in New York City: A Pilot Test Evaluation (October 1999). For the DSNY's "suburban" neighborhood study, conducted for a backyard composting evaluation, see DSNY, Backyard Composting in New York City: A Comprehensive Program Evaluation (June 1999).

5.1.2 Spring Sorts

In May and June of 2004, DSNY conducted a preliminary WCS (Spring Sorts) in which the curbside refuse and recyclables stream was evaluated for the City as a whole. The results, summarized in Section 2.3.2 and detailed in the Preliminary Waste Characterization Report in Appendix D, describe the curbside waste stream in terms of its material composition and the breakdown of refuse and recycling streams. It is important to note that while this study was considered preliminary, the sampling procedures used to analyze the data conform to rigorous analytic standards.

5.1.3 Phases I and II

Phase I of the WCS, which began in summer 2004 and will continue until summer 2005, will examine residential waste to better understand how it varies by season and by housing density and income. It will also assess street-basket waste, and will include a special focus on the relationship between structural and service characteristics of multi-unit buildings and refuse and Recyclables generation and composition. Phase II will cover the characterization of waste from the public institutions served by DSNY. It will also include an examination of C&D debris, lot cleaning and inter-agency fill streams managed by the DSNY. The scheduling of Phase II has not yet been finalized.

5.1.4 Planning Implication

The outcome of the WCS will enable the DSNY to: (i) determine whether additional materials may be appropriate for recycling or other methods of handling and/or reducing wastes in the future; (ii) improve the DSNY's waste prevention, reuse and recycling efforts by targeting of groups of waste generators for outreach and publicity; (iii) improve the DSNY's enforcement of existing recycling and other sanitation laws and codes; (iv) inform DSNY operations, including equipment procurement, facility construction and collection route structure; (v) generate information relevant to recycling processors and other entities engaged in market development for the City's Recyclable materials; and (vi) foster a better understanding of how MSW in the City has changed over the past decade, through comparison of study results with results from prior City WCSs.

The level of detail, number of material categories and range of waste streams being examined under the WCS is unprecedented among municipal waste characterization studies for cities throughout the United States. No other city has examined the variation in waste composition by housing density and income or attempted to link, through direct observation (rather than surveys), structural characteristics of multi-unit buildings and their recyclables composition. The ambitious scope of the WCS is appropriate to the City's massive waste stream and particular demographic characteristics, and will set a new standard in municipal waste characterization in the United States.

5.2 Alternative Technology Studies

5.2.1 Introduction

The City's Long Term Export Program (as described in Section 3) will ensure that the City has reliable access to the disposal capacity it requires for the next 20 years. However, there are compelling reasons to continue to investigate alternatives to the landfilling and conventional waste-to-energy disposal options upon which this long-term export plan relies. These reasons are summarized as follows:

- Diversification – By diversifying the means of disposal available, the City will be in a stronger position to insulate itself from the effects of an increasingly monopolistic, national waste management industry.
- Sustainable resource reuse and recovery – Alternative technologies have the potential to recover and reuse a greater portion of the solid waste stream than landfilling, and claim to do so in a more sustainable manner than conventional waste-to-energy technology.
- Reliability and risk – If alternative technologies provided disposal options that could be sited in or near the City, this would decrease reliance on other states, and reduce the risk of federal legislative obstacles that could undermine component parts of the export plan in the future.

With these goals in mind, the City commissioned a comprehensive evaluation of new and emerging solid waste management technologies. The following section describes the evaluation and its findings, including proposed next steps. The final evaluation report can be found in Appendix F.

5.2.2 Summary of the Evaluation

The objective of the evaluation of new and emerging waste management and recycling technologies and approaches was to guide DSNY in its consideration of innovative technologies as part of its waste management system. The report identifies innovative technologies which are available now, i.e., commercially operational processing MSW, those which are soon-to-be commercially in use for MSW, and those which are promising, but in an earlier stage of development. It also compares these technologies to conventional waste-to-energy technology to identify the potential advantages and disadvantages that may exist in pursuing innovative technologies. Conventional waste-to-energy technology was chosen as a point of comparison since it is the most widely used approach to reducing the quantity of post-recycled waste being landfilled.

5.2.2.1 Definition of New and Emerging Technologies

For the purposes of the evaluation, “new and emerging technologies” were defined as technologies (e.g., biological, chemical, mechanical and thermal processes) that are not currently in widespread commercial use in the United States, or that have only recently become commercially operational. Technologies that are commercially operational in other countries, but only recently or not at all in the United States, are defined as "new and emerging" with respect to use in the United States. Table 5.2-1 lists the technologies considered as new and emerging for purposes of the study, and their development status.

5.2.2.2 Technology Selection

Proven, commercial solid waste management processes and technologies with widespread use in the United States, such as conventional waste-to-energy, landfilling and stand-alone material recovery facilities (MRFs), were not considered for this evaluation. Also, as the DSNY has already conducted a separate, thorough evaluation of aerobic MSW composting/co-composting,

Table 5.2-1
New and Emerging Technologies Categories and Development Status

Technology Category	Commercial Use Outside U.S. for MSW	Pilot Testing with MSW	Additional Research and Testing Required for MSW	Desirable for Monitoring
Anaerobic Digestion	✓	✓		
Thermal Processing	✓	✓		
Hydrolysis		✓		
Aerobic Digestion			✓	
Chemical Processing			✓	✓
Mechanical Processing				✓

prerequisite to new and emerging technologies (e.g., to prepare incoming MSW as feedstock for gasification, anaerobic digestion, waste-to-ethanol systems, etc.) were considered in the evaluation. Stand-alone RDF technologies were also considered, upon demonstration that the RDF technology includes innovative features that offer substantial improvements and advantages over conventional RDF technology.[2]

5.2.2.3 Evaluation Methodology

The evaluation started with a wide search to maximize the number of new and emerging technologies evaluated. The search included both a review of unsolicited proposals received by the City in the recent past, and independent research to expand the list of innovative technologies and project sponsors. To further widen the search, a Request for Information (RFI) was issued to gather consistent information from companies offering new and emerging waste management and recycling technologies.

[2] Conventional RDF technology is considered to be a process that mechanically separates out metals and inert (non-combustible) materials from MSW (e.g., through screening and magnetic separation) and shreds the screened MSW to produce a more homogenous fuel.

The search resulted in the identification of 43 technologies. Using a methodology developed specifically for the City, these 43 technologies were evaluated through three levels of increasing scrutiny to focus efforts on the most promising technologies. The objective of the evaluation was to identify, describe and evaluate new and emerging technologies based on type of technology, status of development and potential applicability for the City. These technologies were categorized as follows:

- **Thermal.** Thermal technologies are those that use or produce a significant quantity of heat during the course of processing MSW. Common descriptors for thermal technologies include gasification, pyrolysis, cracking and plasma. These technologies are similar, in that exothermic or endothermic chemical reactions occur during the processes that change the composition of the MSW. Types of products resulting from thermal processing include syngas (i.e., synthesis gas composed of hydrogen gases, carbon monoxide and carbon dioxide), which is combusted to produce electricity; char, which is a carbon-based solid residue; and organic liquids (e.g., light hydrocarbons).

- **Digestion** (Aerobic and Anaerobic). Digestion is the reduction of the organic fraction of MSW through microbial decomposition, accompanied by the evolution of liquids and gases. The biological process of digestion may be aerobic or anaerobic, depending on whether oxygen is introduced into the process. Anaerobic digestion produces a biogas, which is primarily methane and carbon dioxide, and compost. Biogas can be combusted to generate electricity. Aerobic digestion produces a compost that may be used as a soil amendment or fertilizer; aerobic digestion does not produce a biogas.

- **Hydrolysis.** Hydrolysis is generally a chemical reaction in which water reacts with another substance to form two or more new substances. Specifically with relation to MSW, hydrolysis refers to an acid-catalyzed reaction of the cellulose fraction of the waste (e.g., paper, food waste, yard waste) with water to produce sugars. Additional process steps are used to convert the sugars to ethanol or other products such as levulinic acid, a commonly used chemical feedstock for producing specialty chemicals.

- **Chemical Processing.** Chemical processing is a general term for technologies that utilize one or a combination of various chemical processes. For the purpose of the study, only one technology was included in this category. That specific technology is based on the chemical process of depolymerization, which is the permanent breakdown of large molecular compounds into smaller, relatively simple compounds. The process converts the organic fraction of MSW into energy products (steam and electricity), oil, specialty chemicals and carbon solids.

- **Mechanical Processing for Fiber Recovery.** Technologies included in this category mechanically process MSW to recover fiber for use in making paper. This technology category includes innovative refuse-derived fuel technologies that produce a clean source of secondary fiber.

The technologies were advanced through three levels of scrutiny from preliminary review to more detailed, comparative review of the more established technologies. Fourteen (14) of the 43 technologies initially identified advanced to the most detailed level of comparative review.

5.2.2.4 Categorization of Technologies

As part of the evaluation, the technologies were categorized by their development status (i.e., are they in commercial use, being tested at a demonstration or pilot facility, or in the process of ongoing, developmental research). The results are described below.

- Anaerobic digestion is currently in commercial operation (for MSW) outside of the United States (e.g., Canada, Israel, the Netherlands, Italy, Germany and other European countries). Anaerobic digestion has not been commercially applied within the United States. Therefore, technology transfer to the United States would need to be addressed in considering commercial application in this country (e.g., MSW composition, waste management practices, end-product markets and regulatory requirements).
- Thermal processing (i.e., gasification) is currently in commercial operation (for MSW) outside of the United States (e.g., Japan, Germany and Italy). Several types of gasification technologies are in commercial operation, including fluid bed gasification, high temperature gasification, plasma gasification and gasification/vitrification. These gasification technologies have not been commercially applied within the United States. Again, technology transfer to the United States would need to be addressed in considering commercial application in this country.
- Hydrolysis is not yet in commercial operation for MSW. However, one company (Masada Oxynol) is advancing the technology to commercial application, with pilot testing completed in the United States and a facility under development in Middletown, New York.
- Aerobic digestion (as distinct from MSW composting) is not yet in commercial operation for MSW. However, a 30-tpd demonstration plant is in operation in Vancouver, Canada, processing source-separated food waste and other source-separated organic waste. Additional research and testing is required to advance to pilot-testing for mixed MSW.

- Chemical processing requires research and testing to advance to the pilot stage for MSW. An 8-tpd pilot plant in Philadelphia is available to conduct this research and testing.
- Mechanical processing for fiber recovery bears monitoring. It is the least developed of all the innovative technology categories, with only bench-scale testing completed for the fiber recovery process.

5.2.3 Next Steps

The results of the evaluation suggest a series of next steps for DSNY. Based on success demonstrated outside of the United States by several companies, the evaluation concludes that anaerobic digestion and thermal processing (gasification) technologies merit further consideration by the City. As a first step, a focused, detailed review of these technologies is recommended to supplement and verify information presented by project sponsors during this study. This review should address the potential impact of technology transfer issues such as differences in waste composition and waste management practices, product markets, regulatory requirements and related environmental issues. Should the outcome of the review be promising, a pilot project could be used to establish the basis for commercial application, including project definition and risk sharing.

The evaluation suggests that hydrolysis could also be considered for a pilot project. The City could monitor the development of the commercial hydrolysis project in Middletown, New York, and could consider sending waste to this facility (for pilot testing) when it becomes operational.

The development of aerobic digestion projects should be monitored; chemical processing and mechanical processing technologies should be assessed again, e.g., in five years, to monitor their progress.

5.3 Alternative Fuel and Emission-Control Technologies

DSNY has extensive experience in alternative fuels, and with new engine and the retrofitting of emission-control technologies. Through a number of successful pilot programs, including ongoing initiatives, DSNY has assessed the equipment and fueling options appropriate for collection and other DSNY vehicles.[3] Through its research activities, DSNY has determined that its refuse hauling vehicles and collection operations are currently best suited to the use of clean diesel technology which provides the benefit of a substantial reduction of emissions without a major reduction of fuel efficiency and cost. However, DSNY continues to evaluate natural gas technologies, also available for use in the City's refuse hauling vehicles, despite their requirement for a significant fueling infrastructure investment and greater cost uncertainties.

DSNY was the first City agency to pilot the use of ultra-low-sulfur diesel (ULSD) in 2001 and has moved forward, ahead of schedule, to achieve reductions in sulfur emissions in diesel fuel. On July 1, 2004, DSNY expanded the use of ULSD fuel throughout the five boroughs of the City. The fuel, which contains less than 30 parts per million of sulfur, is now dispensed at all of DSNY's diesel fueling facilities for use by all of DSNY diesel vehicles, making DSNY the first City agency to provide ULSD to its entire diesel fleet, well in advance of USEPA June 2006 regulatory requirements. ULSD gives DSNY the basic platform needed to test advanced emission-control technologies (such as diesel particulate filters and diesel oxidation catalysts) designed for diesel engines. Clean diesel options, including advanced exhaust after-treatment and engine modification technologies used in conjunction with ULSD fuel, can cut vehicle emissions by 90% or more without having a major impact on fuel efficiency and cost.

Also in the forefront on the use of alternative fuel technologies, DSNY recently procured 26 new compressed natural gas (CNG) collection trucks. Based on their performance in the field, DSNY will evaluate these new CNG collection trucks to compare their performance with the first-generation CNG trucks purchased under a prior contract. Investigating CNG paves the way for future transitions that may be made to hydrogen fuel cells as a vehicle-fueling source. One of the major disincentives, however, to creating a CNG refuse truck fleet is the cost related to purchasing the trucks and the infrastructure needed for a CNG facility; a CNG refuse collection vehicle can cost considerably more than a conventional diesel truck and the cost of a CNG facility with fueling, proper ventilation and leakage alarms can be high.

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[3] The City's March 2004 CWM Study (Volume. IV of Appendix E) provides a number of case studies that describe the results of DSNY's groundbreaking partnerships with truck manufacturers to reduce emissions and test new technology.

DSNY currently operates more than 170 collection trucks equipped with an advanced emission-reduction technology (e.g., diesel oxidation catalysts and diesel particulate filters). Having seen success in the use of this new technology, DSNY is moving forward to expand the installation of this retrofit equipment across the entire collection truck fleet. Diesel oxidation catalysts and diesel particulate filters, when used with ULSD fuel, can reduce emissions of particulate matter, hydrocarbons and carbon monoxides.

DSNY has also evaluated the costs and benefits of other fuels and technologies such as biodiesel, fuel cells, propane, ethanol, methanol and hybrid electric vehicles. While none were deemed to be as immediately promising and cost effective as the clean diesel, DSNY will continue to assess these new technologies as they emerge or evolve, and will:

- Continue to use ULSD fuel in all diesel vehicles in its fleet to meet USEPA emissions standards;
- Continue to make clean diesel technology the preferred vehicle standard for new heavy-duty refuse vehicle purchases;
- Continue to test and evaluate the fleet of CNG collection trucks;
- Continue to pursue its CNG heavy-duty program to take advantage of potential advancements in CNG technology and fuel cell technology;
- Continue to develop partnerships with fuel suppliers, original equipment manufacturers and infrastructure providers in order to help reduce the cost of clean fuel implementation;
- Continue to make ethanol vehicle purchases and plan for ethanol fueling facilities for light-duty vehicles; and
- Use government grants and economic incentives to offset the higher costs associated with natural gas, hybrid electric and ethanol vehicles.

Contracts with private waste companies entered into to implement elements of the Long Term Export Program will consider, as applicable, terms to achieve the following goals with respect to new fuel, engine or emission retrofit technologies:

- The retrofitting of old diesel vehicles with clean diesel technology;
- The use of ULSD in collection vehicles and off road vehicles ahead of the June 2006 mandate;

- The purchase of clean diesel vehicles that will be needed to meet scheduled strict USEPA emission standards;
- The use of government grants and economic incentives to help offset the incremental capital costs associated with natural gas refuse vehicles; and
- The exploration of the option of using CNG heavy-duty refuse vehicles in the future in conjunction with infrastructure suppliers and engine manufacturers.

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