Taxes In, Garbage Out

The Need for Better Solid Waste Disposal Policies in New York City

May 2012

FOREWORD

Founded in 1932, the Citizens Budget Commission (CBC) is a nonprofit, nonpartisan civic organization devoted to influencing constructive change in the finances and services of New York State and New York City governments. A major activity of the Commission is conducting research on the financial and management practices of the State and the City.

All research by the CBC is overseen by a committee of its trustees. This report was completed under the auspices of the Solid Waste Management Committee. We serve as co-chairs of that Committee. The other members of the Committee are Paul R. Alter, Eric Altman, Lawrence B. Buttenwieser, Eileen Cifone, Edward F. Cox, David R. Greenbaum, Walter L. Harris, H. Dale Hemmerdinger, Robert N. Hoglund, Brian T. Horey, Peter A. Joseph, Tracey Keays, Robinson Markel, Calvin A. Mitchell III, James S. Normile, Steven M. Polan, John Rhodes, Denise Richardson, Richard L. Sigal, and Kenneth D. Gibbs, *ex-officio.*

A draft of this report was sent to New York City officials and other interested parties. We are grateful for comments and suggestions we received from Caswell Holloway, Deputy Mayor for Operations of the City of New York; David Bragdon, Director of the New York City Office of Long Term Planning and Sustainability; Harry Szarpanski, Deputy Commissioner of the New York City Department of Sanitation, Bureau of Long Term Export; Brian Mahanna, former Senior Advisor to Mayor Michael Bloomberg and former Counsel to Deputy Mayor Caswell Holloway; Kristine Ryan, Deputy Director of the Office of Management and Budget of the City of New York; Ana Champeny, Supervising Analyst for Housing, Infrastructure and Environment of the Independent Budget Office of the City of New York; Marcia Bystryn, President of the New York League of Conservation Voters; and Robin Davidov, former Executive Director of the Northeast Maryland Waste Disposal Authority. Their willingness to provide thoughts and feedback on initial drafts of this paper does not indicate that they agree with its conclusions.

The report was prepared by Tammy P. Gamerman, Senior Research Associate of the Citizens Budget Commission. Charles Brecher, Consulting Research Director of the Citizens Budget Commission, provided editorial and research guidance.

Carol E. Rosenthal, Co-Chair

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May 29, 2012

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EXECUTIVE SUMMARY

This year, New York City will spend over $2 billion in tax dollars to throw out its garbage. More than $300 million of the bill represents the cost of disposing of the garbage – usually in out-of-state landfills. About three-quarters of city garbage goes to landfills, with 98 percent of that shipped to Ohio, Pennsylvania, South Carolina and Virginia. In a single year, tractor trailer trucks travel 40 million miles to dump New York City's garbage. Not surprisingly, shipping and burying garbage hundreds of miles away is not cheap – $95 per ton for the three million tons the City exports to landfills.

Beyond the financial burden, exporting garbage does enormous environmental harm. The trucks and trains that carry residential and commercial waste emit a large volume of greenhouse gases, and putting the garbage in landfills generates additional emissions. The waste that New York City sends to landfills generates about 679,000 metric tons of greenhouse gases per year – the equivalent of adding more than 133,000 cars to the roads.

This report makes the case for a significant change in New York City's solid waste disposal practices, a shift from heavy reliance on long-distance exporting to landfills to greater reliance on use of local waste-to-energy facilities. The case is based on three fundamental points.

1. ***Waste-to-energy technology is cheaper and environmentally better than long-distance exporting.*** From a fiscal standpoint, the benefits are substantial. Currently the cost of sending a ton of garbage to a regional waste-to-energy plant is between $66 and $77 per ton compared to $95 per ton for long distance landfilling, and this differential is likely to grow in the future. From an environmental standpoint, use of local waste-to-energy plants reduces greenhouse gas emissions by 0.36 metric tons per ton of garbage converted to energy rather than shipped to landfill. At this rate, every 14,400 tons of garbage shifted to local waste-to-energy plants is the equivalent of removing 1,000 cars from the road.

2. ***Waste-to-energy technology is now underutilized in New York City.*** Currently the City sends only 9 percent of its municipally-managed waste to waste-to-energy facilities. New York lags far behind other environmentally-sensitive metropolises in its use of waste-to-energy. Within the European Union, 16 countries convert an average 28 percent of their waste to energy, with Norway, Denmark, Sweden and Switzerland converting about half. In the United States, Connecticut sends 63 percent of its garbage to waste-to-energy plants, and Massachusetts has a rate of 37 percent.

3. ***Opposition to expanded use of waste-to-energy technology is rooted in misunderstanding its impacts.*** Resistance to new plants is based on two myths, each of which is refuted in this report.

   Myth #1: *Waste-to-energy plants displace recycling.* In fact, jurisdictions with the highest recycling rates are those which also have high rates of energy conversion.

   Myth #2: *Waste-to-energy plants are a threat to local residents' health due to the air pollution they create.* In fact, modern waste-to-energy plants pose no meaningful health risks.

This report recommends that the City make waste-to-energy conversion a much larger component of its solid waste management strategy. Toward this end, the City should foster the construction of waste-to-energy plants sited and designed for city needs and should partner with owners of existing facilities within the region to expand their capacity and willingness to process New York City's waste. Thirty-three facilities operate in New York and adjacent states, and they may have the ability to take additional supply, either in their current configuration or through adding capacity. Locating a plant within city borders poses significant hurdles, but other cities, including Paris and Copenhagen, have surmounted these challenges by using innovative designs that fit into the urban landscape.

If new and expanded facilities accommodate two million tons of New York City waste – or one-third of the garbage currently disposed of by the public and private sectors – the City would save $119 million annually; over the next 30 years, the present value savings would reach $2 billion.

This policy change would also yield important environmental benefits. The reduction in annual greenhouse gas emissions would be 35 percent or about 240,000 metric tons annually; this is the equivalent of eliminating all current vehicle traffic through the Holland Tunnel.

Waste reduction and recycling remain at the top of the waste management practice hierarchy, and this report also identifies ways to promote those practices. However, New York City will continue to generate significant amounts of solid waste for the foreseeable future, and municipal leaders should give high priority to managing it in a way that is fiscally and environmentally sound. Waste-to-energy plants represent the best solution – on both scores – for a significant portion of New York City's solid waste disposal needs.

INTRODUCTION

Managing garbage in New York City is no small task. Every minute, residents, tourists, and commercial enterprises produce more than 25 tons of waste. This adds up to 14 million tons each year, or 3,500 pounds per resident. Due to the city's density, any disruptions in the City's solid waste disposal system quickly lead to mounting piles of malodourous trash bags, unsanitary conditions, and an angry electorate. A nine-day sanitation workers strike in 1968 resulted in 120,000 tons of uncollected trash on the sidewalks, a mayoral request to send in the National Guard, and warnings of typhoid from the Health Department.[1]

A good urban waste management system must not only be reliable, it should also be efficient and minimize environmental damage. This report finds that New York City falls short on these latter criteria, and identifies new policies that would make the system less expensive and less environmentally harmful.

The report is organized in four sections. The first describes current waste management practices in New York City. The second identifies the fiscal and environmental costs of the current primary method of disposal, exporting to landfills. The third focuses on an underutilized practice with potential benefits, waste-to-energy conversion at nearby plants. The last presents recommendations for improvement in the City's current disposal policies.

SOLID WASTE DISPOSAL IN NEW YORK CITY – CURRENT POLICIES

Two Trash Systems – Private and Public

Although the primary focus of this report is the policies pursued by the municipal agency responsible for waste management, the New York City Department of Sanitation (DSNY), it is important to begin by noting that New York City has two systems for handling its 14 million annual tons of trash – one private and one public.[2] Since the 1950s, private businesses have been responsible for managing their own waste, negotiating waste management contracts with private companies.[3] In the 1990s the City created the Business Integrity Commission (BIC) in part to root out the influence of organized crime in private sanitation services and to lower prices. Crime is no longer a major issue, but the BIC still regulates private waste carters and sets a price ceiling for commercial services by weight and by volume, which ranges from $127 to $208 per ton.[4]

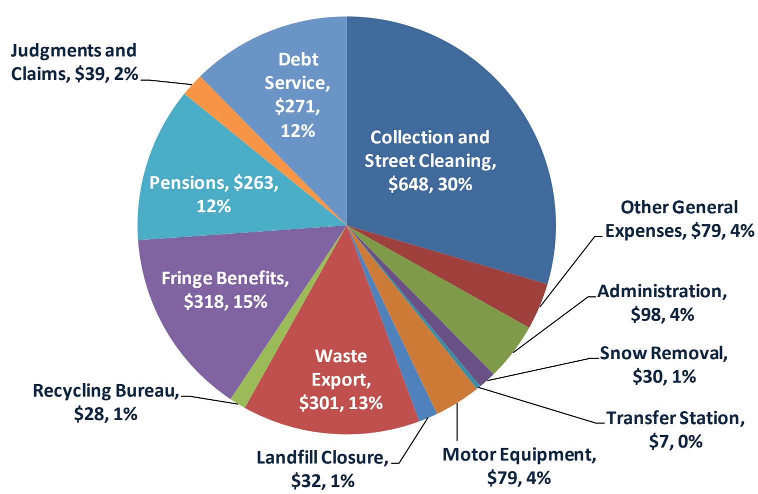
Currently, a network of private carters handles the 3.9 million tons of garbage generated at commercial establishments, such as office buildings, restaurants, and grocery stores.[5] Businesses can choose from over 200 waste carters licensed by the BIC or register with the BIC to haul their own waste. At the capped rate, private businesses pay as much as $816 million each year for waste services. About 4,000 private collection trucks travel the city picking up this commercial waste. Separately, the BIC regulates (but does not control prices for) the nearly 700 carters who handle the 6.5 million tons of waste generated in the construction and demolition of buildings and other infrastructure.[6]

The public system operated by DSNY collects the 3.8 million tons of waste generated each year by government agencies and institutions, residential buildings, and non-profit organizations located on tax-exempt land.[7] This includes waste deposited in 25,000 sidewalk litter baskets, as well as abandoned automobiles and street debris.[8]

In fiscal year 2012, DSNY's waste management responsibilities will cost taxpayers $2.2 billion, about $700 annually or $60 monthly per household.[9] (See Figure 1.)

Figure 1: New York City Department of Sanitation $2.2 Billion Budget, Fiscal Year 2012

(dollars in millions)

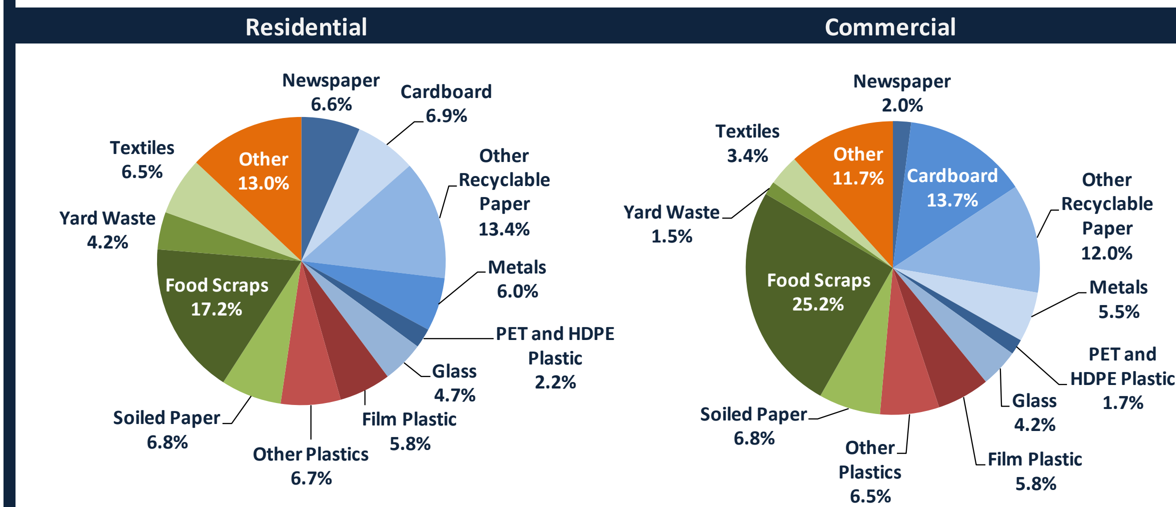


Sources: New York City Office of Management and Budget, *Fiscal Year 2013 Executive Budget, Mayor's Message,* May 2012, p. 134. New York City Office of Management and Budget, *Fiscal Year 2013 Executive Budget, Budget Function Analysis,* p. 347, May 2012.

The biggest expense for DSNY is collection and street cleaning, which involves 2,022 collection trucks, 450 street-sweeping trucks, and nearly 6,000 sanitation workers.[10] Direct agency collection costs are $648 million, but centrally-allocated costs such as pension benefits and administration bring the full cost to $1.5 billion.[11] Collection costs, particularly for recyclables, are a serious concern and have been the subject of numerous reports.[12] After collection, the biggest functional expense (about $300 million) is payments to railroads, long-distance trucking companies, and landfill operators to transport and dispose of refuse outside the city.

The nature of the waste handled by the two systems is similar. (See Figure 2.) Paper and cardboard represent the largest portion of the waste stream, accounting for 34 percent of residential and commercial waste.[13] Food waste is the second largest category, at 17 percent for residential and 25 percent for commercial. For residential waste 40 percent is recyclable (paper, metal, plastic and glass) and 28 percent is compostable (soiled paper, food scraps, and yard waste). Other types of waste include difficult-to-recycle plastics numbered #3 through #7, plastic bags (referred to as film plastic), textiles, diapers, electronic waste, and household construction material.

Figure 2: Composition of New York City Residential and Commercial Waste

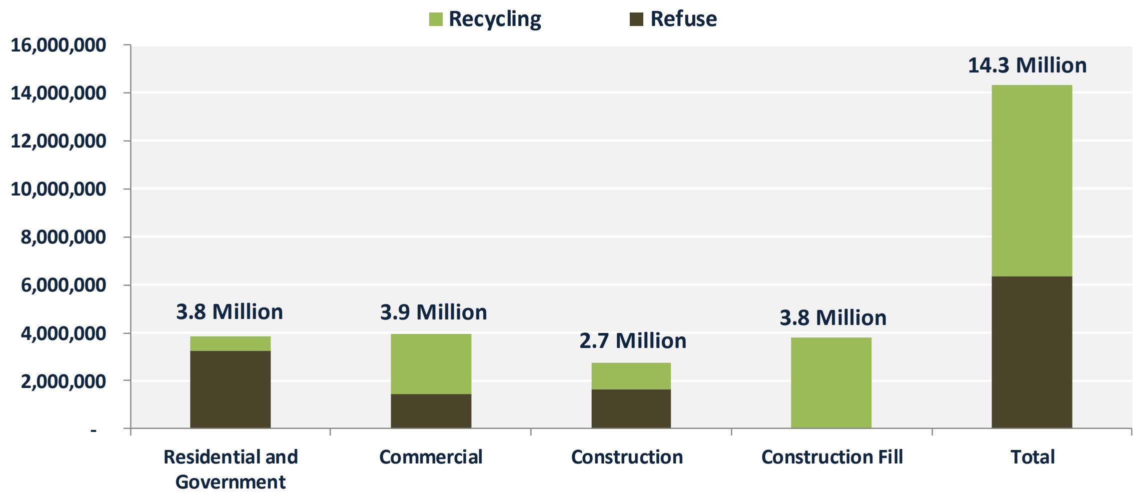


Note: Based on 2008 data.

Source: New York State Department of Environmental Conservation, *Solid Waste Composition and Characterization: MSW Materials Composition in New York State, Urban.*

Although the waste streams are similar, the two systems differ dramatically in the extent of recycling. (See Figure 3.) About 63 percent of commercial waste is recycled, compared to only 15 percent of residential and government waste. Of the entire municipal solid waste stream, about 55 percent is recycled. This rate includes a 100 percent diversion rate for construction fill and 39 percent for other construction material.[14]

Figure 3: New York City Tons of Recycling and Refuse by Sector, Fiscal Year 2011



Note: The Residential and Government sector includes curbside and container collections, as well as other categories of refuse, such as street baskets, and other categories of recycling, such as leaf collections. The Construction and Construction Fill sectors include recyclable construction material managed by the DSNY.

Sources: CBC analysis. New York City Department of Sanitation, *Annual Report for New York City Municipal Refuse and Recycling Statistics, Fiscal Year 2011.* New York City Department of Sanitation, *Commercial Material (Private Transfer Station) Recycling Tons per Day Collected and Diversion, Quarterly Reports, Third Quarter 2010 through Second Quarter 2011.* New York City Office of Management and Budget, *Export Costs and Tons by Vendor and Paper and Metal, Glass, and Plastic Tonnage and Costs, Fiscal Year 2011.*

The high rate for commercial waste is likely tied to the significant financial incentives businesses have to recycle. Unlike city residents, businesses pay for their waste disposal based on the total amount of waste and the allocation between refuse and recycling. In particular, office-grade paper and cardboard are valuable materials. When the price per ton of cardboard reached $75 in 2009, theft of commercial cardboard became a serious problem for city businesses and the BIC.[15]

The low diversion rate for municipally-managed waste reflects a mix of factors, including the absence of financial incentives, confusing rules, and small living spaces. New York's troubles with recycling also stem in part from self-inflicted policy decisions, discussed more fully below.

History of the Municipal System

Until the 1990s, New York City disposed of its solid waste within city boundaries, relying principally on City-owned landfills and municipal and apartment building trash incinerators.[16] Beginning in the 1960s, a series of state and federal environmental mandates led to the gradual closure of municipal and apartment building incinerators. The City ultimately ordered all remaining incinerators closed by 1994, increasing reliance on six city landfills to dispose of its solid waste.

In the 1980s, Mayor Edward Koch proposed building five waste-to-energy plants, one in each borough. The plan was delayed because of community opposition, became enmeshed with debates over the City's commitment to its 1989 recycling laws, and was ultimately abandoned.[17]

Meanwhile, the City's landfills were filling up. From 1979 to 1991, five of the City's six landfills closed, leaving the 2,200-acre Fresh Kills landfill in Staten Island as the lone in-city disposal option. Most waste reached that landfill by barge through transfer stations located on the waterfront. In the 1980s, concerns about reaching capacity at Fresh Kills led the City to raise landfill prices (known as tipping fees) for private haulers of commercial waste.[18] Private haulers responded by building a network of waste transfer stations to weigh and containerize waste for truck transport out of the city. In 1996, responding to concern from Staten Island residents, the City and the State agreed to close Fresh Kills by 2001, a few years before it was projected to reach capacity. The landfill closed in March 2001.[19] Thus, in the late 1990s the City began its use of the privately-built network of transfer stations to send its government and residential waste to out-of-city disposal facilities. This practice continues today.

Today, New York City municipal solid waste policy is guided mainly by two documents: the Solid Waste Management Plan (SWMP), last revised in 2006, and PlaNYC, introduced in 2007 and revised in 2011.

Solid Waste Management Plan

The City's SWMP has three main goals: price stability; elimination of long-haul truck transport and reduction of in-city trucking; and equitable distribution of waste transfer stations among the five boroughs.[20] These goals are to be achieved through constructing new and refurbished facilities in every borough, except the Bronx, and 20-year waste export contracts for rail and barge connections to landfill or waste-to-energy facilities. This vision contrasts with the current system, in which 60 percent of transfer stations are in two neighborhoods – the South Bronx and Newtown Creek, Brooklyn – and most waste is exported by tractor trailer trucks.[21] If the SWMP is fully implemented, each borough would house a rail or marine transfer station, thus reducing garbage collection truck traffic and enabling most residential and commercial waste to reach its final disposal location by rail or barge.

The City has made progress in achieving these goals.[22] The City has signed 20-year contracts for export from a municipal railcar transfer station in Staten Island and from two private railcar transfer stations in the Bronx and Brooklyn. Another private transfer station in Long Island City, Queens will be retrofitted to containerize waste for rail export from a rail yard one-half mile from the station.

The City has also begun construction on two municipal marine transfer stations, one on the north shore of Queens and the other on Hamilton Avenue in Brooklyn. These two waterfront stations are slated to operate in mid-2013, although the Queens waterfront station, which will be a half mile from La Guardia Airport, has been criticized for its potential to exacerbate problems with geese interference with flight paths.[23]

A state-of-the-art recycling facility on the Brooklyn waterfront at the South Brooklyn Marine Terminal is scheduled for completion by the end of fiscal year 2013. Most city recyclables will be barged to this facility through refurbished and existing waterfront transfer stations, reducing city collection truck traffic by an estimated 230,000 miles per year.[24] The City has entered into a 20-year contract with the operator of the facility.

Community opposition and legal challenges have delayed other parts of the plan. Plans to refurbish an old marine transfer station on the East River and 91st Street in Manhattan were stalled by strong opposition from the surrounding neighborhood. After prevailing against numerous legal challenges, the City issued a construction bid in January 2012 and hopes to begin work in June 2012. Construction for another marine transfer station in Southwest Brooklyn is also projected to begin in 2012. The City plans to complete the Manhattan and Southwest Brooklyn stations in 2016 and 2017, respectively.

The final part of the plan includes two marine transfer stations on the Hudson River in Manhattan, one at Gansevoort Street and the other at 59th Street. The 59th Street station currently handles recyclable paper but will be retrofitted to handle Manhattan's commercial waste. The Gansevoort Street transfer station will handle metal, glass and plastic, as well as the paper waste currently handled at 59th Street. Thus, construction of the refurbished 59th Street station is contingent on transferring operations to the Gansevoort Street station, which is slated to begin construction in fiscal year 2014 and become operational in fiscal year 2017. Barges from Gansevoort Street will transport paper to an existing facility in Staten Island and metal, glass and plastic to the new South Brooklyn Marine Terminal recycling plant.

The delays in the SWMP's implementation have increased the cost of construction. In 2007 the City planned to invest $545 million in the new waste disposal infrastructure from fiscal year 2008 through 2017.[25] Through fiscal year 2011, $444 million had been spent while a further $527 million is planned for fiscal years 2012 and 2013.[26] In total the facilities may cost $970 million, or $426 million more than originally estimated, a 78 percent increase.

A City-commissioned study of new and emerging waste conversion technologies was completed prior to the SWMP's approval in 2006. At the time, the City deemed that new technologies were not viable to handle a significant portion of city waste but supported the identification of pilot projects. The SWMP also called for a 20-year contract for the continued disposal of a portion of Manhattan waste at a waste-to-energy plant in Newark, New Jersey. The long-term contract would replace an existing five-year contract, while increasing the number of Manhattan neighborhoods served by the facility.

PlaNYC

In April 2007 Mayor Michael Bloomberg unveiled PlaNYC, a comprehensive sustainability agenda for the next 20 years. The plan reaffirmed the commitment to pilot waste conversion technologies – specifically, anaerobic digestion and thermal processing – but did not include any other solid waste-related goals.[27]

In April 2011 Mayor Bloomberg released a revised PlaNYC, including an ambitious solid waste agenda. The City set a goal of increasing the combined residential, business, and construction waste diversion rate from 50 percent to 75 percent by: (1) reducing waste generation through incentives, public outreach, and city regulatory and procurement laws, and (2) increasing recovery of resources through reuse, recycling, composting, and piloted waste conversion technologies.[28] The plan also aims to improve the efficiency of waste management by coordinating commercial waste operations and ensuring the completion of the new transfer stations proposed in the SWMP. An interim goal to double the residential diversion rate from 15 percent to 30 percent by 2017 was set in January 2012.[29]

In March 2012 the City released a Request for Proposals (RFP) to construct one or more waste conversion facilities, employing thermal, anaerobic digestion or hydrolysis technologies.[30] Combustion – the oldest and most commonly used waste conversion technology – is excluded from eligibility. Companies can propose to develop on privately-owned sites in the city or within an 80-mile radius. Any approved project will have a three-year pilot phase in which to meet all performance standards, including facility availability, tons processed, energy produced, health and environmental criteria, residue generated, and recovered material. The pilot processing capacity must be at least 100 tons per day but not more than 450 tons per day. Upon meeting specified performance criteria, the facility could expand to 900 tons per day, which would accommodate about 5 percent of non-recycled city waste. The City anticipates that project contracts will start in September 2013.

Recycling Initiatives

Recycling has been mandatory for New York City residents and businesses since 1989.[31] Households must recycle paper, cardboard, plastic bottles and jugs made with resins type 1 and 2 (HDPE and PET), glass bottles and jars, and household and bulk metal. Non-food businesses (offices, retail stores, and supermarkets) must recycle high-grade office paper, newspapers, magazines, catalogs, phone books, corrugated cardboard, bulk metal, and some textiles. Food establishments must recycle glass and metal containers, plastic bottles, aluminum foil, and cardboard.[32] Since 2008, large retail and chain stores must collect plastic carry-out bags for recycling.[33] DSNY also runs programs to divert electronic and hazardous waste, yard waste, clothing, and tires.

Although construction and demolition waste is not subject to mandatory recycling, much of it is reused, because there is a ready market for it. The closing of Fresh Kills landfill, and need for landfill cover, prompted an increase in this category of recycling, with 409,000 tons of clean construction fill being reused by DSNY as landfill cover in fiscal year 2011.[34] The City also reuses construction material, including asphalt and road millings, at public construction projects.

As residential curbside recycling collection was rolled out, the City's curbside and containerized diversion rate climbed, reaching 20 percent in fiscal years 2001 and 2002.[35] When the City suspended collection of recyclable glass and plastic from July 2002 through April 2004 as a budget savings measure, the recycling rate fell to 11 percent.[36] The rate recovered somewhat, reaching 16.5 percent in fiscal year 2008 but declined to 15.4 percent in 2011.[37]

When the new recycling facility in Brooklyn opens, the City expects a small boost to its recycling rate. Upon the facility's opening, DSNY expects to designate all rigid plastic containers as recyclable, rather than only plastic jugs made of resin types 1 and 2.[38] The City estimates that an additional 8,000 tons of plastic per year would be diverted, which would increase the curbside and containerized recycling rate slightly from 15.4 percent to 15.6 percent. The City also hopes the simplification will make recycling easier and encourage more recycling of all materials.

New York's recycling rate for municipally managed waste has room for improvement.[39] In a June 2011 comparison of 27 American and Canadian cities on environmental measures and policies, New York ranked number 16 for solid waste management.[40] Two California cities ranked first and third – San Francisco and Los Angeles – with recycling rates of 77 percent and 62 percent. Second-place Seattle reported a recycling rate of 51 percent. PricewaterhouseCoopers and the Partnership for New York City also compare recycling performance among international cities in their annual *Cities* *of Opportunity* report.[41] In the 2011 report, New York ranked number 13 out of 26 cities for recycled waste. Topping the list were Seoul, San Francisco, Toronto, Berlin and Hong Kong.

Disposal Practices

The amount of trash that DSNY must dispose of has declined by more than 30 percent over the last 20 years, principally reflecting diversion to recycling and some decline in generation rates for non-recyclables.[42] Suspension of glass and plastic recycling in 2003 resulted in a 13 percent uptick in refuse in a single year, but following resumption of recycling the downward trend resumed.[43]

Without a landfill or other disposal facility within the city, DSNY exports all its waste, most of it to distant landfills. DSNY sends almost 2.9 million tons of refuse to landfills every year. The remaining refuse, about 360,000 tons, is carried by DSNY trucks to two waste-to-energy plants in Essex County, New Jersey and Hempstead, Long Island.

THE FISCAL AND ENVIRONMENTAL IMPACTS OF CURRENT DISPOSAL PRACTICES

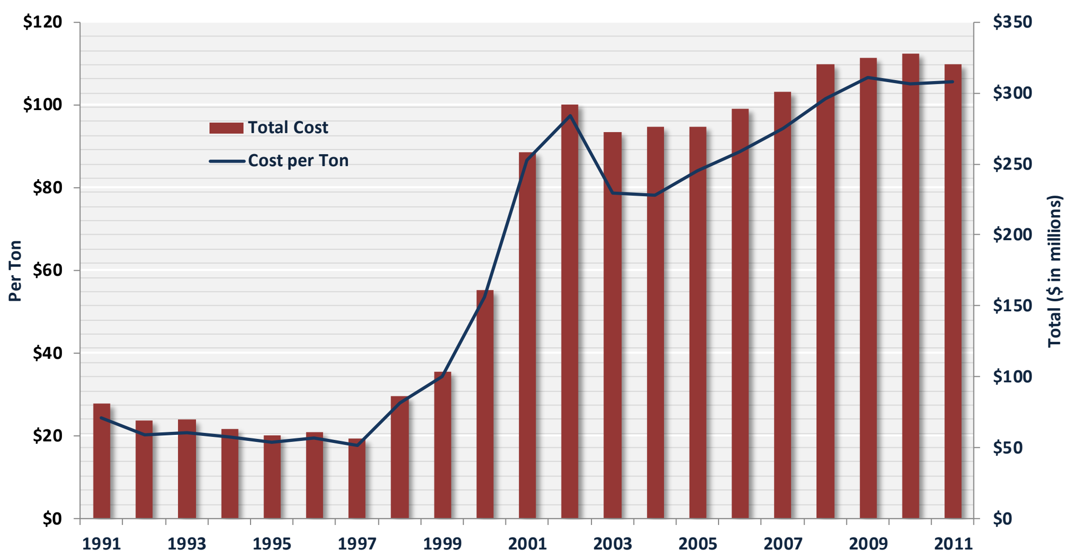
Fiscal Impact

New York City's disposal costs have risen dramatically. (See Figure 4.) In the past two decades, they nearly quadrupled, from $81 million in fiscal year 1991 to $320 million in 2011.[44] The principal factor in the increase was the closure of municipal incinerators and landfills – culminating with the closure of Fresh Kills in 2001 – necessitating the export of waste.

Prior to 1998, city refuse was brought to municipally-owned incinerators and landfills. With the impending closure of the City's last landfill, DSNY began to send its non-recycled waste to distant landfills via private transfer stations. The percent of refuse that was exported grew from 15 percent in fiscal year 1998 to 100 percent in 2002.[45] Many observers, including the Citizens Budget Commission, warned that disposal costs would soar as the City became dependent on outside disposal facilities.[46] This prediction came true, as costs rose from less than $20 per ton in fiscal year 1997 to roughly $100 per ton in 2002.

Post-2001, the bulk of disposal costs shown in Figure 4 are the prices paid to private firms to export and dispose of garbage. Of the $320 million spent on disposing non-recycled waste in fiscal year 2011, $300 million paid for waste export - $276 million for transport and disposal at distant landfills and $24 million for processing at nearby waste-to-energy facilities.

Figure 4: New York City Solid Waste Disposal Cost, Total and Per Ton of Refuse Collected, Fiscal Years 1991 through 2011

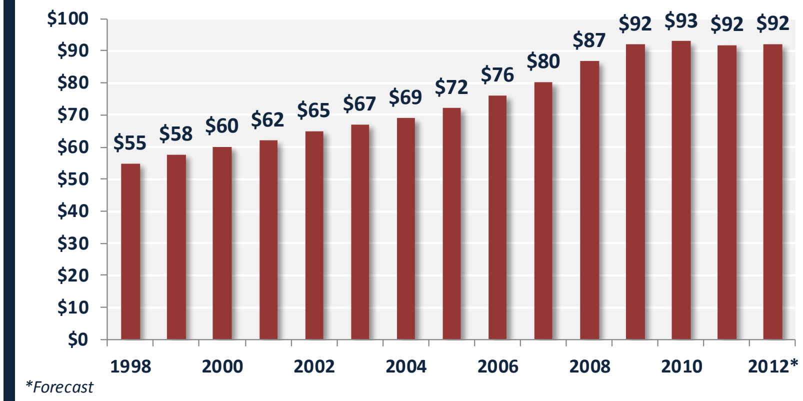


Note: Includes the costs associated with operating waste transfer stations and the Bureau of Waste Disposal but excludes the cost of landfill closure.

Sources: CBC analysis. New York City Office of the Comptroller, *Comprehensive Annual Financial Reports,* Fiscal Years 1991 through 2011. Cost of landfill closure provided by the New York City Independent Budget Office.

The first export contract was signed in 1997 at a price of $55 per ton.[47] By 2002, when all refuse had to be exported, the average price had jumped 20 percent to $65 per ton. Over the next eight years, unit costs rose about 5 percent annually, reaching $93 per ton in fiscal year 2010 before falling slightly to $92 per ton in 2011. (See Figure 5.)

Figure 5: New York City Average Export Price per Ton of Refuse, Fiscal Years 1998 through 2012



**Forecast*

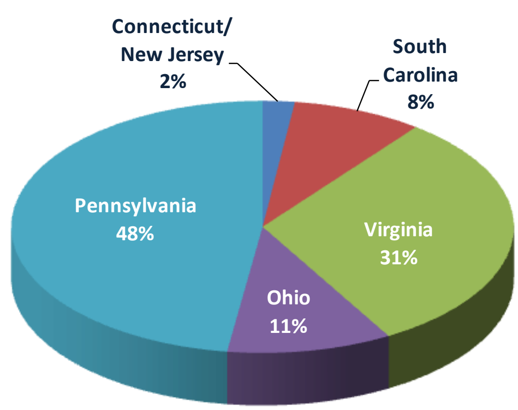
Sources: New York City Office of Management and Budget, *Budget Function Analysis, Multiple Years.* New York City Office of Operations, *Mayor's Management Report, Multiple Years.* New York City Independent Budget Office, *Refuse and Recycling: Comparing the Costs,* February 2004. New York City Office of the Comptroller, *No Room to Move: New York City's Impending Solid Waste Crisis,* October 2004. Data for fiscal year 2012 provided by the New York City Office of Management and Budget.

Why Costs are Rising

As already discussed, DSNY's cost for disposal is not growing because more trash must be handled; in fact, the trend in waste volume is a modest decline. Instead, the unit cost, or cost per ton, has been rising rapidly. The cause of this growth is primarily the added transport costs due to a need to move the garbage longer distances to reach a suitable landfill.

Landfill prices are high in areas with high population density and high land values, such as the areas surrounding New York City. In 2008 the national average landfill fee was $44 per ton, but ranged from $68 in New Jersey to $32 in Ohio and $35 in South Carolina.[48] As a result, waste haulers have a strong financial incentive to ship New York City waste long distances before dumping. The New York State Department of Environmental Conservation (DEC), which tracks the final disposal sites for waste exported from New York transfer stations, reports the most popular destinations are Virginia and Pennsylvania, which together accept 79 percent of exported refuse.[49] (See Figure 6.)

Figure 6: New York City Refuse Disposal Destinations by State, 2010



Source: New York State Department of Environmental Conservation, Division of Materials Management, *New York State 2010 Waste Import/Export for Selected States,* November 30, 2011.

New York City sends its waste to these landfills by truck and by railcar. Truck transport accounts for about 1.8 million tons or 62 percent of the landfilled trash, a share that has been shrinking as reliance on railcars has increased.[50] (See Table 1.)

Table 1: New York City Landfilled Refuse, Export Cost by Mode of Transport, Fiscal Year 2011

	Tons	Cost per Ton	Total Cost ($ in millions)
Rail to Landfill	**1,116,336**	**$106**	**$119**
Bronx	617,945	$94	$58
Brooklyn	225,144	$135	$30
Staten Island	210,209	$117	$25
New Jersey Transfer Station	63,038	$89	$6
Tractor Trailer Truck to Landfill	**1,783,574**	**$88**	**$157**
In-City Transfer Station	1,545,698	$91	$141
New Jersey Transfer Station	237,876	$68	$16
Total Landfilled	**2,899,910**	**$95**	**$276**

Source: CBC analysis. New York City Office of Management and Budget, *Export Costs and Tons by Vendor, Fiscal Year 2011.*

The SWMP commits to shipping about 40 percent of the City's refuse by railcar under long-term contracts; as of fiscal year 2011, approximately 32 percent departed in this way. These long-term rail contracts cover all waste generated in Staten Island and the Bronx and a portion of Brooklyn.

One reason for favoring rail-based transport is its fuel efficiency. One gallon of diesel fuel can move one ton of waste 110 miles on a truck, but 484 miles on a train.[51] At $4 per gallon, that translates to $0.04 per ton per mile (or per ton-mile) for trucking and $0.008 per ton-mile for rail. Rail transport also minimizes the number of roundtrips to landfill. For the rail transfer station in Brooklyn, each trip to a landfill consists of 186 railcars carrying almost 14,000 tons of refuse.

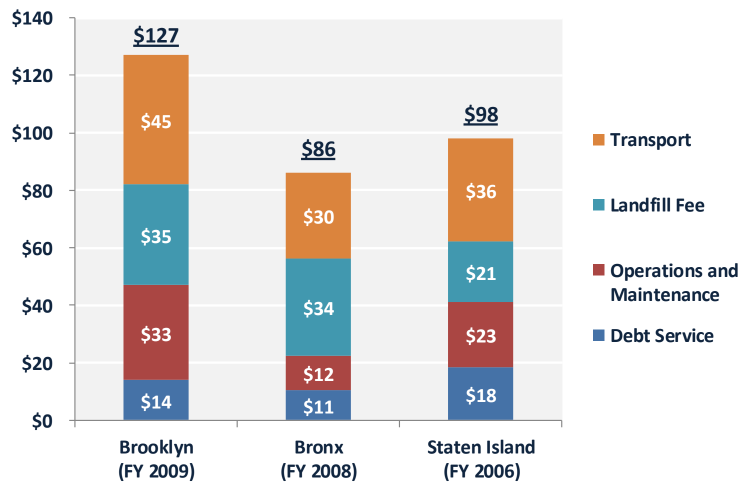
Yet despite rail's fuel efficiency, it is currently more expensive per ton than trucking. For fiscal year 2011, the rail contract for Bronx waste costs $94 per ton, and Staten Island and Brooklyn waste cost $117 and $135 per ton, respectively.[52] This compares to an average trucking price of $88 per ton.

The higher price of trains largely reflects the longer distances they travel. To be awarded 20-year contracts, rail haulers had to find landfills with long-term capacity and existing track connections. A 2004 survey conducted for DSNY found that most landfills meeting these criteria are more than 400 miles from New York City.[53] Additionally, for rail trips from the Bronx and Brooklyn, the journey is extended by the "Selkirk Hurdle" - a 280-mile detour to Selkirk, New York in order to cross the Hudson River and travel south or west.[54] The initial disposal site for waste from the Bronx and Brooklyn is more than 650 miles away in Waverly, Virginia, and the final destination for Staten Island waste is 660 miles away in Bishopville, South Carolina.[55] In comparison, trucks carrying New York City waste travel an average of 315 miles one-way to disposal.[56]

While the roundtrip journey for trucks is much shorter than for railcars, the City anticipates that as closer landfills fill up, these distances will grow. In the long-term, the City is expected to save money by having the more fuel-efficient rail infrastructure in place. Despite the relatively shorter distances traveled by trucks, because tractor trailers carry much smaller loads, they log more than 40 million miles each year carrying New York City garbage.[57]

For the rail contracts, costs associated with transportation drive about one-third of the total price. For the first year of the Brooklyn rail contract, fiscal year 2009, the cost of transport added $45 per ton, or 35 percent of the total cost. (See Figure 7.) The transport portion of each rail contract will be escalated according to a cost index that has averaged 4 percent annual growth over the past five years.[58] Each contract includes a fuel charge escalator as well. Over the 20-year contracts, the City hopes that fee increases for rail export will be more predictable, and smaller, than market prices for long-haul trucking.

Figure 7: New York City Railcar Waste Export Contracts, Per Ton Price by Cost Components
(Year 1 of Contract)



Note: The City pays additional personnel costs for the publicly-owned Staten Island transfer station out of its expense budget.

Sources: CBC analysis. Service Contract for Municipal Solid Waste Transportation and Disposal for the Staten Island Transfer Station between City of New York and Allied Waste Systems, Inc. Signed July 7, 2006. Service Contract for Municipal Solid Waste Transportation and Disposal for the Waste Management Bronx Project between City of New York and Waste Management of New York, LLC. Signed July 18, 2007. Service Contract for Municipal Solid Waste Transportation and Disposal for the Waste Management Brooklyn Project between City of New York and Waste Management of New York, LLC. Signed February 28, 2008.

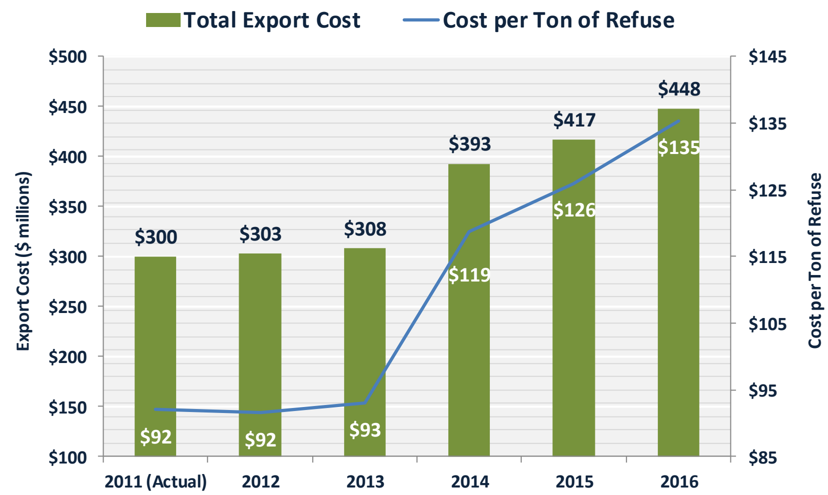
The SWMP anticipates that 47 percent of refuse will eventually be exported by barge. No barge transport contracts have yet been signed, but prices are projected to be higher than rail, primarily due to the significant capital investments. A recent analysis by the New York City Independent Budget Office projects that the cost at the East 91st Street marine transfer station will be $238 per ton.[59] In addition, connections to landfill by barge are even more limited than those by rail. In DSNY's 2004 survey, only one landfill with long-term capacity and barge access was identified. If direct barge access is not available, relays to rail or truck will be necessary, further adding to costs. A March 2012 environmental review for the four new marine transfer stations for non-recyclable waste estimated that containerized waste would be transported by barge approximately 15 to 30 miles to one or more rail freight terminals in the metropolitan area before traveling to final disposal sites.[60] The review estimated that waste will travel 670 miles one-way from the rail terminals if the final destination is a landfill, or 290 miles if the disposal site is a waste-to-energy facility.

Full implementation of the SWMP, including completion of the marine transfer stations, may or may not result in cost savings over the long-term, but in the short-term costs will certainly rise. DSNY predicts waste export costs will grow from $300 million in fiscal year 2011 to about $450 million in 2016, a 50 percent increase.[61] (See Figure 8.) Thus, within the next few years, a price of $135 per ton will no longer be the maximum charge for removing trash from the city; it will be the norm. The cost of long-distance landfilling may be greater than $140 per ton within five years.[62]

Environmental Impact

New York City's current disposal practices exact a significant toll on the environment. Carbon dioxide emitted from fuel consumed by long-haul trucks and trains and methane gas emissions from landfills contribute significantly to global climate change.

Figure 8: Projected Cost of New York City Solid Waste Export, Fiscal Years 2011 through 2016



Note: The quantity of refuse is projected to increase 1.5 percent in 2012 and then remain constant. Total solid waste export costs include long distance landfilling and processing at local waste-to-energy plants.

Source: CBC analysis. New York City Department of Sanitation, *New and Emerging Conversion Technology: Background.*

Long Distance Transport

Trucks carrying DSNY-managed refuse log 40 million miles every year, the equivalent to driving from New York City to Los Angeles 7,000 times.[63] These trucks emit carbon dioxide, consume diesel fuel, contribute to road wear and tear, and congest highways. Because rail transport is significantly more fuel efficient than trucking, the City achieved a 35 percent reduction in greenhouse gas emissions from solid waste transport from fiscal year 2005 to 2010, as rail transport increased.[64] Per ton of waste, trains carrying DSNY-managed refuse emit 0.01 metric tons of greenhouse gas, while trucks emit 0.05 metric tons.[65] Even though the City's move to rail has decreased the quantity of fuel consumed in transport and the subsequent air emissions, in 2010 railcars hauling DSNY trash to landfill still consumed 1.5 million gallons of diesel fuel, while trucks carrying trash consumed 7.4 million gallons.[66] Based on the current mix of transport modes used by DSNY, the City averages 0.03 metric tons of emissions for every ton of refuse transported.

Landfill Gas

Landfills emit large amounts of methane, a gas with 21 to 25 times more heating potential than carbon dioxide.[67] Production of methane is caused by anaerobic bacteria combining with organic material, such as food, yard waste, paper, and wood. The process begins one to two years after disposal and can continue for 10 to 60 years.[68] The amount of gas released depends on the composition of waste, moisture content, and temperature. These emissions are mitigated by landfill gas collection systems, mandated under a 1996 federal law for large landfills.[69] In 2010, across all landfills, 61 percent of potential methane emissions were avoided, predominantly through gas-to-energy projects and flaring.[70] The United States Environmental Protection Agency (EPA) estimates that about two-thirds of landfills capture methane, and that the typical capture system collects 85 percent of the gas.[71] Nationally, an average landfilled ton of mixed municipal solid waste emits 1.45 metric tons of methane, but emissions vary from 3.28 metric tons in landfills with no methane capture to 0.49 metric tons when capture is employed.[72]

Partially offsetting the emission of methane, landfills act as carbon sinks. Because organic material does not fully decompose in landfills, as it would under normal conditions, it stores carbon. On average, mixed municipal solid waste stores 0.22 metric tons for every ton landfilled.[73] For landfills with gas-to-energy projects, emissions are further offset by displacing the usage of other fuel sources. Using the national composition of energy sources, a landfilled ton of mixed waste in a landfill with a gas-to-energy system offsets an estimated 0.36 metric tons of greenhouse gas emissions from power plants.[74] Considering methane emissions, carbon sinks, and gas capture, the net methane emissions for one landfilled ton vary from 3.06 metric tons in landfills with no methane capture to negative 0.09 metric tons in landfills with gas-to-energy conversion.

Total Emissions

An accurate estimate of total emissions from city waste is difficult, given the complexity of the city's waste disposal methods. DSNY sends 2.9 million tons of garbage to distant landfills every year. Assuming that privately-managed waste goes to waste-to-energy facilities in the same percentage as DSNY waste, residents and businesses annually generate 5.6 million tons of landfilled garbage. Determining the exact landfills utilized and the technology at those landfills is difficult, since many contracts are short-term, and no comprehensive tracking is done. A reasonable estimate is that half of city garbage goes to landfills that simply capture methane and half goes to landfills that convert methane into energy. Using this assumption, New York City garbage creates about 0.12 metric tons of greenhouse gas emissions per ton of landfilled waste – about 509,000 metric tons of emissions from landfill gas and almost 170,000 metric tons from transport.[75] (See Table 2.) An equivalent level of annual emissions is produced from roughly 133,000 cars on the road.[76]

Table 2: Environmental Impact of Landfilling

	Metric Ton of Carbon Dioxide Equivalent per Ton of Mixed Municipal Solid Waste				
Emissions	**No Methane Capture**	**Methane Capture, No Gas-to-Energy**	**Gas-to-Energy**	**Estimated NYC Average[3]**	**Estimated Total NYC Emissions[4]**
Methane	3.28	0.49	0.49	0.49	2,773,176
Displaced Energy[1]	NAP	NAP	-0.36	-0.18	(1,018,718)
Carbon Storage	-0.22	-0.22	-0.22	-0.22	(1,245,099)
Landfill Subtotal	**3.06**	**0.27**	**-0.09**	**0.09**	**509,359**
Transport to Distant Landfill[2]	**0.03**	**0.03**	**0.03**	**0.03**	**169,786**
Total Emissions	**3.09**	**0.30**	**-0.06**	**0.12**	**679,145**

NAP = Not Applicable

1) Based on the national energy profile.

2) Based on refuse managed by DSNY.

3) Assumes one-half of non-recycled NYC garbage goes to landfills with methane capture but no energy conversion and the other half goes to landfills with gas-to-energy conversion.

4) An estimated 5.6 million tons of DSNY- and privately-managed garbage is landfilled annually. Calculation is based on waste data in Figure 3 and assumes that 11 percent of non-recycled NYC garbage goes to waste-to-energy facilities.

Sources: United States Environmental Protection Agency, *Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Landfilling.* New York City Mayor's Office of Long-Term Planning and Sustainability, *Inventory of New York City Greenhouse Gas Emissions,* September 2011.

WASTE-TO-ENERGY: AN UNDERVALUED, UNDERUTILIZED AND MISUNDERSTOOD OPTION

Waste-to-energy (WTE) technology has the potential to improve vastly New York City's waste disposal practices. It can save taxpayers money and reduce environmental harm. The major obstacles to implementing this better strategy are misunderstandings about how it works and its consequences.

What is Waste-to-Energy?

Trash can be converted to energy in alternative ways. The most common and widely used method is combustion. Other more recently identified technologies are not currently used on a significant scale in the United States, but these emerging technologies have potential that should be explored.

In WTE plants with combustion technologies, waste is fed into a boiler and converted into electricity through the production of steam.[77] Operators use the generated electricity to power plant operations and sell the excess. Most plants produce 550 to 650 kilowatt-hours of electricity for sale per ton combusted. Some plants also sell the steam produced or use the steam for district heating. The ash remaining after the combustion process is 90 percent smaller than the feedstock by volume (75 percent smaller by weight). Any remaining recyclable metal can be extracted post combustion from the resultant ash, and ash not used as landfill cover or in asphalt manufacture is landfilled. To meet strict state and federal environmental requirements, plants use a combination of pollution control technologies, such as scrubbers, fabric filters, and ammonia, lime and carbon injections.

Combustion is the oldest and most mature WTE technology, but others have been developed in Europe and Japan. These technologies include anaerobic digestion, thermal processing, fermentation and hydrolysis. In a series of studies, a consultant to New York City identified anaerobic digestion and thermal processing as the most financially and environmentally promising of the emerging technologies.[78] At the time of the consultant reports, no operators of either technology had U.S. operational experience.

Anaerobic digestion is the controlled decomposition of organic waste into biogas.[79] The resultant gas is similar to natural gas and can be combusted on site or collected to be combusted elsewhere. Because energy is extracted from only the organic portion of the waste, energy conversion is low. One ton of waste can generate 150 to 250 kilowatt-hours through anaerobic digestion. The process also produces compost, which can be sold unless it contains a high level of pathogens or metals. About 25 percent of the waste input by weight needs to be landfilled at the end of the process. Although the U.S. has no commercial-scale plants for processing municipal solid waste, at least 124 anaerobic digestion plants process municipal solid waste in Europe.[80] San Jose, California plans to open the first commercial-scale anaerobic digestion plant in the U.S. in July 2012, but it will process only food and yard waste.[81] The New York City Department of Environmental Protection is implementing a similar technology for its wastewater treatment plants.[82]

Thermal processing includes gasification, plasma gasification, and pyrolysis, which use very high temperatures to convert the organic and plastic fraction of waste into carbon monoxide or hydrogen, called syngas.[83] The "syn" is short for synthesis. Metal, glass and other portions of the waste that are not vaporized are turned into molten slag, a sand-like material that can be used in brick-making or road paving. Thermal technologies offer higher energy efficiency than combustion, generating between 550 and 800 kilowatt-hours per ton. In addition, some plants have zero residues to be landfilled after processing. Gasification plants have operated in Japan for a decade and have recently attracted attention in the U.S.

Benefits of Waste-to-Energy

Cheaper

As discussed, New York City's lack of nearby disposal options for garbage has driven up the cost of solid waste management and will continue to do so in the future. The average price for long distance landfilling from New York City is now $95 per ton, but it will exceed $140 per ton by 2016. In contrast, current fees at nearby combustion WTE plants and the projected fees of new plants are much lower.

The price charged to use WTE facilities, known as the tipping fee, is based on net operating costs, including revenue offsets from the sale of energy and recovered metals. The two biggest costs are capital charges and general operations. For example, the Onondaga County Resource Recovery Authority (OCRRA), which owns a plant in Jamesville, New York, spent 43 percent of its 2010 budget on an operating lease with a private company and one-third on bond payments.[84] In 2010, revenues from the sale of electricity funded 30 percent of costs, and recovered metals offset an additional 4 percent. Unlike the operating costs, revenues can vary significantly year to year. When wholesale electricity prices were higher in 2008, 6.8 cents per kilowatt-hour versus 4.5 cents in 2010, OCRRA's electricity sales netted 47 percent of total costs.[85] In general tipping fees fund the remaining costs. The OCRRA enters into multi-year contracts with waste haulers for the tipping fee. Their fee increased from $69 in 2009 and 2010 to $74 in 2011, and the fee will increase to $79 in 2013.[86]

The current contract prices for New York City waste delivered to plants in Newark, New Jersey and Hempstead, Long Island are $66 and $77 per ton, respectively.[87] These prices are set under short-term contracts, but the City wants to enter into a 20-year contract at Newark. This is currently the City's least expensive method of refuse disposal. In Connecticut, WTE plant fees range from $60 to $69 per ton.[88]

Based on these regional prices, if existing plants in the region had capacity to accept additional New York City waste, the price would likely be in the range of $60 to $80 per ton. However, a significant expansion of WTE usage for the City would likely necessitate an expansion at an existing plant or construction of a new plant. The tipping fees at new or expanded WTE plants in the region are difficult to project because of the multiple, dynamic factors involved, but reasonable estimates confirm that fees would be much less than the future cost of long distance landfilling.

The New York City Independent Budget Office (IBO) estimates that a new 900,000-ton per year combustion WTE plant would cost about $108 per ton in 2019, the first year of operation in the analysis.[89] The calculation assumes the plant would cost $714 million and be financed at 6 percent over 30 years. IBO also assumes electricity prices would be 10 cents per kilowatt-hour in 2019.

Fiscal studies for newer technologies also conclude that fees would be less than continuing to landfill. A 2010 feasibility study of constructing an anaerobic digestion plant by the Hunts Point food distribution market in the Bronx found that tipping fees would be financially viable at $70 per ton.[90] The analysis assumed that this plant would process only waste from the market, which is largely organic. The City-commissioned study on new and emerging technologies assessed a new anaerobic digestion plant for mixed municipal solid waste and found that tipping fees would range from $43 to $65 per ton if public financing is used.[91] If a private company had to raise the funds, the cost would range from $56 to $80 per ton.

The same study found that a new City-financed, thermal processing plant would require tipping fees of between $76 and $129 per ton. Without public financing, the costs would be higher, ranging from $103 to $165. An economic analysis prepared for Marion, Iowa, which is considering building a plasma gasification plant, estimated that tipping fees for a 600-ton per day plant would be $88 per ton in 2014.[92]

Greener

Modern combustion WTE plants reduce greenhouse gas emissions. Bringing New York City waste to local resource recovery facilities would lower greenhouse gases by 1) eliminating long-haul transport, 2) preventing methane production in landfills, 3) displacing other energy sources, and 4) increasing metal recovery.

Based on estimates in the previous section, landfilling and long distance transport generate 0.12 metric tons of emissions per ton of city waste. (Refer to Table 2.) Bringing garbage to local WTE plants avoids this.

WTE plants also displace energy produced at local utilities. The EPA calculates the value of these avoided emissions according to the average heat content of municipal solid waste, conversion system efficiency, and regional energy profiles.[93] In the Middle Atlantic region, a ton of waste combusted is estimated to avoid 0.56 metric tons of emissions from local utilities.[94]

Lastly, because combustion plants recover metal, greenhouse gas emissions are avoided from the extraction of virgin material. The EPA estimates that every ton of waste combusted saves 0.04 tons of carbon dioxide from metal recovery.[95] In total 0.72 metric tons are avoided for every ton of waste processed.

Partly offsetting these avoided emissions are carbon dioxide and nitrous oxide emissions associated with the combustion process at WTE plants. Actual emissions depend on the composition of waste, with the percentage of plastic waste being a principal factor.[96] The EPA estimates that combusting one ton of mixed municipal solid waste emits 0.32 metric tons of carbon dioxide and 0.04 metric tons of nitrous oxide.[97]

Combining the avoided emissions with the carbon dioxide and nitrous oxide emissions, a combustion WTE plant in the New York region saves 0.36 metric tons of emissions for every ton of garbage processed. Thus, New York's current practice of sending 360,000 tons of garbage to energy recovery plants in New Jersey and Long Island reduces greenhouse gas emissions by 129,600 metric tons. About 25,000 cars would need to be removed from the road to achieve the same environmental benefits.[98]

Underutilization of Waste-to-Energy in New York City

New York City's practice of sending annually only 360,000 tons, 9 percent of DSNY managed waste and 11 percent of non-recycled waste, to WTE plants underutilizes this beneficial technology. WTE plants have operated in the U.S. for decades and range in size from a 200-ton per day plant in Oswego County, New York to a 2,700-ton per day plant in Newark, New Jersey. Nationally, 29 million tons of refuse, or 18 percent of non-recycled waste, went to these facilities in 2010.[99]

To encourage development in the 1970s and 1980s, New York State provided $122 million to its local governments to subsidize the planning and construction of WTE plants.[100] Although New York City did not build any facilities, surrounding communities did. Of 76 plants in operation today nationwide, 10 are in New York and 23 are in neighboring states.[101] As previously noted, New York City contracts with two of these neighboring facilities, sending about 353,000 tons annually to a facility in Newark, New Jersey and about 6,000 tons to a plant in Hempstead, Long Island.[102]

Two of New York's neighbors – Massachusetts and Connecticut – lead the nation for the highest reliance on energy recovery. In 2008, Massachusetts sent 52 percent of its non-recyclable solid waste to energy recovery facilities, while the figure for Connecticut was 76 percent.[103] WTE technology is even more common in parts of Europe, where more than 400 WTE plants are in operation.[104] Notably, Denmark – a country with fewer people than New York City – sends 94 percent of its non-recyclable or compostable municipal waste to 29 energy recovery plants.[105] In Austria, Belgium, the Netherlands, Sweden and Switzerland, close to 100 percent of non-recyclable municipal waste goes to WTE facilities.[106]

Misunderstandings about Waste-to-Energy Plants

New York City's laggard performance in using WTE plants is largely attributable to misunderstandings among the broader public about the consequences of their use. Two myths or false arguments against WTE technology have led to New York's current more expensive and more environmentally harmful practices:

> *Myth #1: WTE plants displace recycling.*
>
> *Myth #2: WTE plants are a threat to local residents' health due to the air pollution they create.*

Perceived Competition with Recycling

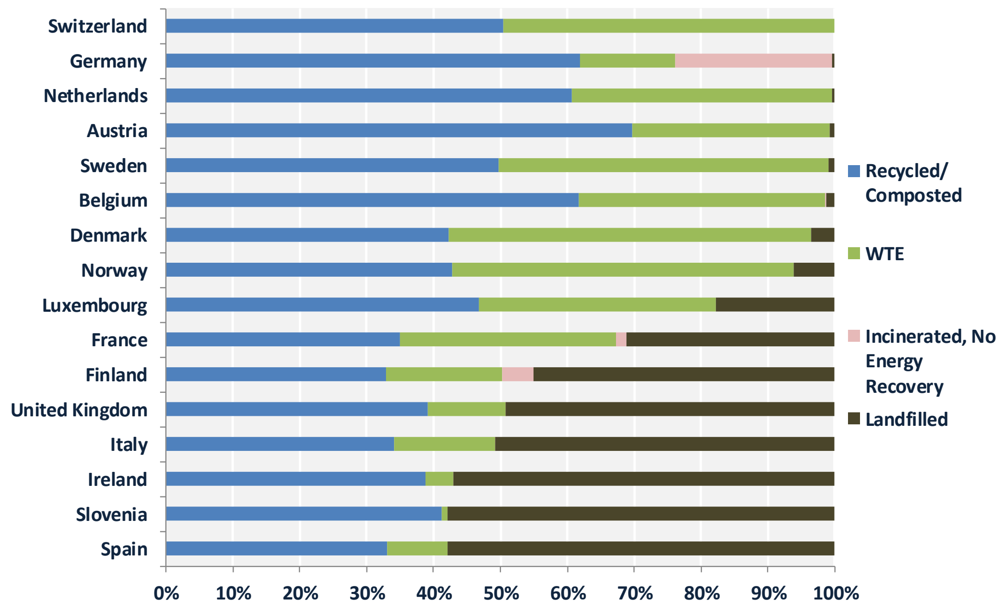
From an environmental perspective, waste reduction and recycling are preferable to any form of disposal; accordingly, a common argument against WTE plants is that they detract from these efforts. However, the experience of places with the most environmentally friendly solid waste practices shows that high reliance on WTE is in fact correlated with high recycling rates. Thus, recycling and WTE are not mutually exclusive.

In the European Union, 16 member and candidate countries recycled or composted more than 30 percent of municipal waste in 2010.[107] On average, these countries used WTE plants for 28 percent of their waste. (See Figure 9.) In four countries – Norway, Denmark, Sweden and Switzerland –

about half of waste collected by municipalities is processed at WTE plants, while 40 to 50 percent is recycled or composted. Europe's top recycler, Austria, recycled or composted 70 percent of municipal waste and sent the rest to WTE plants. In comparison, in the 18 European countries with recycling rates below 30 percent, WTE plants treated only 4 percent of waste. Consequently, these countries landfilled an average of 85 percent of their garbage.

Figure 9: Treatment of Municipal Waste in the European Union

(Countries with Recycling Rates Above 30%, 2010)



Note: "Municipal waste" includes all waste collected by municipalities, which varies from municipality to municipality and from country to country.

Source: European Commission, *Eurostat Database: Municipal Waste Statistics,* 2010.

The same pattern holds in the U.S. Twenty-seven states have recycling rates below 20 percent.[108] These states send an average of only 3 percent of their waste to WTE plants. On the other hand, the 23 states with rates above 20 percent send an average of 12 percent to WTE plants. For example, Connecticut – the state with the least reliance on landfills – diverts 26 percent through recycling and sends 63 percent to WTE plants. Massachusetts achieves a recycling rate of 36 percent while relying on WTE for 37 percent of its waste. The best recycler in the nation is California, with a rate of 53 percent, but without significant use of WTE, California landfills 28 million tons of garbage in the ground every year.

Alleged Pollution and Adverse Health Impacts

The notion that WTE plants are unhealthy polluters of the air is an outdated picture that no longer applies. Solid waste incineration peaked in New York City in the 1960s, when 11 large municipal incinerators and 17,000 apartment incinerators were in operation.[109] At the time, 40 percent of city refuse was incinerated, with little regulatory limitation on pollutants. Consequently, waste incinerators emitted 35 percent of city particulate matter and were significant contributors to air pollution. In 1970 the federal Clean Air Act mandated a federal system of air quality standards, to be established by the newly-formed Environmental Protection Agency (EPA). The tough antipollution regulations eventually brought about closure of these 1960s-era incinerators. For some environmental advocates, mention of WTE recalls this checkered past. However, modern WTE plants differ significantly from 1960s-era incinerators, having been designed specifically to comply with stringent pollution controls and to emphasize energy production.

Numerous studies have documented that modern combustion plants pose no significant health risk. For example, a human health risk assessment for a Montgomery County facility found that even in a worst case scenario a nearby farmer has a one in three million chance of increased health risk from exposure to the plant.[110] A study in Germany, which had 70 WTE plants in 2009, found that dioxin levels near new plants are only 1 to 2 percent of the level considered harmful to human health.[111] The addition of a large plant in New York City would likely increase total emissions by less than 1 percent for sulfur dioxide, nitrogen oxides, volatile organic compounds, and carbon monoxide.[112]

The contrast between 1960s-era incinerators and modern WTE plants is a consequence of technological advances and tighter regulations. Under the federal Clean Air Act, operators must comply with Maximum Achievable Control Technology (MACT) rules, which apply to eight different air pollutants. The federal EPA updates MACT every five years, requiring pollution control retrofits for any plants not in compliance with new EPA limits. The New York State Department of Environmental Conservation (DEC) recently analyzed eight air pollutants at the state's municipal waste combustion plants, and found that most pollutants had declined by 30 to 60 percent from 1996 to 2010.[113] Using a different time frame, the EPA found that from 1990 to 2005, nationwide waste combustion emissions from six of eight pollutants declined by more than 90 percent, while sulfur dioxide emissions fell 88 percent and nitrogen oxides fell 24 percent.[114]

In addition to MACT limits, the federal government regulates how data is monitored and collected. For example, large municipal waste combustion plants must make pollution monitoring data available during at least 90 percent of the hours of operation per quarter and 95 percent per year.[115] The EPA also regulates and monitors the combined impact of all local pollution sources on six criteria pollutants through the National Ambient Air Quality Standards.[116] In addition to federal oversight, the DEC monitors and regulates air pollutants from WTE plants.[117] The DEC requires that operators continuously screen incoming waste for hazardous material, and, prior to permit approval, operators must submit a health risk assessment that models air emissions and public health impacts. For the ten plants in operation in New York, the DEC compares actual emissions to the health risk assessments to ensure that plants operate within approved parameters.

Some WTE plants, including the one in Onondaga County, New York, publish air emissions online. In 2011, the Onondaga County resource recovery plant operated within its state permits for all 11 regulated pollutants. The plant produced less than 5 percent of its state permit for four pollutants, between 5 and 20 percent for six pollutants, and 88 percent for nitrogen oxides.[118]

Furthermore, in conjunction with PlaNYC, the New York City Department of Health and Mental Hygiene (DOHMH) publishes an annual Community Air Survey that evaluates geographic air pollution patterns at 150 locations across the city.[119] This new survey is one of many PlaNYC initiatives to reduce air pollution, including plans to reduce emissions from vehicles and residential heating oil.[120] The City's recent solicitation for waste conversion projects mandates an independent health evaluation completed by DOHMH prior to project approval.[121]

RECOMMENDED GOALS AND STRATEGIES

Municipal officials should revise New York's waste management practices to better address the challenges of high cost and unnecessary environmental damage. The goals should be to reduce garbage generation and divert garbage from landfills to WTE facilities.

Increase Waste-to-Energy Capacity and Use

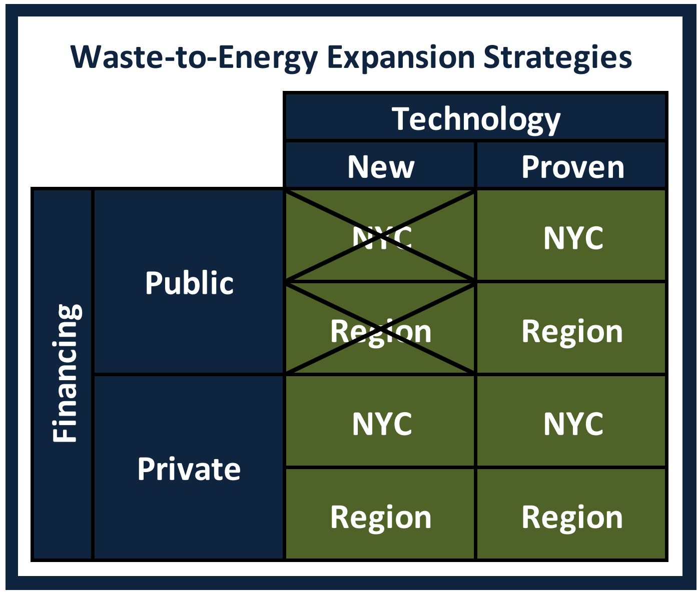
As shown in the previous section, using nearby WTE facilities offers both fiscal and environmental benefits compared to shipping to distant landfills. Recognizing this, the City has issued a request for proposals for a waste conversion plant with initial capacity to process 164,250 tons per year.[122] A plant of this size would divert approximately 3 percent of city refuse from landfills. If the plant is successful, it will be allowed to expand its capacity to process 328,500 tons per year, or about 5 percent of refuse that would otherwise go to landfills. Importantly, the City's RFP limits bids to those involving new technology, and explicitly bans the combustion technology now in widespread use. While the intended experiment with new technology is an important step, much more should be done to avoid landfilling. An appropriate goal is to shift two million tons from landfills to nearby WTE plants.

Although New York's residents and businesses currently create annually about 5.6 million tons of waste to be landfilled, the goal of a WTE capacity of a lower two million tons is based on the long-run objective of reducing the amount of garbage that requires disposal through waste reduction and recycling initiatives. Expanding WTE use requires assuring a predictable level of supply; for economic and environmental reasons, capacity should not be built for garbage that eventually will not require disposal. If New York were to reach its long-term diversion goals of 30 percent for residential and 75 percent overall, DSNY would still landfill 2.3 million tons of garbage, and the private sector would landfill 550,000 tons each year. In addition, over the long-term, the City may also adopt policies that have effectively lowered waste production in other municipalities. Berlin, Germany is a useful benchmark; each person in Berlin produces about 40 percent less waste than the average New Yorker.[123] If New York were to reduce its waste generation level to that of Berlin and reaches its long-term diversion goals, just under two million tons would still need to be landfilled (including 1.4 million from DSNY). Thus, it is reasonable to plan that New York would supply at least two million tons of garbage annually to any new facilities for the foreseeable future.

The pursuit of expanded WTE use involves three key policy choices involving the financing, location, and technology of the plant. The following matrix represents possible strategies. With the exception of publicly-financed, new technology plants, all options should be pursued.

Public versus Private Financing

If risk can be adequately managed, public financing for the construction of WTE plants offers a key advantage – lower cost. In its financial analysis, the City's consultant projected that financing would cost 4.75 percent under public ownership and 8.04 percent under private ownership.[124] The estimate for private financing assumes that 85 percent is financed with tax exempt private activity bonds and 15 percent is financed with owners' equity. Under federal tax law, privately-owned solid waste disposal facilities qualify for private activity bonds under each state's cap.[125] Most municipalities with publicly-financed plants issue bonds through public authorities or other quasi-governmental entities. If public financing is used, as long as maintenance and depreciation have been properly funded, after the debt service is paid off disposal costs should fall dramatically. In the Onondaga County example cited earlier, debt service is one-third of operating costs for the resource recovery plant.



However, using taxpayer funds to finance a large utility – particularly if a newer technology is employed – puts a significant amount of public money at risk. A large plant that can process 3,000 tons per day – about 1 million tons per year – would cost upwards of $700 million to construct. A new 1,500 ton per day combustion WTE plant in Frederick County, Maryland is estimated to cost $370 million.[126]

The city of Harrisburg offers the most extreme example of downside risk. After passage of the federal Clean Air Act, most municipalities shut down their existing incinerators, but Harrisburg decided to upgrade its 1970s-era incinerator to meet new environmental standards. A series of costly and ineffective upgrades – financed without the use of performance bonds – piled on debt for the financially-struggling city.[127] Poor financial decisions over several decades culminated with Harrisburg filing for bankruptcy in 2011. Harrisburg is not representative of most municipalities' financial experience with WTE, but a number of combustion WTE plants have run into financial strain from expensive upgrades and unreliable garbage supply. A 450-ton per day plant in Poughkeepsie, New York costs $102 per ton to process waste and has required municipal subsidies to remain solvent.[128]

Even though these examples are exceptions, they highlight the importance of risk management. All WTE facilities face significant risks, including energy prices, landfill prices, and environmental regulations. Therefore, the use of public financing should be reserved for technologies with a proven performance record in the U.S. Over time more technologies may meet this definition.

Regardless of technology, any WTE project should involve a partnership with the private sector. The majority of publicly-owned plants contract with a private company for the ongoing operations and maintenance of the plant. These contracts typically include performance guarantees and a formula for calculating the annual fee.

Location

For practical reasons, New York City may have to consider solutions outside its borders. New York and its neighboring states of Connecticut, New Jersey, Pennsylvania, and Massachusetts have 33 operating combustion WTE plants. While they generally operate at full capacity, some have expressed interest in adding new capacity, including the plant in Hempstead, Long Island.[129] The City should forge partnerships with the governments that own these existing assets.

An expansion of existing plants would alleviate some siting issues, but new plants in the region would add greater capacity. If New York pursues new regional options, it need not stray from its commitment to end truck export. Opportunities exist for a new waterfront plant in the region that is accessible by barge, for example along the Hudson River or along the ocean coast.

While a regional approach broadens location possibilities, ideally a new plant would be located within the city. This would minimize the fiscal and environmental costs associated with transporting waste long distances. Additionally, if the plant is owned by the City, DSNY would have maximum control over fees and access to the plant's capacity, as well as the energy generated.

However, local residents' opposition to being near such a plant would pose a significant hurdle. The community opposition to the marine transfer stations, based largely on the truck traffic that they would bring, highlights the challenge. One of the goals of the new stations is to equalize the burden of solid waste infrastructure throughout the city and enable each borough to manage its own waste. This argument has not been universally persuasive, leading neighborhood groups to file legal challenges against the new stations.

The political challenge of siting WTE facilities within the city has been made especially difficult by zoning rules and other constraints. Only 11 percent of city land is zoned for industrial, manufacturing, transportation or utilities, and much of that is already developed.[130] Prior to releasing the request for proposals for a new waste conversion plant, the City conducted a study of sites that would be suitable for WTE plants.[131] The study required that sites include at least six to eight acres of suitable land (for example, zoned for manufacturing and no wetlands or floodplains), as well as be accessible by major transportation routes and have connections to transmission lines. These criteria identified nine potential sites. A detailed examination of each criterion for each site deemed five sites to be "acceptable" but only two sites to be "advantageous or highly advantageous." One of these two was a portion of the publicly-owned former Fresh Kills landfill, and the other was the former site of the Brooklyn Union Gas Company. The Fresh Kills site was identified in the request for proposals, but in just five weeks, political opposition convinced the administration to recant the site.

Nonetheless, in-city siting should not be dismissed as impossible based on these self-imposed limitations. Other world metropolises have been more imaginative in dealing with these challenges. European cities have designed plants that fit within the urban landscape. In December 2007 a combustion WTE plant opened on the banks of Seine River in Paris with capacity to process 460,000 tons annually.[132] This plant, located one and a half miles from the Eiffel Tower, was constructed largely underground, and the modern design used soundproof material and negative air pressure to eliminate sound and odor. An older plant in Vienna, Austria includes a colorful, artistic façade, bearing little resemblance to a traditional power plant,[133] and the roof of a plant under construction in Copenhagen, Denmark will function as an urban ski park.[134] (See images on next page.)

Waste-to-Energy Plants in European Cities

The Isséane, Issy-les-Moulineaux, Paris, France

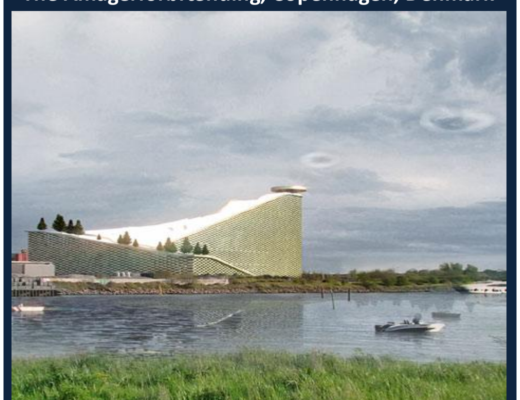
(Distant view)

Source: Co-Generation & On-Site Power Production Magazine. Artistic rendering.

(Close-up view)

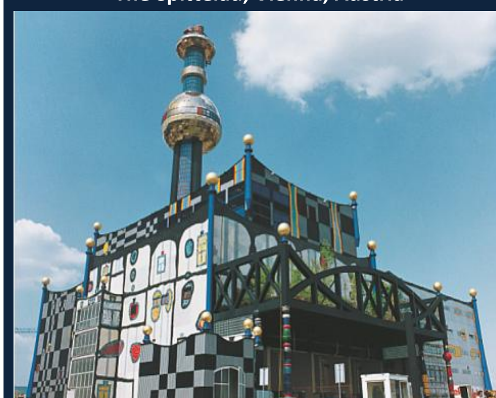
Source: Hitachi Zosen Inova, Plants in Operation.

The Amagerforbrænding, Copenhagen, Denmark



Source: Bjarke Ingels Group. Artistic Rendering.

The Spittelau, Vienna, Austria



Source: Fernwärme Wien/Ernst Schauer.

New or Proven Technology

In addition to financing and location, the City must consider the plant's technology. New York City is in the early stages of pursuing a privately-financed demonstration WTE facility, and has explicitly excluded conventional combustion as the technology for a new plant, arguing that newer technologies, such as anaerobic digestion and thermal processing, offer enhanced environmental benefits. This approach can be contrasted to the solicitation issued by the Northeast Maryland Waste Disposal Authority (NMWDA) in 2006, which set financial and environmental performance targets but did not specify a technology.[135] Because newer technology companies could not show a proven track record in the U.S., the Authority selected a combustion WTE provider.

Rather than excluding specific technologies, New York should require prospective companies to demonstrate a record of meeting fiscal and environmental benchmarks. If companies can meet a stringent set of criteria, then they should be eligible for public financing. If not, no public dollars should be invested. A separate, less stringent, set of criteria should be applied to privately-financed projects using a broad spectrum of technologies. Whether or not public funds are invested, the City has a strong interest in achieving a workable operating plant. For this reason, the risks associated with choosing a technology that has not demonstrated significant commercial reliability in the U.S. should be weighed carefully.

The experience of St. Lucie County, Florida highlights the risk inherent in seeking to use unproven technologies. In 2007 the County signed a contract with a private developer for a $450 million waste conversion plant using plasma gasification, a technology that has not yet been used commercially in the U.S.[136] In response to the economic downturn, falling natural gas prices, and difficulties securing financing, the project was downsized in 2010. However, the smaller project failed to attract investors, and the development was cancelled in April 2012. The County is now seeking waste-to-energy developers with proven technologies and at least two years of successful commercial-scale operational experience.

The tradeoffs involved in financing, location and technology choices suggest that multiple strategies are appropriate. The most benefits would come from a publicly-financed plant in the city using a proven technology. Because this strategy faces many hurdles, the City should also encourage private developers to build in and around the city, seek an expansion of nearby WTE plants through new partnerships, and facilitate construction of new plants within the region.

Fiscal and Environmental Savings

Numerous dynamic factors are involved in estimating the savings from expanded use of WTE facilities. One key factor is the future price of exporting waste to landfills. The planning, designing and construction of a new plant would take some time, thus the cost of WTE should be compared to New York City export costs about 10 years in the future. With the full implementation of rail and barge export, the average cost of long distance landfilling will be approximately $143 per ton in 2016.[137] Under the 20-year contracts, these prices should ultimately stabilize but continue to grow at a modest rate. If the long-term contract prices grow 3 percent annually post-2016, then the City will be paying $170 per ton to export to landfill by 2022, a reasonable timeframe for new or expanded plants to be operational.

If the City finances a 3,000-ton per day combustion WTE plant at a cost of $750 million, the cost of operations and capital financing, net of electricity sales, would be approximately $109 million in 2022. Assuming the plant operates 365 days per year with 90 percent availability, the plant could process 985,500 tons annually, at a cost of $111 per ton.[138] Thus, $59 would be saved for every ton sent to the new plant instead of exported to landfill. Using this estimate, if the City were able to create capacity to divert two million tons from landfill to local energy recovery, taxpayers would save $119 million in 2022. The projected cost of disposing solid waste for New York City in 2022 would fall from $526 million to $408 million, a 23 percent drop.[139] Over the next 30 years, such an expansion would have a net present value of almost $2 billion.[140]

The environmental benefits are also significant. The diversion of two million tons from distant landfills would cause total greenhouse gas emissions to fall 35 percent, from 679,000 to 439,000 metric tons of carbon dioxide equivalent.[141] This would achieve the same benefits as convincing every driver going through the Holland Tunnel to turn in their keys.[142]

Reduce Waste for Disposal

Even if New York diverts an additional two million tons of garbage to WTE facilities, more than 3.6 million tons of residential and commercial garbage will still have to travel to landfills every year without other initiatives. The City should pursue strategies to bring this number down through policies aimed at less waste generation and more recycling.

Less Generation

The best way to reduce the fiscal and environmental impact of garbage is simply to not create it. On the fiscal side, waste avoidance eliminates the need for both collection and disposal. Similarly, in addition to avoided landfilling, this avoids the environmental harm associated with garbage collection trucks, as well as the manufacturing and shipment of new consumer goods. The most promising policies to reduce waste generation in New York City are price incentives (and disincentives).

A common use of financial incentives is known as "pay-as-you-throw" (PAYT). When general taxes support waste collection, residents have no direct financial incentive to limit waste. PAYT charges in direct relation to the amount of garbage produced, similar to payments for other utilities, including water and electricity. In the U.S., over 7,000 communities have some version of PAYT, including Austin, San Francisco, and Seattle.[143] Typically, residents receive one refuse bin for "free" but must pay extra for additional bins or for larger bins. No charge is levied for additional recycling or composting bins. A study found that PAYT results in an average garbage disposal reduction of 16 percent in American communities.[144]

An oft-cited hurdle to PAYT in New York City is the predominance of multi-unit housing and relative dearth of single-family home neighborhoods. Two large international cities, Zurich and Seoul, have addressed that issue by mandating the use of government-supplied trash bags and imposing a strict system of fines. In Zurich, garbage is expensive; the smallest trash bag, called a Zuri-Sak costs $6.80.[145] After instituting the policy in 1992, the amount of garbage collected annually dropped 40 percent.[146] In South Korea's capital city, Seoul, costs are much lower. Special bags can be purchased from local retail stores and vary in price by district. In the district of Yongsan-gu, prices range from 190 won (about $0.17) for a 10 liter bag to 880 won (about $0.77) for a 50 liter bag.[147]

Another hurdle for communities such as New York, which pay for garbage out of general revenues, is how to avoid a net increase in the local tax burden. Toronto offers one approach. In 2008 Toronto required all residential home and building owners to purchase garbage bins but provided an offsetting tax rebate.[148] The rebate was structured such that low trash producers would pay nothing for trash collection. Another option is to dedicate trash fees to funding garbage and recycling services and to lower property tax collections by a commensurate amount.

Opponents of PAYT claim that such schemes lead to illegal dumping or trash burning. An early study of PAYT found that 20 percent of communities experienced increases in illegal dumping, but this persisted for only three months.[149] In New York City, this would likely take the form of depositing trash into public street bins. Strong enforcement, penalties, and free disposal for bulky items have proven to be effective barriers to this behavior in other places. The complexities of PAYT in New York suggest that the City implement a trial pay-as-you-throw system in the short-term, taking lessons learned to a citywide program in the long-term.

Other cities have had success with fees or bans related to carry-out plastic bags. The potential for waste reduction is significant; plastic bag waste adds up to 116,000 tons in New York City.[150] Washington, D.C. recently established a 5 cent fee on plastic bags and saw usage decline 87 percent.[151] A 33 cent tax on plastic bags in Ireland had a similar effect, causing per capita plastic bag consumption to fall 94 percent.[152] Mayor Bloomberg unsuccessfully proposed a 6 cent fee in 2008 and a 5 cent fee in 2009.[153] Early estimates predicted that the fee would prevent the disposal of two billion bags while generating over $100 million in new revenue.[154] San Francisco employed a different approach to plastic bags, banning large supermarkets and retail pharmacies from providing non-reusable or non-compostable shopping bags.[155]

More Recycling

Recycling offers many environmental benefits, including the preservation of virgin materials, reducing landfill use, and avoiding long-distance transport. In addition to the environmental benefits, disposing of recycled materials is inexpensive relative to landfilling. Some types of recycling even make money. In fiscal year 2011, the City paid $69 per ton to process metal, glass and plastic (MGP), but received $12 per ton for recyclable paper and cardboard.[156] Revenues from paper have fluctuated corresponding to changes in commodity prices. At its peak in fiscal year 2008, recycled paper grossed $27 per ton.[157]

PlaNYC set a goal of a residential recycling rate of 30 percent by fiscal year 2017 and a citywide recycling rate of 75 percent by 2030.[158] The composition of city residential waste indicates that 30 percent is a reasonable goal. As noted earlier, about 40 percent of New York waste is paper, metal, plastic and glass that could be recycled. Reaching the residential goal would reduce waste disposed by the DSNY by 555,000 tons annually and result in substantial fiscal and environmental savings. Based on processing fees for MGP, the savings from avoided export and landfilling would be at least $15 million annually.

The price disincentives for refuse production noted above would also serve as important incentives to recycle. Other promising strategies to achieve a 30 percent target are changing recycling rules to ease compliance and recycling organic material.

Many communities have increased compliance by expanding eligible materials for recycling, in particular plastics. A case is made on two grounds: (1) technology continually advances to convert lower quality plastics into usable material, and (2) the expansion simplifies the process and encourages more recycling of all materials. San Francisco and Los Angeles currently accept all types of plastic for recycling.[159]

In 2010 the New York City Council passed legislation to expand plastic recycling when the new recycling plant in Brooklyn is operational.[160] The DSNY has been negative in the past about expanding plastic recycling because of increased sorting costs and the lack of markets for higher numbered plastic material. These concerns are still valid, but technology has advanced for sorting and beneficial reuse. For example, a South Carolina company has developed a pyrolysis technology to convert all types of plastics into synthetic oil for the clean diesel, syn-lube and wax markets.[161]

The City should stick to its plan and reinvigorate the recycling program by touting the expansion and the simplification of recycling rules.

Another approach, called single stream recycling, allows residents to put different types of recyclable material into the same container. Currently, New Yorkers separate paper from all other recyclable material. At least 100 municipalities in the U.S. use a single stream system, including San Francisco, Los Angeles, Phoenix and Madison, Wisconsin.[162] A case study of Madison, Wisconsin found that in the first year of the program the amount of recycling increased 25 percent.[163]

Another way to expand recycling is to include organic materials, such as food and yard waste. In April 2008, Seattle became the first city in the U.S. to require the collection of food waste. In 2009, San Francisco enacted a stricter law requiring all residents and businesses to collect separately food waste.[164] Most commonly, food and yard waste is composted and converted into soil. In New York, inmates operate an 8-ton composting plant at the Rikers Island Correctional Facility. Other environmental groups have helped promote composting through collection centers at farmers markets and community gardens. Getting New Yorkers to separate food waste would be challenging, given the City’s difficulties with traditional recycling. Opportunities for composting may be most feasible at locations with high food waste. Possible sites include restaurants, school and office cafeterias, hospitals, grocery stores, and food distribution markets.

CONCLUSION

New York City residents, commuters, visitors and businesses put 14 million tons of waste into garbage cans and recycling bins every year. Of the non-recyclable waste managed by the City, three million tons are sent to distant landfills, and private sector garbage almost doubles that figure. This report finds that this practice is perhaps the most expensive and environmentally harmful option available.

To mitigate these negative impacts, the City should create local capacity for processing an additional two million tons of garbage at waste-to-energy plants. A multi-pronged approach to attaining this goal should include promoting the expansion of capacity at combustion waste-to-energy facilities in the nearby vicinity and constructing new plants in or near the city.

In the long-term, expanding local waste-to-energy capacity by two million tons would save taxpayers more than $119 million annually. The present value savings over the next 30 years would be almost $2 billion. In addition, an estimated 240,000 metric tons of greenhouse gas would be prevented from entering the atmosphere every year, a 35 percent reduction from the status quo.

New York City should also employ a combination of financial incentives and streamlined recycling rules to further reduce landfilling. The City's low residential recycling rate and current lack of price incentives indicate that significant reductions can be achieved.

A rethinking of current solid waste management practices should be a high priority for municipal officials. The potential for such environmental and fiscal benefits should not be wasted.

ENDNOTES

[1] "New York: Fragrant Days in Fun City," *Time Magazine,* February 16, 1968. Available from http://www.time.com/time/magazine/article/0,9171,837855,00.html.

[2] Solid waste includes all recycled and non-recycled materials generated by households, government, businesses and construction and demolition activities. Excluded from this definition are industrial waste and biosolids processed at the City's wastewater treatment facilities. In this report, "waste" refers to all discarded items, including those intended for recycling. The terms "waste," "garbage," and "trash" are used interchangeably. "Refuse" refers to non-recyclable waste.

[3] New York City Department of Sanitation, *Solid Waste Management Plan: Executive Summary,* September 2006. Available from http://www.nyc.gov/html/dsny/downloads/pdf/swmp/swmp/swmp-4oct/ex-summary.pdf.

[4] Customers choose to be charged by volume or by weight. If the volume rate of $15.89 per cubic yard is chosen, the cost is approximately $127 per ton, assuming that one cubic yard of solid waste is 250 pounds. If the weight rate of $10.42 per pound is chosen, the cost is $208 per ton. New York City Business Integrity Commission, *Trade Waste: Maximum Rates.* Available from http://www.nyc.gov/html/bic/html/trade_waste/max_rates.shtml. Accessed May 9, 2012.

[5] Based on waste and source separated recycling at private putrescible waste transfer stations from July 2010 through June 2011 (third quarter 2010 through second quarter 2011). Available from http://www.nyc.gov/html/nycwasteless/html/resources/reports_ll40.shtml.

[6] Based on waste and fill material reported at private non-putrescible waste transfer stations from July 2010 through June 2011 (third quarter 2010 through second quarter 2011). Available from http://www.nyc.gov/html/nycwasteless/html/resources/reports_ll40.shtml. Additional recyclable construction waste reported in New York City Department of Sanitation, *Annual Report for New York City Municipal Refuse and Recycling Statistics, Fiscal Year 2011.* Available from http://www.nyc.gov/html/nycwasteless/downloads/pdf/DSNY-reports/FY2011_Annual_Municipal_Refuse_and_Recycling_Statistics.pdf.

[7] New York City Department of Sanitation, *Annual Report for New York City Municipal Refuse and Recycling Statistics, Fiscal Year 2011.* Available from http://www.nyc.gov/html/nycwasteless/downloads/pdf/DSNY-reports/FY2011_Annual_Municipal_Refuse_and_Recycling_Statistics.pdf. New York City Office of Management and Budget, *Export Costs and Tons by Vendor, Fiscal Year 2011.*

[8] New York City Department of Sanitation, *Fiscal Year 2010 Annual Report.* Available from http://www.nyc.gov/html/dsny/downloads/pdf/pubinfo/annual/ar2010.pdf.

[9] Includes fringe benefits, debt service, legal services, and judgments and claims. New York City Office of Management and Budget, *Fiscal Year 2013 Executive Budget, Mayor's Message,* May 3, 2012, p. 134. Available from http://www.nyc.gov/html/omb/downloads/pdf/mm5_12.pdf. New York City Office of Management and Budget, *Fiscal Year 2013 Executive Budget, Budget Function Analysis,* May 7, 2012, p. 347. Available from http://www.nyc.gov/html/omb/downloads/pdf/bfa5_12.pdf. The 2010 U.S. Census reported 3.1 million households in New York City.

[10] New York City Department of Sanitation, *Fiscal Year 2010 Annual Report.* Available from http://www.nyc.gov/html/dsny/downloads/pdf/pubinfo/annual/ar2010.pdf.

[11] Based on per ton collection costs in fiscal year 2010 and total annual tons of refuse and recycling in fiscal year 2011 reported in the New York City Office of Operations, *Preliminary Fiscal Year 2012 Mayor's Management Report,* February 2012, p. 104. Available from http://www.nyc.gov/html/ops/downloads/pdf/mmr/0212_mmr.pdf.

[12] See DSM Environmental, *Analysis of New York City Department of Sanitation Curbside Recycling and Refuse Costs,* Prepared for the Natural Resources Defense Council, May 2008. Available from http://docs.nrdc.org/cities/cit_08052801A.pdf. Office of the New York City Comptroller, *Recycling Cost Projections for City Council,* May 19, 2003. Available from http://www.comptroller.nyc.gov/bureaus/opm/reports/Recycling_Cost_Projections_for_City_Council_REPORT.pdf. New York City Independent Budget Office, *More Recycling Needed to Help Lower City's Trash Costs,* Inside the Budget, Number 150, May 1, 2007. Available from http://www.ibo.nyc.ny.us/newsfax/insidethebudget150.pdf.

[13] New York State Department of Environmental Conservation, *Solid Waste Composition and Characterization: MSW Materials Composition in New York State,* 2008. Available from http://www.dec.ny.gov/chemical/65541.html. Accessed May 9, 2012.

[14] The City reports a curbside and containerized recycling rate in its annual *Mayor's Management Report*. This figure is slightly different than the residential and government sector rate shown in Figure 3, which includes refuse and recycling collected outside of the curbside and container programs, such as street basket waste. The City also reports a total DSNY-managed diversion rate which includes construction materials contracted by the City for reuse. This rate fluctuates greatly year to year and can be much higher than the curbside and containerized rate. In Figure 3, residential and government waste excludes city-contracted construction fill and other construction-related recyclables. These construction materials are instead allocated to the construction sector. The commercial and construction figures in Figure 3 are based on reports posted by DSNY on private waste transfer stations. Commercial waste includes source separated recycling and putrescible waste; construction waste includes all non-putrescible waste. According to the New York City Solid Waste Management Plan, Attachment IX, putrescible solid waste is "office waste…and restaurant and other… municipal solid waste from commercial sources," that contains "organic material having the tendency to decompose." Non-putrescible waste is defined as "inert waste generated from commercial and residential demolition, new construction and renovation projects." Available from http://www.nyc.gov/html/dsny/downloads/pdf/swmp/swmp/swmp-4oct/attmnt09.pdf.

[15] Thomas Zambito, "Crooks' 1-G-a-Night Cardboard Thefts," *New York Daily News,* September 8, 2009. Available from http://www.nydailynews.com/news/crime/crooks-1g-a-night-cardboard-thefts-article-1.404858.

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[17] Steve Polan, "Garbage Gridlock," *The City Journal,* August 1992 (57).

[18] New York City Department of Sanitation, *Solid Waste Management Plan: Executive Summary,* September 2006. Available from http://www.nyc.gov/html/dsny/downloads/pdf/swmp/swmp/swmp-4oct/ex-summary.pdf.

[19] New York State Legislation, Chapter 107 of 1996. See New York Environmental Conservation Law section 27-0707 (7). Fresh Kills was briefly reopened to accept debris from the destruction of the World Trade Center in September 2001.

[20] New York City Department of Sanitation, *Solid Waste Management Plan,* September 2006. Available from http://www.nyc.gov/html/dsny/html/swmp/swmp-4oct.shtml.

[21] New York City Mayor's Office of Environmental Coordination, *2012 City Environmental Quality Review, Technical Manual, Chapter 14: Solid Waste and Sanitation Services,* January 2012. Available from http://www.nyc.gov/html/oec/downloads/pdf/2012_ceqr_tm/2012_ceqr_tm_ch14_solid_waste_and_sanitation_services.pdf. Also see Erin Durkin, "Bronx, Brooklyn Residents Claim City Targeting Their Neighborhoods for Waste Transfer Stations," *New York Daily News,* April 13, 2011. Available from http://articles.nydailynews.com/2011-04-13/local/29434369_1_transfer-stations-nyc-environmental-justice-alliance-eddie-bautista.

[22] For information on the progress of SWMP, see the following: New York City Department of Sanitation, *City Environmental Quality Review Technical Memorandum: Comprehensive Solid Waste Management Plan,* Updated March 2012. Available from http://www.nyc.gov/html/dsny/html/swmp/swmp_tech.shtml. New York City Mayor's Office of Environmental Coordination, *2012 City Environmental Quality Review, Technical Manual, Chapter 14: Solid Waste and Sanitation Services,* January 2012. Available from http://www.nyc.gov/html/oec/downloads/pdf/2012_ceqr_tm/2012_ceqr_tm_ch14_solid_waste_and_sanitation_services.pdf. The Council of the City of New York, Hearing on the Mayor's Fiscal 2013 Preliminary Budget and the Fiscal 2012 Preliminary Mayor's Management Report, Department of Sanitation, March 13, 2012, p. 15. Available from http://legistar.council.nyc.gov/View.ashx?M=F&ID=1823101&GUID=E187000E-A2D8-4198-B5CD-A05E1F4BAA50. Courtney Gross, Staten Island's Waste Transfer Station Does Dirty Work of Mayor's Trash Plan, *NY1,* September 27, 2011. Available from http://www.ny1.com/content/news_beats/politics/147975/staten-island-waste-transfer-station-does-dirty-work-of-mayor-s-trash-plan.

[23] James Hall, "No Trash, No Crash," *New York Times,* June 27, 2011. Available from http://www.nytimes.com/2011/06/28/opinion/28hall.html?_r=1. Former Deputy Mayor Stephen Goldsmith disputed the

claims in "Waste Site Near La Guardia," Letter to the Editor, *New York Times,* July 1, 2011. Available from http://www.nytimes.com/2011/07/02/opinion/l02trash.html.

[24] New York City Office of Long-Term Planning and Sustainability, *PlaNYC: A Greener, Greater New York, Chapter on Solid Waste,* April 2011, p. 143. Available from http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_solid_waste.pdf.

[25] New York City Office of Management and Budget, *Fiscal Year 2008 Executive Budget, Mayor's Message,* April 26, 2007, p. 167. Available from http://www.nyc.gov/html/omb/downloads/pdf/mm4_07.pdf.

[26] Projections for fiscal years 2012 and 2013 from New York City Office of Management and Budget, *Fiscal Year 2013 Executive Budget, Mayor's Message,* May 3, 2012, p. 136. Available from http://www.nyc.gov/html/omb/downloads/pdf/mm5_12.pdf. Actual data for fiscal year 2010 from New York City Office of Management and Budget, *Fiscal Year 2012 Executive Budget, Mayor's Message,* May 5, 2011, p. 143. Available from http://www.nyc.gov/html/omb/downloads/pdf/mm5_11.pdf. Actual data for fiscal year 2009 from New York City Office of Management and Budget, *Fiscal Year 2011 Executive Budget, Mayor's Message,* May 6, 2010, p. 143. Available from http://www.nyc.gov/html/omb/downloads/pdf/mm5_10.pdf. Actual data for fiscal year 2008 from New York City Office of Management and Budget, *Fiscal Year 2010 Executive Budget, Mayor's Message,* May 1, 2009, p. 155. Available from http://www.nyc.gov/html/omb/downloads/pdf/mm5_09.pdf.

[27] New York City Office of Long-Term Planning and Sustainability, *PlaNYC: A Greener, Greater New York,* April 2007, p. 113. Available from http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/full_report_2007.pdf.

[28] New York City Office of Long-Term Planning and Sustainability, *PlaNYC: A Greener, Greater New York, Chapter on Solid Waste,* April 2011. Available from http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/planyc_2011_solid_waste.pdf.

[29] New York City Mayor's Office Press Release, *Mayor Bloomberg Delivers 2012 State of the City,* January 12, 2012. Available from http://www.nyc.gov/html/om/html/2012a/pr014-12.html.

[30] New York City Mayor's Office Press Release, *Mayor Bloomberg Announces Request for Proposals to Build State of the Art Conversion Technology Facility to Convert Waste To Clean Energy,* March 6, 2012. Available from http://www.nyc.gov/html/om/html/2012a/pr077-12.html.

[31] New York City Local Law 19 of 1989. For more information, see New York City Department of Sanitation Bureau of Waste Prevention, Reuse and Recycling, *New York City Recycling Law.* Available from http://www.nyc.gov/html/nycwasteless/html/laws/local_recycling.shtml.

[32] New York City Department of Sanitation, Bureau of Waste Prevention, Reuse and Recycling, *Recycling: It's Not a Choice, It's the Law.* Available from http://www.nyc.gov/html/dsny/downloads/pdf/contact/requests/decal_request/comm_recy/commercial.pdf.

[33] Anne Barnard, "City Council Passes Bill for Recycling of Plastic Bags," *New York Times,* January 10, 2008. Available from http://www.nytimes.com/2008/01/10/nyregion/10bags.html.

[34] Based on 1,358 tons per day and 301 collection days per year. New York City Department of Sanitation, *Annual Report for New York City Municipal Refuse and Recycling Statistics, Fiscal Year 2011.* Available from http://www.nyc.gov/html/nycwasteless/downloads/pdf/DSNY-reports/FY2011_Annual_Municipal_Refuse_and_Recycling_Statistics.pdf.

[35] New York City Office of Operations, *Fiscal Year 2004 Mayor's Management Report,* September 2004, p. 134. Available from http://www.nyc.gov/html/ops/downloads/pdf/mmr/0904_mmr.pdf.

[36] *Ibid.*

[37] Fiscal year 2011 data from New York City Office of Operations, *Preliminary Fiscal Year 2012 Mayor's Management Report,* February 2012, p. 104. Available from http://www.nyc.gov/html/ops/downloads/pdf/mmr/0212_mmr.pdf. Fiscal year 2008 data from New York City Office of Operations, *Fiscal Year 2011 Mayor's Management Report,* September 2011, p. 110. Available from http://www.nyc.gov/html/ops/downloads/pdf/mmr/0911_mmr.pdf.

[38] New York City Council Press Release, *Speaker Quinn Announces Major Expansion of NYC Recycling Program,* April 11, 2010. Available from http://council.nyc.gov/html/releases/041210_recyling.shtml. Prior to the expansion in plastics recycling, the

Department of Sanitation must find that the cost is "reasonable" in comparison with current costs. See Section 1. Subdivision c of section 16-305 of the administrative code of the City of New York, as amended by Introduction 148-A. Available from http://legistar.council.nyc.gov/LegislationDetail.aspx?ID=657935&GUID=5FF99078-A684-4530-A686-411212EB4F5D&Options=ID|Text|&Search.

[39] Comparing municipal recycling rates is an imperfect science. First, the inclusion or exclusion of different waste streams can significantly alter diversion rates. Prior to April 2010, redeemed beverage containers were excluded from New York City's recycling calculations, but under amendments to Local Law 19 in April 2010, DSNY can count the following in its department-managed waste: bottles and cans returned under the state bottle bill deposit program, leaf and yard waste, rechargeable batteries and electronic waste returned through retailer take-back programs, household hazardous waste collected at city-sponsored events, textiles collected from city-owned or managed bins, and plastic bags collected by retailers under city law. The DSNY has also cautioned against comparisons to municipalities with more backyard space and therefore more yard waste, which can be composted and counted in the diversion rate. Finally, California follows its own rules in calculating recycling rates. New York City and most other municipalities calculate it as tons of collected recycling divided by the sum of collected recycling and refuse. California calculates its diversion rate as the difference between actual per capita disposal and projected per capita disposal based on changes in population and economic growth. By capturing the impacts of waste prevention, as well as recycling, California's formula has the effect of inflating its reported rates relative to other states.

[40] Economist Intelligence Unit, *U.S. and Canada Green City Index,* sponsored by Siemens, June 30, 2011. Available from http://www.siemens.com/press/en/events/2011/corporate/2011-06-northamerican.php.

[41] PricewaterhouseCoopers and the Partnership for New York City, *Cities of Opportunity,* 2011. Available from http://www.pwc.com/us/en/cities-of-opportunity/index.jhtml. Accessed May 10, 2012.

[42] New York City Office of Operations, *Mayor's Management Report,* Multiple Years. Available from http://www.nyc.gov/html/ops/html/data/mmr.shtml.

[43] See Reuven Blau, "Trash Output Increases in the Bronx but Down Elsewhere in City; Expert Blames Low Recycling Rate," *New York Daily News,* October 26, 2011. Available from http://www.nydailynews.com/new-york/bronx/trash-output-increases-bronx-city-expert-blames-recycling-rate-article-1.968316#ixzz1dJvaaPdw.

[44] Includes costs associated with operating waste transfer stations and the Bureau of Waste Disposal but excludes the cost of landfill closure in fiscal year 2011. Office of the New York City Comptroller, *Comprehensive Annual Financial Report, Fiscal Years 1991 and 2011.* Available from http://www.comptroller.nyc.gov/bureaus/acc/cafr-pdf/CAFR2011.pdf. Data for the cost of landfill closure from New York City Office of Management and Budget, *Fiscal Year 2013 Executive Budget, Budget Function Analysis,* May 7, 2012, p. 347. Available from http://www.nyc.gov/html/omb/downloads/pdf/bfa5_12.pdf.

[45] New York City Independent Budget Office, *The Waste Stream Managed by the NYC Department of Sanitation,* February 2001, p. 10. Available from http://www.ibo.nyc.ny.us/iboreports/nycwastemanagement.pdf.

[46] INFORM, *Solid Waste Management: A Challenge for New York City,* Prepared for the Citizens Budget Commission Future Shocks to New York Conference, January 24, 1989. Available upon request from the Citizens Budget Commission.

[47] New York City Independent Budget Office, *The Waste Stream Managed by the NYC Department of Sanitation,* February 2001, p. 9. Available from http://www.ibo.nyc.ny.us/iboreports/nycwastemanagement.pdf.

[48] Rob van Haaren, Nickolas Themelis and Nora Goldstein, "State of Garbage in America," *BioCycle*, October 2010, Vol. 51, No. 10, p. 16. Available from http://www.jgpress.com/archives/_free/002191.html.

[49] New York State Department of Environmental Conservation, Division of Materials Management, *New York State 2010 Waste Import/Export for Selected States,* November 30, 2011.

[50] Amount of garbage exported under short-term contracts by railcars from New Jersey estimated using available information on waste transfer station rail connections. In March 2012, the operator of a Long Island City, Queens waste transfer station submitted a completed application to the New York State Department of Environmental Conservation to switch from export by tractor trailers to railcars. Available from http://www.dec.ny.gov/enb/20120307_reg2.html.

[51] New York City Mayor's Office of Long-Term Planning and Sustainability, *Inventory of New York City Greenhouse Gas Emissions,* September 2010, p. 22. Available from

http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/greenhousegas_2010.pdf. Association of American Railroads, *A Short History of U.S. Freight Railroads,* October 2011, p. 4. Available from http://www.aar.org/~/media/aar/Background-Papers/A-Short-History-of-US-Freight.ashx.

[52] The Bronx rail contract benefits from significant economies of scale, as compared to the other rail contracts, resulting in a relatively low per-ton price of $94. In fiscal year 2011, 618,000 tons of garbage traveled through this transfer station, three times the quantities at the others. (Refer to Table 1.)

[53] Henningson, Durham, and Richardson Architecture and Engineering, P.C., *Commercial Waste Management Study, Volume IV, Evaluation of Waste Disposal Capacity Potentially Available to New York City,* March 2004, Prepared for the New York City Department of Sanitation for submission to the New York City Council. Available from http://www.nyc.gov/html/dsny/downloads/pdf/swmp/swmp/cwms/cwms-ces/v4-ewdc.pdf.

[54] For more information on the "Selkirk Hurdle" see, The Port Authority of New York and New Jersey, *Cross Harbor Freight Program.* Available from http://www.panynj.gov/about/cross-harbor.html. Accessed May 10, 2012. Railcars originating from Brooklyn must also travel through Middle Village, Queens before heading north. These railcars form a long train with other railcars and a locomotive from CSX. For more information, see Joseph Berger, "A Landfill's Closing Alters How a Neighborhood Views Freight Trains," *New York Times,* May 7, 2010. Available from http://www.nytimes.com/2010/05/08/nyregion/08metjournal.html?scp=3&sq=queens%20garbage%20train&st=cse.

[55] Service Contract for Municipal Solid Waste Transportation and Disposal for the Waste Management Bronx Project between City of New York and Waste Management of New York, LLC. Signed July 18, 2007. Service Contract for Municipal Solid Waste Transportation and Disposal for the Waste Management Brooklyn Project between City of New York and Waste Management of New York, LLC. Signed February 28, 2008. Information for Staten Island export contract provided by the New York City Department of Sanitation.

[56] Waste-hauling tractor trailers travel an average roundtrip of 1,015 kilometers (631 miles) and carry 20 metric tons (22 short tons) of waste. New York City Mayor's Office of Long-Term Planning and Sustainability, *Inventory of New York City Greenhouse Gas Emissions,* September 2011, p. 21. Available from http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/greenhousegas_2011.pdf.

[57] Analysis based on 28 million liters (7.4 million gallons) of consumed diesel fuel and 2.3 kilometers per liter (5.4 miles per gallon) fuel efficiency reported in the New York City Mayor's Office of Long-Term Planning and Sustainability, *Inventory of New York City Greenhouse Gas Emissions,* September 2011, p. 21 and p. 32. Available from http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/greenhousegas_2011.pdf.

[58] Association of American Railroads, *All-Inclusive Index Less Fuel,* First Quarter 2007 through Fourth Quarter 2011. Available from http://www.aar.org/StatisticsAndPublications/Rail-Cost-Indexes.aspx. Accessed May 10, 2012.

[59] The projection includes $128 per ton in city-funded infrastructure and $110 to transport and dispose of the waste. New York City Independent Budget Office, Letter to Council Member Jessica S. Lappin, May 22, 2012. Available from http://www.ibo.nyc.ny.us/iboreports/wtsletter52318.pdf.

[60] New York City Department of Sanitation, *City Environmental Quality Review Technical Memorandum: Comprehensive Solid Waste Management Plan,* Updated March 2012. Available from http://www.nyc.gov/html/dsny/html/swmp/swmp_tech.shtml. Accessed May 10, 2012.

[61] DSNY's forecasted cost of waste export assumes that waste tonnage remains constant beginning in fiscal year 2012. New York City Department of Sanitation, *New and Emerging Conversion Technology: Background.* Available from http://www.nyc.gov/html/dsny/html/emerging_technology/new_emerging_convtech_DSNY.shtml#Background.

[62] The City forecasts the average export price, including long distance landfilling and waste-to-energy in New Jersey and Long Island, will be about $135 per ton in fiscal year 2016. If the existing waste-to-energy contracts grow by 3 percent per year, then the average cost of long distance landfilling would be $143 per ton in 2016. See New York City Department of Sanitation, *New and Emerging Conversion Technology: Background.* Available from http://www.nyc.gov/html/dsny/html/emerging_technology/new_emerging_convtech_DSNY.shtml#Background.

[63] Analysis based on 28 million liters (7.4 million gallons) of consumed diesel fuel and 2.3 kilometers per liter (5.4 miles per gallon) fuel efficiency reported in the New York City Mayor's Office of Long-Term Planning and Sustainability, *Inventory of New York City Greenhouse Gas Emissions,* September 2011, p. 21 and p. 32. Available from http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/greenhousegas_2011.pdf.

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[66] Analysis based on 5.7 million and 28.1 million liters (1.5 million and 7.4 million gallons, respectively) of diesel fuel consumed by trains and trucks, respectively, in fiscal year 2010, as reported in New York City Mayor's Office of Long-Term Planning and Sustainability, *Inventory of New York City Greenhouse Gas Emissions,* September 2011, p. 32. Available from http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/greenhousegas_2011.pdf.

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[68] United States Environmental Protection Agency, *Documentation for Greenhouse Gas Emission and Energy Factors Used in the Waste Reduction Model (WARM): Landfilling*. Available from http://epa.gov/climatechange/wycd/waste/downloads/landfilling-chapter10-28-10.pdf.

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[80] Maria Kelleher, "Anaerobic Digestion Outlook for Municipal Streams," *BioCycle,* Vol. 48, No. 8, August 2007, p. 51. Available from http://www.jgpress.com/archives/_free/001406.html.

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[94] *Ibid,* p. 9.

[95] *Ibid,* p. 11.

[96] According to the Intergovernmental Panel on Climate Change (IPCC), carbon dioxide emissions from organic waste, (e.g., food, paper, yard waste, and wood) should not be counted in emissions from combustion plants because these emissions are

part of the natural carbon cycle of growth and decomposition, in which plants absorb carbon dioxide during photosynthesis and release carbon dioxide during decomposition. By contrast, methane emissions from organic material are classified as man-made, since the methane gas would not have been created in the absence of landfilling. See United States Environmental Protection Agency, *Documentation for Greenhouse Gas Emissions and Energy Factors Used in the Waste Reduction Model (WARM): Introduction and Background,* p. 14. Available from http://epa.gov/climatechange/wycd/waste/downloads/background-and-overview10-28-10.pdf. It should be noted that debate exists around carbon accounting. Opponents to current practices argue that products made from unsustainable or emissions-producing farming practices are not carbon-neutral and some materials, such as textiles, are a mix of plastics (synthetic material) and organics. In July 2011, the EPA announced a review of the issue. See EPA Final Deferral for CO_2 Emissions from Bioenergy and Other Biogenic Sources under the Prevention of Significant Deterioration (PSD) and Title V, Final Rule. Available from http://www.gpo.gov/fdsys/pkg/FR-2011-07-20/pdf/2011-17256.pdf.

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operates 365 days per year at 90 percent availability; no revenues are received from the sale of metal or other recovered material; 25 percent of the waste input requires landfilling as ash; and plant operating costs are $64 million in 2022. For information on estimating the cost of waste-to-energy see, Alternative Resources, Inc., *Evaluation of New and Emerging Solid Waste Management Technologies, Phase 1 Study,* Prepared for the New York City Department of Sanitation and the Economic Development Corporation, September 2004, p. 90. Available from http://www.nyc.gov/html/dsny/downloads/pdf/swmp_implement/otherinit/wmtech/phase1.pdf. Alternative Resources, Inc., *Focused Verification and Validation of Advanced Solid Waste Management Conversion Technologies, Phase 2 Study,* Prepared for the New York City Department of Sanitation and the Economic Development Corporation, March 2006, Section 9. Available from http://nyc.gov/html/dsny/downloads/pdf/swmp_implement/otherinit/wmtech/phase2.pdf. New York City Independent Budget Office, *Budget Options for New York City,* April 2011, p. 7. Available from http://www.ibo.nyc.ny.us/iboreports/options2011.pdf. New York City Independent Budget Office, *Budget Options for New York City,* April 2012, p. 8. Available from http://www.ibo.nyc.ny.us/iboreports/options2012.pdf.

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