Chapter 8: Sustainable Materials Management

INTRODUCTION

***Waste** is society's ultimate externality. It is no longer affordable – both in terms of direct and indirect costs – to simply discard used items without considering the value those items may contain or the impact on the environment which could result.*

Much of the material that ends up in landfills contains a value – usually as an input resource into another process. Landfills generate methane, a gas that is 21 times more intense than carbon dioxide in its global warming impact. Also, carbon-based fuels are used to collect and transport materials to their destination and waste to landfill locations. Finally, greater percentages of wastes are coming from chemicals and other potentially hazardous components.

A new waste management paradigm would lead to the recognition that waste shouldn't and doesn't have to be a part of the consumption cycle, and to actions that ensure that no waste is created in the first place. As in nature, all by-products of production processes would be used for something else; any scraps or materials not going into the final product would be rebuilt or reused in another product. The concepts of cradle-to-cradle and zero waste embody this perspective, rethinking all aspects of a product – from its design to reuse and recycling.

The United States has a long way to go to reach any kind of future with less waste. The U.S. alone generated 243 million tons of municipal solid waste from residential, commercial and institutional sources in 2009; this amounts to 4.3 pounds per person per day of consumer discards, such as durable and non-durable goods, packaging, food scraps, yard trimmings and miscellaneous organic and non-organic items. From 1960 to 2009, per capita waste increased by 62 percent, while the annual amount of municipal solid waste (MSW) in the U.S. increased by 275 percent. With the constant challenge of finding appropriate landfill sites, striving towards zero waste is more important now than it has ever been. Mobilizing the community to protect natural resources will require changes to cultural practices and economic incentives.

Change, however, is possible and is happening. Per capita waste and the total MSW in the U.S. stopped climbing in 2007 and diversion rates are steadily on the increase, growing significantly since the early 1990s.

New York State recognized the need for change when it developed and updated its **Beyond Waste Plan** in 2010. The Executive Summary of the plan states that the state must

"shift from focusing on 'end-of-the-pipe' waste management techniques to looking 'upstream' and more comprehensively at how materials that would otherwise become waste can be more sustainably managed through the state's economy." Central to this shift and the state's plan is recognition that the state must "reduce demand for energy, reduce dependence on disposal, minimize emission of greenhouse gases and create green jobs."

It is with these same objectives that the CNY region undertook an examination of regional waste practices to identify the waste handling opportunities that will no longer "toss the baby out with the bathwater."

Material Definitions and Flows

The U.S. Environmental Protection Agency (EPA) defines municipal solid waste as the materials traditionally managed by municipalities, whether by burning, burying, recycling, or composting. This material is actually a small fraction of the far larger universe of waste created "upstream" of the consumer in the course of extracting raw materials, processing and manufacturing products, and packaging. These industrial-process wastes are called industrial hazardous waste and industrial nonhazardous waste. There are three major components of municipal solid waste:

1. Inorganics (inert material such as ashes, rocks, bricks, etc.).
2. Food scraps and yard trimmings and other biodegradable wastes.
3. Manufactured products and their associated packaging.

The widely accepted "waste hierarchy" (see Figure 1) not only outlines the most to least desirable waste management strategies but also can be viewed as the historical evolution of waste management, beginning with disposal. In the past, waste was "managed" by simply being disposed of in a landfill located on the fringe of a community. In the late 1960s, higher regulatory standards and public resistance to facility siting began to limit access to affordable landfill space. Waste managers responded to these issues with solutions – mega landfills and waste export – that didn't address any of the root causes of the waste. These types of solutions are referred to as **end-of-the-pipe**, as they don't consider where the waste came from or how the product that produced it was used.

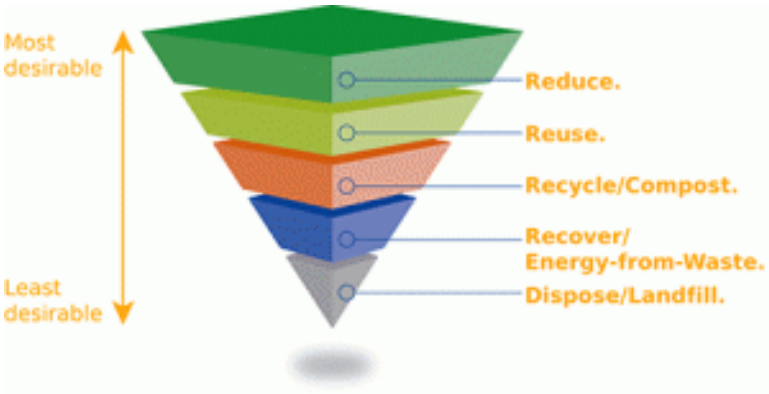


FIGURE 1–The waste hierarcy.

Recognition that landfill sites were finite led to the addition of the "first R," recovery, which refers to the recovery of energy from waste, commonly through incineration. Technologies such as waste-to-energy (WTE) plants were conceived to recover the energy released when waste is burned. Moving up the hierarchy, managers conceived of another "R option" for waste diversion efforts: recycling. But it has become increasingly clear that, while recycling solves the problem of finite landfill space, it moves the problem while doing little to prevent it in the first place. The next two "Rs" in the hierarchy, reduce and reuse, were heavily promoted beginning in the 1990s through education campaigns and encourage behaviors which address the root causes of the problem. The top and most evolved strategy, and the one that should be used most frequently, is "avoid", which demands frameworks for not creating waste in the first place.

BASELINE CONDITIONS

Total Volume of Waste Generated in NYS and CNY

As shown in Figure 2, the largest material stream in NYS is MSW, which makes up 50 percent of the total. The second largest stream is C&D waste, at 36 percent of the total. It is assumed that the Central NY Region has a similar profile; however, data availability is limited, particularly for non-MSW materials.

The composition of the MSW waste stream in New York State is shown in Figure 2 to the right. It should be noted that combustion rates are higher for the Central New York Region due to the fact that two of the five counties (Onondaga and Oswego, accounting for nearly 75 percent of the region's population) combust a large proportion of their MSW, as shown in Table 1.

Data collected by the New York State Department of Environmental Conservation (NYSDEC) and reported by transfer stations, landfills, waste-to-energy (WTE) plants, and recycling centers provide a baseline against which to measure waste reduction and reuse efforts, as well as to show some deficiencies in reported data:

Approximately 0.62 tons of Municipal Solid Waste (MSW) per capita per year is generated in the five counties of CNY. The waste counted in this indicator includes all MSW waste produced, whether it is incinerated or landfilled. However, this value includes only MSW and excludes unreported commercial waste, and also construction and demolition (C&D) debris. This exclusion is a likely reason why the estimated average tonnage of MSW per capita per year is less than the New York State average of 0.75 tons of waste per capita per year. Commercial and industrial waste is counted separately by NYSDEC. Central New York's total waste generation rate is difficult to accurately estimate.

By weight, 33 percent of all reported waste (both MSW and C&D) ends up being landfilled. Landfilled

BY WEIGHT, 33 PERCENT OF ALL REPORTED WASTE (BOTH MSW AND C&D) ENDS UP BEING LANDFILLED.

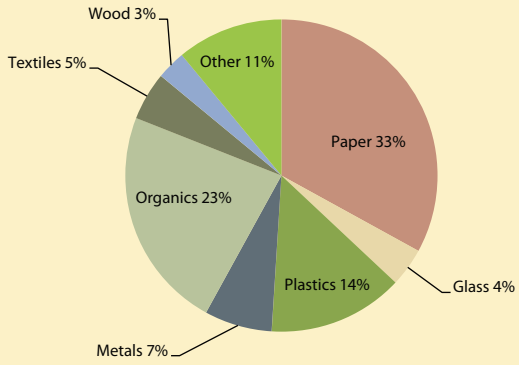


FIGURE 2–Estimated MSW Generation in New York State Source: NYS DEC, Beyond Waste

TABLE 1–Materials and Waste Management in NYS, 2008

Source: NYS DEC 2010. Beyond Waste: A Sustainable Materials Mangement Strategy for New York State

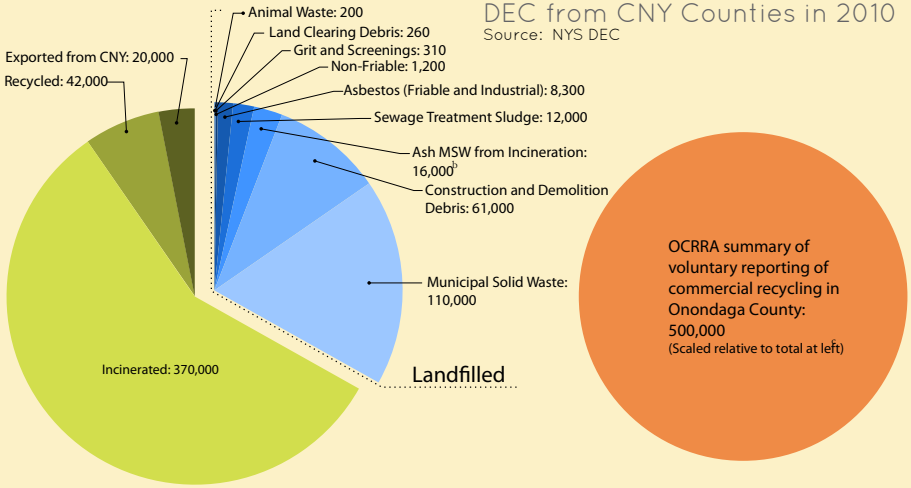
Type	MSW		Industrial		C&D		Biosolids		Total	
	Million Tons	%	Million Tons	%	Million Tons	%	Million Tons	%	Million Tons	%
Recycle/ Compost	3.7	20	1.4	39	7.2	55	0.9	47	13.1	36
Landfill	6	33	2.1	60	4.1	32	0.3	17	12.5	34
Combustion	2.5	14	<0.1	1	<0.1	0	0.4	24	3	8
Export for Disopsal	6.1	33	1.7	0	1.7	13	0.2	12	8	22
Total	18.3	100	13	100	13	100	1.8	100	36.6	100

TABLE 2–2010 Waste Generated by County (tons)

County	MSW Sent to Landfill Facilities (tons)	C&D Sent to Landfill Facilities (tons)	MSW Sent to Landfill Waste Combustion Facilities (tons)	C&D Sent to Landfill Waste Combustion Facilities (tons)	Total Waste Generated (tons)
Cayuga	53,245	10,661	-	-	63,906
Cortland	25,035	3,510	-	-	28,545
Madison	36,963	7,560	-	-	44,523
Onondaga	14,503	40,350	312,846	-	367,699
Oswego	5,972	10,205	56,852	2,545	75,574
Central New York Total	135,719	72,288	369,698	2,545	580,252

Note: Totals may not sum due to independent rounding.

FIGURE 3–Total MSW reported to NYS DEC from CNY Counties in 2010
Source: NYS DEC



a Data culled form 2010 DEC Landfill reports rounded to 2-digits.
b Ash does not include Onondaga WTE plant ash which is hauled out of CNY.
c Reported in OCRRA's 2010 Recycling Report. Figure is OCRRA complete recycling calculation. DEC standard "Processible" waste reported as 230,000 tons.

waste - described in more detail by Figure 3 - is primarily composed of MSW and C&D, but also includes WTE ash, sewage treatment sludge, and various organic materials. This indicator is of uncertain accuracy, as quite a bit of waste generated within CNY is landfilled out of county, and the waste source reporting is poorly represented in the datasets. For instance, OCRRA reports that 77,534 tons of ash were hauled to the Seneca Meadows Landfill in 2010; meanwhile, annual NYSDEC data report only 70,084 total tons of waste hauled to Seneca and only 474 tons of ash for the same reporting period (see Table 2).

Percentage of waste that is recycled tells another complicated reporting story. Municipal recycling collection is reported to NYSDEC, and that value (42,280 tons) is represented by the indicator as 6.5 percent of the total volume of waste generated in the five - county region (see Figure 4 and Figure 5 on page 199). However, this significantly under-reports the actual recycling rate for three reasons: (1) Reuse and incineration of C&D debris isn't considered to be recycled; (2) Organics reuse programs (composting for example) are a significant activity for some counties and aren't included in the figures, despite the fact that these programs divert waste from landfills; and (3) privately hauled commercial recycling isn't reported. If OCRRA's commercial and organics collection data from Onondaga County are included, the recycling rate jumps to 43.5 percent of all wastes. Figure 3 includes a circle to the right, scaled relative to the total solid waste figure in the pie graph on the left, which was drawn from NYSDEC data. OCRRA's commercial recycling reporting figure alone is nearly 80 percent as large as all the waste/ recycling collection reported in the NYSDEC charts.

Materials Management Roles and Responsibilities

As a result of the **Solid Waste Management Act of 1988** (Chapter 70, Laws of 1988), the development of a statewide network of local solid waste management (SWM) plans helped New York State move from an "out-of-sight, out-of-mind" approach to a planned system of integrated solid waste management that considers waste as a resource with value to be recovered. Consequently, each of Central New York's five counties developed their own local SWM plans under their own Planning Unit designation. It was acknowledged that up-to-date solid waste management planning at the local level was a necessary and essential element in maintaining an environmentally-sound integrated solid waste management program in New York State.

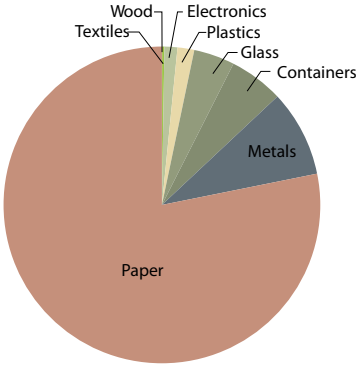


FIGURE 4–CNY Counties Municipal Recycling Composition as Reported to NYS DEC in 2010 in New York State (total 42,000 tons)

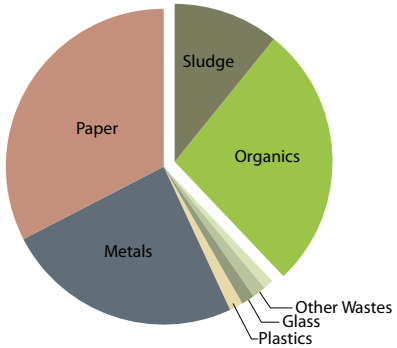


FIGURE 5–Onondaga County Municipal and Commercial Recycling Composition as Reported by OCRRA 2010 (total 540,000 tons)

The following are the solid waste management priorities set forth by the State:

+ first, to reduce the amount of solid waste generated;
+ second, to reuse material for the purpose for which it was originally intended or to recycle material that cannot be reused;
+ third, to recover, in an environmentally acceptable manner, energy from solid waste that cannot be economically and technically reused or recycled; and
+ fourth, to dispose of solid waste that is not being reused, recycled or from which energy is not being recovered, by land burial or other methods approved by the Department. (from New York State Environmental Conservation Law 27-0106.1).

A decade after the last biennial update of the 1987 Solid Waste Management Plan, NYSDEC issued a statewide solid waste management plan (SWMP), Beyond Waste: A Sustainable Materials Management Strategy for New York in December 2010 that maintains the essence of the 1988 priorities while acknowledging the need for greater progress in reducing the amount of waste New Yorkers dispose of every year. It defines broad statewide objectives for waste reduction, reuse and recycling, waste-to-energy, landfilling, and special issues.

The quantitative goal of **Beyond Waste** is to reduce the amount of waste New Yorkers dispose by preventing waste generation and increasing reuse, recycling, composting and other organic material

THE QUALITATIVE GOALS OF BEYOND WASTE ARE TO:

+ Minimize Waste Generation
+ Maximize Reuse
+ Maximize Recycling
+ Maximize Composting and Organics Recycling
+ Advance Product and Packaging Stewardship
+ Create Green Jobs Maximize the Energy Value of Materials Management
+ Minimize the Climate Impacts of Materials Management
+ Reemphasize the Importance of Comprehensive Local Materials Management Planning
+ Minimize the Need for Export of Residual Waste
+ Engage all New Yorkers—government, business, industry and the public—in Sustainable Materials Management
+ Strive for Full Public Participation, Fairness, and Environmental Justice
+ Prioritize Investment in Reduction, Reuse, Recycling and Composting Over Disposal
+ Maximize Efficiency in Infrastructure Development
+ Foster Technological Innovation
+ Continue to Ensure that Solid Waste Management Facilities are Sited, Designed, and Operated

recycling methods. Currently, New Yorkers throw away 4.1 pounds of MSW per person per day, or 0.75 tons per person per year. Through the implementation of reduction, reuse and recovery management priorities, the Plan seeks to reduce the amount of MSW destined for disposal via energy recovery or landfilling by approximately ten percent every two years, reaching a level of 0.6 pounds of MSW per person per day, or 0.11 tons per person per year, by 2030. Achieving this target will require the engagement of manufacturers through product and packaging stewardship and the development of additional reuse and recycling infrastructure, as well as a strong partnership with other states and the United States Environmental Protection Agency (EPA).

Achieving the goals and objectives of the SWMP may be pursued through policy initiatives within the state or within each planning unit. These policies may include an updated Solid Waste Management Act and product stewardship framework, expanded financial assistance for progressive solid waste and sustainable materials management, and education for consumers and businesses to help them reduce their generation of waste. Additionally, the state would like to see each planning unit be responsible for achieving these goals by taking on the following roles: acquire land for waste management and disposal facilities, construct solid waste management facilities, provide or contract for waste and recyclable collection services, conduct facility siting studies, manage application processes for state permits, lead the state environmental quality review (SEQR) process, operate or contract the operation of facilities, ensure compliance and reporting, enact flow control ordinances; and educate the public.

Local SWM Plans and Facilities

As discussed above, each of the five counties has been designated as their own planning unit, which grants the authority to take into account the objectives of the State's solid waste management policy; provide for, or take into account, management of all solid waste within the planning unit; and embody sound principles of solid waste management, natural resources conservation, energy production, and employment creating opportunities. The implementation of solid waste management practices in New York State has historically been the responsibility of local governments.

Since the Act of 1988, all five planning units have faced financial challenges while trying to implement their local solid waste management goals while also handling the day-to-day activities at the core of materials and waste management (e.g., separation, collection, recycling, transport, storage, transfer, and disposal). With shrinking municipal budgets and variations in waste disposal tonnages that provide much of the revenues needed to pay for facility and program costs, the planning units have struggled to successfully increase or improve the programs that already exist within the planning units. However, even with financial pressures, the planning units have worked to improve their solid waste management and recycling facilities that currently serve their constituents. Each planning unit is in various stages of planning how to efficiently and cost effectively enhance their current solid waste management and recycling facilities and programs to be more consistent with the Beyond Waste goals.

Madison County Landfill

Cayuga County completed its original solid waste management plan approximately twenty years ago. Under the Department of Planning and Economic Development, Cayuga County is currently in the initial planning stage of updating their Solid Waste Management Plan. The Solid Waste Management Program Office within the Department of Planning and Economic Development has most recently been responsible for hazardous chemical collection events, which includes hazardous materials, electronic wastes, propane tanks, fluorescent bulbs, and tires. Additionally, the City of Auburn owns and operates a municipal solid waste landfill in the City of Auburn limits, which accepts waste from the City as well as areas within the County.

Cortland County completed its original Final Solid Waste Management Plan (SWMP) in 1993. The County's original SWMP called for the continuation of its integrated solid waste management system consisting of a County landfill and recycling center. In general the SWMP Modification called for the continuation of its integrated solid waste management system consisting of continued operation of the County landfill, recycling center and Town transfer station; and waste reduction and recycling programs.

Madison County's integrated solid waste management system consists of one central sanitary landfill in the Town of Lincoln, three transfer stations (located in the Towns of Hamilton, Cazenovia, and Sullivan), a central materials recovery facility(MRF) located adjacent to the landfill site, and four yard waste and recyclables drop-off locations (at the three transfer stations and the sanitary landfill).The curbside collection of municipal solid waste has traditionally been the responsibility of either the local municipality or individual residents and waste generators. All residents are permitted to utilize the transfer stations to dispose of their solid waste and/or recyclables. Residents can purchase a punch card to be used at the transfer station, on a pay-as-you-throw basis.

Madison County completed its original Final Solid Waste Management Plan (SWMP) in 1991, which was subsequently revised in December 2009 as the Comprehensive Solid Waste Management Plan Modification. In general the SWMP Modification called for the continuation of its integrated solid waste management system consisting of a regional landfill, central and intermediate solid waste transfer stations, and recyclables collection facilities. In addition, it called for the continued operations of the material recovery facility, yard waste composting facility, sharps collection program, and public recycling education program.

In the 1980s, the Onondaga County Solid Waste Management Program developed a plan to deal with the community's mounting garbage crisis. Realizing that there were no easy answers, they set out to design a safe, reliable, and cost-effective program that would serve the community's needs, at that time and into the future. They carefully analyzed the environmental impacts of different trash disposal alternatives and determined that no single method of disposal would solve the trash dilemma. Ultimately, a comprehensive and integrated solid waste management system was required to manage Onondaga County's waste.

At County government's request, the New York State Legislature created a public benefit corporation – the Onondaga County Resource Recovery Agency (OCRRA) to manage this new County-wide waste management system. The OCRRA service area consists of Onondaga County, with the exception of the Town and Village of Skaneateles. There are 33 municipalities encompassed within the system (1 city, 18 towns, and 14 villages).

Onondaga County Waste to Energy Facility

OCRRA administers the County's solid waste management program with a prioritization of management methods that mirror New York State's Solid Waste Management Plan:

1. a waste reduction program,
2. an aggressive recycling program,
3. recovery of useful energy through solid waste combustion (i.e., modern waste-to-energy facilities), and
4. use of permitted landfill facilities.

After a rigorous procurement process in 1988 and 1989, Ogden Martin Systems was selected to design, build, and operate the Onondaga County Resource Recovery Facility (WTE Facility). OCRRA entered into a service agreement with Ogden Martin Systems of Onondaga (currently Covanta Onondaga) in 1990. On December 18, 1992, with environmental permits in place and project revenue bonds totaling $178 million, formal groundbreaking ceremonies were held for the construction of the waste-to-energy facility. By late 1994 the Facility had its first official burn and by early 1995 the Facility was commercially operational.

Today, the Onondaga County WTE Facility continues to be an integral part of OCRRA's resource recovery system. About 45 percent of materials that could otherwise go to the WTE Facility are source separated for recycling. The remaining non-recyclable portion goes to the WTE

Facility, which uses a mass burn combustion system (and temperatures of 1800° - 2000° F) to convert non-hazardous, non-recyclable trash into steam. The steam is then used to generate electricity that is sold to National Grid, providing enough electricity for approximately 25,000-30,000 households and the Facility itself. Ferrous and non-ferrous metals that would otherwise have gone to a landfill are recovered at the WTE Facility for recycling. The byproduct of the combustion process is a non-hazardous ash residue, which is about 10 percent of the original volume of the trash processed at the Facility. The ash residue is sent to a landfill for use as alternative daily cover.

Incorporated into the operations of the Facility is an air pollution control system, which helps the Facility comply with one of the strictest air permits in the nation, meeting federal and state emissions requirements. Emissions from the Facility are carefully monitored through a Continuous Emissions Monitoring System (CEMS) and annual stack testing. Since its start-up in 1994 the facility's operational and environmental performance has exceeded expectations.

An important component to the success of the WTE facility is the guaranteed delivery of municipal solid waste by all local haulers within the Planning Unit through the signing of Waste Hauler Agreements. Additionally, OCRRA has secured the required permits for construction of an in-county landfill in the Town of Van Buren; however, construction has not occurred given environmental and economic factors. OCRRA currently transports the ash by-product from the WTE facility and other non-burnable waste to the High Acres Landfill near Rochester, NY. OCRRA operates two transfer stations (Ley Creek and Rock Cut

TABLE 3–Summary of Disposal Facilities

Disposal Facility	Town or City	County	Facility Type	Owner/ Operator	Ownership	Waste Type	Site Life (years)
City of Auburn Landfill	Auburn	Cayuga	Landfill	City of Auburn	Public	MSW	5.4
Cortland County Landfill	Cortlandville	Cortland	Landfill	Cortland County	Public	MSW	20
Madison County Landfill (westside)	Lincoln	Madison	Landfill	Madison County	Public	MSW	105
Camillus C&D Landfill	Camillus	Onondaga	Landfill	Honeywell International, Inc./Town of Camillus	Private	C&D	4.4
Bristol Hill Landfill	Volney	Oswego	Landfill	Oswego County	Public	MSW	6.5
Onondaga County Resource Recovery Facility	Jamesville/ Onondaga	Onondaga	Municipal Waste Combustion Facility	Covanta Onondaga L.P.	Private	MSW	N.A.
Oswego County Energy Recovery Facility	Fulton	Oswego	Municipal Waste Combustion Facility	Oswego County	Public	MSW	N.A.

Notes:
1. Information gathered from NYSDEC Annual Reports, 2011, which are based on 2010 data.
2. Site life is based upon currently permitted capacity reported as available as of the end of 2010, and may underestimate the total useful life for those facilities that are able to obtain permit renewals and/or additional permitted capacity in the future.

Road) where haulers and residents can bring their materials for disposal or recycling. Additionally, OCRRA has long term contracts with two (2) Material Recovery Facilities (MRFs) that offer more market stability for recyclable commodities and a uniform definition of "blue bin" materials.

Of the 33 municipalities in the OCRRA service area, 26 provide residential curbside collection of trash and recyclables through either municipal employees, or by contracting with a private waste hauler. Such transport and waste disposal services are supported by the residents' taxes. In the other 6 municipalities, residents must either contract directly with a waste hauler to provide trash and recyclables collection, or personally deliver these materials to one of OCRRA's two transfer stations (Ley Creek or Rock Cut Road). OCRRA does not provide any material collection services. All waste generators in the OCRRA service area, including businesses, schools, and residents, are required to "source separate" their recyclable materials pursuant to a local recycling law approved by the County Legislature. OCRRA offers an aggressive series of programs and supports an ongoing, high profile public education campaign promoting waste reduction and the recycling of discards where markets exist to create new products.

Oswego County has a full-service system so that all waste and recyclables generated in the County can be delivered to County facilities, and then on to their final destination for disposal or recycling. Residential solid waste and recyclables are currently collected by a combination of public and private haulers, roadside pick-up, and self-haul to the County transfer stations. The County has left to local municipalities, individual homeowners, and private haulers the decisions on how to best provide collection and delivery to the County facilities.

Oswego County completed its original Final Comprehensive Solid Waste Management Plan (SWMP) in May 1993, prior to which the Oswego County Legislature adopted Resolution #76 on June 15, 1989 establishing the County as the designated Planning Unit. In 2007 the planning process for the modified LSWMP was initiated at which time the County identified specific goals to guide the operation of the system in the coming years. These goals were consistent with the goals of the state's **Beyond Waste** plan.

Additionally Oswego County has built a comprehensive system of facilities and programs to manage the waste and recyclables generated in the County in an efficient, cost-effective and environmentally sound way. This existing system can serve as a strong foundation to meet the County's goals for the future. The following nine principal components of the system will serve the needs of the County over the next ten years: reuse & reduction, materials recycling, household hazardous waste facility (HHW), organics composting, construction and demolition debris processing, energy recovery facility, transfer stations, landfill, and information and education.

A summary of disposal facilities located in each county is provided in Table 3 on page 202. Each of these facilities is considered to be a component of the Planning Unit's integrated solid waste management system. There are a total of seven disposal facilities including landfills and waste to energy facilities located within the study area. Of the seven disposal facilities, two are waste to energy facilities; five are publicly owned; and four are owned by the county it is located within.

ANALYSIS

Climate Change and Sustainable Materials Management

Concern about climate change has altered how communities handle and think about solid waste. The U.S. EPA has been studying the links between solid waste and climate change for over a decade. Their website contains detailed analysis and summary steps that individuals and businesses can take to reduce their carbon footprint. Figure 6 on page 204 highlights the different sources of GHG emissions from waste. The disposal of solid waste produces GHGs in a number of ways. First, the anaerobic decomposition of waste in landfills produces methane, a GHG 21 times more potent than carbon dioxide. Second, the incineration of waste produces carbon dioxide as a by-product. In addition, the transportation of waste to disposal sites produces GHGs from the combustion of the fuel used in the equipment. Finally, disposal of materials indicate that new products are being produced as replacements; this production often requires the use of fossil fuels to obtain raw materials and manufacture the items.

The U.S. EPA released a report in September 2009 that shines new light on the greenhouse gas impacts of goods bought and thrown away by consumers. Conventional greenhouse gas analysis apportions emissions based on industrial sectors – electricity, transportation, and so on. This report instead used life-cycle analysis to incorporate all of the emissions associated with end-user materials and energy that are consumed by households, businesses and governments. In this new systems-based

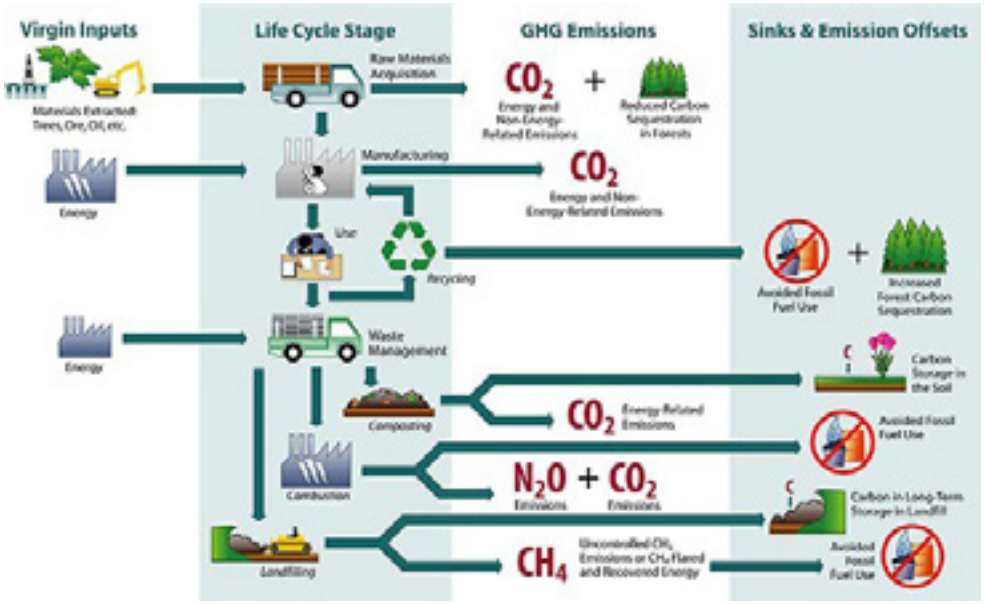


FIGURE 6– Life Cycle of Waste. Source: U.S. EPA

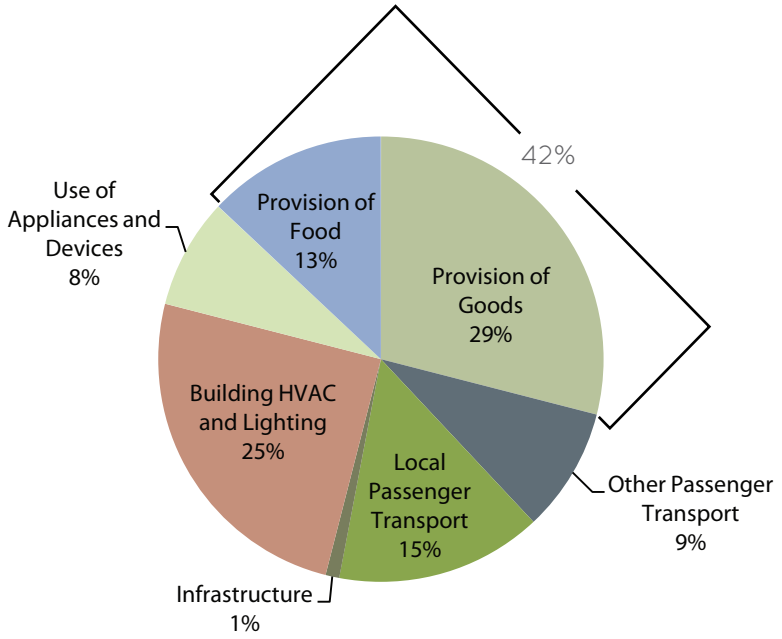


FIGURE 7–Direct U.S. Greenhouse Gas Emissions by Sector Source: U.S. EPA

analysis, the greenhouse gas emissions that are embodied in the goods that are bought and used are quantified. These include the energy used at all stages of the product life cycle: to extract and process the resources, to manufacture and transport the products, to operate the retail outlets, to use the products themselves, and then to dispose of them by recycling, burying in landfills, or burning in incinerators. As shown in Figure 7, the report concluded that the provision of goods and materials is responsible for the largest share, by far, of direct U.S. greenhouse gas emissions. Waste accounts for more than the emissions from the energy used in buildings, passenger transportation, or the provision of food – activities that get the lion's share of attention in government and business efforts to reduce greenhouse gas emissions.

A recent report on these issues, Stop Trashing the Climate, provides compelling evidence that preventing waste and expanding reuse, recycling, and composting programs is one of the fastest, cheapest, and most effective strategies available for combating climate change, finding that "significantly decreasing waste disposed in landfills and incinerators will reduce greenhouse gas emissions the equivalent to closing 21 percent of U.S. coal-fired power plants. This is comparable to leading climate protection proposals such as improving national vehicle fuel efficiency. Indeed, preventing waste and expanding reuse, recycling, and composting are essential to put us on the path to climate stability."

Central New York Emissions

For the regional greenhouse gas inventory prepared as a part of the process of developing the **VisionCNY** plan, both Scope 1 and Scope 3 emissions for solid waste were calculated. Scope 1 represents emissions from landfills located within the region, regardless of where the waste originated. Scope 3 represents emissions from waste generated by the region, regardless of where the waste is ultimately transported. To avoid double-counting, only Scope 3 emissions are included in the total. Scope 1 emissions from solid waste are reported here for informational purposes.

Scope 1 Solid Waste Emissions

Solid waste Scope 1 accounts for emissions from landfills located within Central New York counties. Municipal solid waste landfill facilities in the region include City of Auburn Landfill, Cortland County Landfill, Madison County Sanitary Landfill, and Oswego County Bristol Hill Landfill. Scope 1 does not include emissions from waste combustion facilities to avoid double-counting. Combustion facilities within the region, Onondaga County Resource Recovery Facility and Oswego County Energy Recovery Facility, are also used to generate electricity and are included under the electricity generation sector.

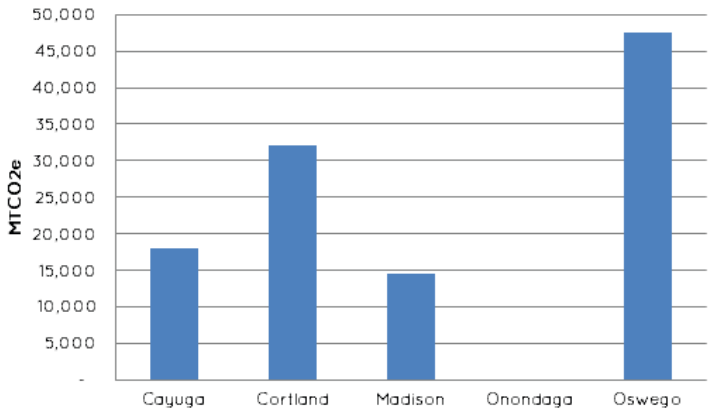
Results indicate that landfills in the region emitted 112,450 MTCO2e in 2010. The majority of these emissions came from Oswego County Bristol Hill landfill (42 percent), followed by the Cortland County landfill (29 percent). Results are shown in Table 4 and Figure 8.

TABLE 4–2010 Emissions from Landfills in Central New York (MTCO2e) – Scope 1 Solid Waste Emissions

County	Landfill	Emissions ($MTCO_2e$)	Percent of Total
Cayuga	City of Auburn Landfill	18,077	16%
Cortland	Cortland County Landfill	32,197	29%
Madison	Madison County Sanitary Landfill	14,617	13%
Onondaga	-	-	0%
Oswego	Oswego County Bristol Hill Landfill	47,559	42%
Central New York Total		112,450	100 percent

Note: Totals may not sum due to independent rounding.

FIGURE 8–2010 Emissions from Landfills in Central New York (MTCO2e) – Scope 1 Solid Waste Emissions



Scope 3 Solid Waste Emissions

Scope 3 solid waste emissions account for emissions from waste generated within the Central New York counties, regardless of where the waste is sent. Results from the regional GHG inventory indicate that total emissions from waste generation in the region in 2010 were 102,812 MTCO2e, which accounts for approximately 1 percent of the region's total gross GHG emissions. By comparison, the waste management sector accounted for 3 percent of New York's total gross emissions in 2008. Municipal solid waste generation contributed 85 percent of regional emissions (87,310 MTCO2e) and C&D contributed 15 percent (15,502 MTCO2e). Overall, 580,252 tons of solid waste was generated in the region in 2010. Table 5 and Figure 9 on page 206 summarize the results.

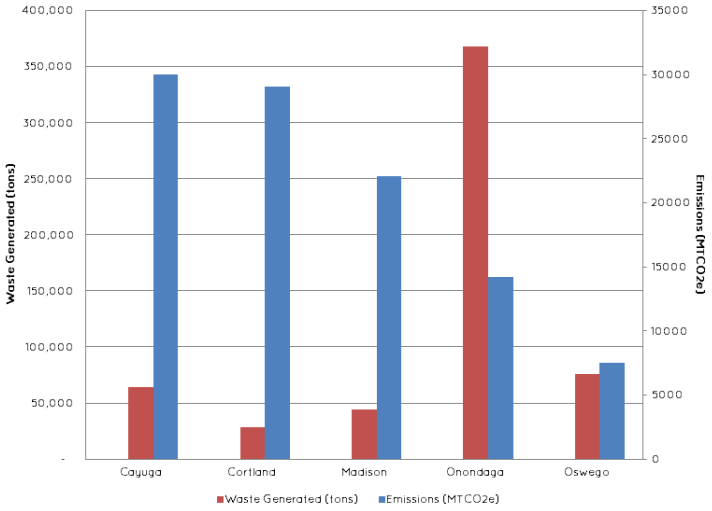
Onondaga County generated the largest portion of that waste, which is driven primarily by population, but generated a much smaller portion of emissions. This is because 95 percent of waste from Onondaga County is sent to combustion facilities rather than landfills. A similar pattern occurs in Oswego County, where 91 percent of waste is combusted. All waste generated in Cayuga, Cortland, and Madison Counties was landfilled in 2010. As a result, those counties have higher per capita waste emissions than Onondaga and Oswego. Cortland County has the highest per capita waste emissions, as their waste is sent primarily to Cortland County Landfill, which does not have an LFG capture system. Note that emissions

TABLE 5–2010 Scope 3 Solid Waste Emissions (MTCO2e)

County	MSW CH4 Emissions (MTCO2e)	C&D CH4 Emissions (MTCO2e)	Total CH4 Emissions (MTCO2e)	Percent of Total	Emissions per Capita
Cayuga	27,709	2,286	29,994	29%	0.37
Cortland	28,334	753	29,087	28%	0.59
Madison	20,413	1,621	22,034	21%	0.30
Onondaga	5,542	8,653	14,195	14%	0.03
Oswego	5,312	2,189	7,500	7%	0.06
Central New York Total	87,310	15,502	102,812	100%	0.13

Note: Totals may not sum due to independent rounding.

FIGURE 9–2010 Waste Generation (tons) and Emissions (MTCO2e) – Scope 3 Solid Waste



from composting are not included. Emissions from the collection and transportation of waste are included in overall transportation emissions.

The GHG emissions noted in Table 5 should be reviewed with caution. For example, Onondaga and Oswego County incinerate much of their solid waste – these emissions are not included in the figures above, but rather in electrical generation emissions noted in Chapter x. Furthermore, the emissions calculated above used NYSDEC-provided data, which may differ substantially from county-provided MSW data. These factors all underscore the need for an organized, systematic method of accounting based on consistent regional definitions.

Case Studies of Best Practices

The VisionCNY Planning Team examined best practices within the region and from around the world to develop its strategies and recommendations. Case studies are a key indicator to establish proof of concept for investment.

Onondaga County – In 2007, the Onondaga County Resource Recovery Agency (OCRRA) began developing food waste processing capacity after gathering data that indicated food waste comprised about 15 percent of the local waste stream. The County has recently received approval to collect 9,600 tons of food scraps from commercial and institutional customers. This waste will be aerobically composted along with yard waste utilizing aerated static pile (ASP) technologies. Thirty-two towns and villages in the area already produce their own mulch from collected yard waste.

OCCRA Organic Compost

OCRRA's food waste diversion program is aimed at the commercial and institutional sectors. The key to success has been the involvement of dozens of local businesses – and at least one local school district -- utilizing the Agency's food scrap processing system. The Marcellus School District's elementary, junior and senior high schools collect pre and post-consumer food wastes and milk from the students' breakfasts and lunches. The school reports an 87 percent decrease in trash in their first two months of food waste diversion, and project an annual disposal savings of $2,500. Additionally, Lemoyne College, Onondaga Community College and Syracuse University have joined OCRRA's food waste composting program. Syracuse University diverted over 300 tons of food waste in 2011, consisting mostly of fruit and vegetables discarded during food preparation along with some spoiled leftovers. The program has since expanded to include post-consumer waste (diners' uneaten food); SU now diverts roughly 9 tons of food waste from its garbage dumpsters each week. Other early food scrap composting adopters include nearly two dozen restaurants in a local shopping mall, a large coffee roasting company, and area hotels.

OCRRA's current program does not yet include residential customers as a viable compost customer, in part because residential customers may see an increase in collection costs as yet another collection vehicle is required to pick up materials at the curb. Additionally, contamination rates are expected to be higher in the residential market place, which would hinder the composting process and require rejection of loads.

Based on the U.S. EPA's Waste Reduction Model (WARM), OCRRA's efforts of composting 1,000 CY of food waste and 10,000 CY of yard waste annually versus waste to energy combustion would reduce greenhouse gas emissions by 40 metric tons of carbon dioxide equivalents (CO_2e), which is equivalent to the annual emissions of eight passenger vehicles. Composting and compost use leads to a number of beneficial results, such as:

- reductions in trash and waste,
- reduced greenhouse gases,
- healthier soil and plants,
- better nutrient cycling,
- greater fertility,
- aids in erosion control, and
- stormwater management.

In addition to the benefits described above, OCRRA sells the finished compost in bulk, which provides a revenue source. Customers include landscapers, top soil producers, golf courses, and local residents. A description of the program's operations, economic benefits, and opportunities for growth are included in Appendix XX, Technical Report.

Lemoyne College, Onondaga Community College and Syracuse University have joined OCRRA's food waste composting program. Syracuse University diverted over 300 tons of food waste in 2011, consisting mostly of fruit and vegetables discarded during food preparation along with some spoiled leftovers.

Food waste delivered for composting at OCRRA's Amboy site Aerated Static Pile (ASP) composting pile

Madison County – The county landfill has a gas collection and control system, which includes a landfill gas-to-energy (LFGTE) facility. This facility is operated by Waste Management, Inc., which generates electricity from combusting methane from the landfill. The electricity is in turn sold to the grid. Future intentions are to have the waste heat from the LFGTE facility be used by tenants of the nearby Agriculture and Renewable Energy (ARE) Park (see the call-out box below).

To construct the Madison County Landfill gas-to-energy facility, the county received a $998,000 grant from the U.S. Department of Energy; the remainder of the $3 million total cost was paid by the private waste management company which owns the internal combustion engine. Madison County DSW crews provided some of the labor to install pipes. The recently operational (October 2011) solar cap on the county landfill is the first of its kind on a municipally-owned landfill. As part of other on-site capping activities, the County installed thin-film flexible photovoltaic (PV) modules on a portion of the 1 acre south facing slope of the West side. The solar cap is rated to produce 37 kW of AC electricity, or approximately 37,700 kWh/year. This value is just under the amount of electricity required to operate Madison County's materials recovery facility (MRF) that processes county residents' recyclable materials.

Installation of the Madison County Landfill Solar Cap. The County installed thin-film flexible photovoltaic (PV) modules on a portion of the 1 acre south facing slope of the West side of the landfill. The solar cap is rated to produce approximately 37,700 kWh/year.

The landfill is now a popular fieldtrip location for local schools.

AGRICULTURAL PLASTIC DISPOSAL AT THE AGRICULTURE AND RENEWABLE ENERGY (ARE) BUSINESS PARK; LINCOLN, NY

Agricultural plastics bundled for recycling. Source: Madison County Department of Solid Waste

The Madison County ARE Park is a business and industrial site that aims to attract companies with a focus on renewable energy, recycling, and raw material use, including food and wood. Because of the existing LFGTE facility operated by Waste Management, tenants have access to 42.7 MBtu of high-quality, renewable heat and 12,000 MWh of reduced-price electricity, pending agreements on the site. Currently, Waste Management delivers electricity to the grid at wholesale price, and less than half the heat is being used by the recycling facility and lumber company in the park. This site already has a culture of industrial symbiosis; landfill gas provides cogeneration for Johnson Lumber and the county's recycling facility, solar power provides additional electricity, and waste wood is sold as wood pellets. Plans are also underway to utilize excess moist heat in a hydroponic greenhouse. U.S. Department of Energy (U.S. DOE) grants, NYSERDA grants, and local funding have helped make this project possible. The Technical Appendix describes the ARE Park concept and potential benefits in greater detail.

The ARE Park is a promising site for a newly created pilot program to deal with agricultural plastics, a significant problem throughout New York State. These "ag bags" are used for bailing and storing feed, manure, and grain on farms. Historically, this waste was often buried or burned on-site. While open burning of plastic has been illegal since October 2009, it still occurs at some farms. Most of the remaining "ag bags" are eventually landfilled, as they are typically too contaminated for recycling. Other plastics are also often landfilled, including "bulky plastics" like plastic bins or films. Karen Baase, Agricultural Educator from Cornell Cooperative Extension of Madison County, estimates that the Central New York region generates approximately 630 tons of agricultural plastic to recycle annually, with 80 tons in Madison County alone.

Madison County began collecting agricultural plastics in December 2012. The program allows farmers, gardeners and other generators of agricultural plastic materials to drop them off at transfer stations in Cazenovia, Sullivan, Hamilton and the main landfill site in the town of Lincoln. Currently, the waste is shipped to Niagara Falls where it is processed into diesel fuel by JBI, Inc., which has developed a method of converting plastics into ultra-low sulfur diesel fuel. This process also works for contaminated waste streams. JBI is currently commercializing this process, and has received the necessary air permits from NYSDEC. The County hopes to sign a contract with JBI to develop a facility at the ARE Park. Madison County, whose waste and highway departments use $600,000 per year in diesel fuel, could be an attractive customer for JBI's renewable diesel, and could potentially save money from a deal to receive renewable fuels for their vehicles. However, capital funding remains a challenge. With proper seed money to cover feasibility studies, environmental quality review, and construction, a plastics-to-fuel facility could build on existing projects at the ARE Park (see Figure x.x in Technical Appendix X).

Cayuga County Methane Digester

Cayuga County – Cayuga County has recently developed an anaerobic digester facility that produces methane from farm organic waste. This digester produces heat for the county jail, and generates electricity which is sold to the grid. The system also uses grease and food waste collected from restaurants to supplement the digester's organic waste supply.

The Auburn landfill practices landfill gas extraction, but because the 2 MW generators are underserved by landfill gas, the county has had to purchase natural gas to keep the generators running at capacity. That energy is used to power the City's Wastewater Treatment Plant, and the excess is sold to the regional utility, NYSEG. An unrealized opportunity for IS exists, in that waste heat from the gas-to-electricity conversion process could be captured by recovery boilers, which could provide industrial users with hot water.

Oswego County – Much of Oswego County's waste is incinerated at its waste-to-energy facility, which produces up to 2 MW of power (with natural gas used as a secondary fuel). In 2009, a program was implemented to separate out iron and steel from waste streams headed for incineration. This allows the material to be recycled and reduces the quantity of ash to be landfilled. Oswego County has also experimented with different composting methods for organic waste including fish and onion waste, and may be able to benefit from a large, consistent supply of bulking material like cardboard or paper waste.

Model waste generator "green fee" system.

As with many waste diversion strategies, a reliable and long-term source of revenue to help fund waste management and recycling programs is a challenge to achieve since the programs are typically funded by waste disposal fees. As a planning unit strives to reduce the amount of waste requiring landfill disposal, it is concurrently reducing the amount of revenue it collects from disposal fees. The fundamental policy of "waste paying for waste", which Madison County and the other planning units in this region have employed for years as a means to provide economic incentives for waste reduction and recycling while also not relying upon local property taxes to pay for solid waste and recycling programs, is ultimately doomed for failure if the amount of waste requiring disposal declines substantially over time; less waste equates to less revenue to pay for waste diversion programs. In order to ensure a reliable source of revenue and enable the development, maintenance and sustainability of integrated solid waste management systems, some communities have instituted annual "green/sustainability" fees that are typically charged on a per parcel basis. These annual fees are typically charged to residential and non-residential properties to cover a portion of the costs associated with solid waste management and recycling programs and facilities, with the balance of system costs generally paid for from disposal fees to continue to provide an economic incentive to recycle and reduce waste requiring disposal.

Tompkins County, NY, provides an example of a community that has implemented an annual green fee. The genesis for the green fee program began in 1990 with the creation of its trash tag program, which

Oswego County Energy Recovery Facility plant in Fulton.

Source: Oswego County

enabled Tompkins County to shift the funding source for its solid waste system from a completely tax-based to a disposal fee-based system. Residents pay for disposal based on the amount of waste they produce, and hence residents realize a direct cost savings through their efforts at waste reduction and recycling. The Tompkins County trash tag program requires all residents to pay for waste disposal by weight. Residents and small businesses that place their waste at the curb purchase trash tags from their haulers who then pay the tipping fee at the landfill. Larger businesses, institutions, and those with their own dumpsters pay the waste disposal fee by volume as a part of their hauler's bill. Until the end of 1992 all ongoing solid waste operations, programs, and administration were paid for by users of the system. However, in 1992 some private haulers chose to take advantage of cheaper rates at neighboring landfills rather than the County's own landfill or transfer station. To assure adequate revenue for 1993 the County opted for multiple revenue streams to support its solid waste program, with 90 percent being covered by two sources: (1) a transfer station tipping fee reflected in trash tags, and (2) an annual user fee per household/hauler (i.e., a green fee). Licenses, grant moneys, revenues from sale of recyclable materials, and sewage composting fees provide the remainder of revenues to balance the budget. The annual fee helps to defray the costs of the County's Solid Waste Program, exclusive of garbage disposal.

Extended Producer Responsibility

Extended Producer Responsibility (EPR), also known as "Product Stewardship," establishes a legal chain of producer custody extending through the entire product life cycle. Product Stewardship is based on the concept that all producers selling a product should be responsible for designing, managing, and financing a stewardship program that addresses the lifecycle impacts of their products including end-of-life management.

Ultimately, there could be a significant reduction in the overall flows of materials and energy if producers rethink their products and supply chains to avoid the costs that are currently incurred in waste management. Indeed, we are already seeing rapid development of new recycling services where EPR has been introduced. In Canada every province has adopted EPR legislation, and this has given rise to a whole range of new programs provided at no cost to local communities for recycling electronics, tires, used oil, paint, solvents, pesticides, pharmaceuticals, and beverage containers.

There is a growing undertaking to encourage government, at the State level, to implement EPR legislation based on the same framework principles, with a goal of ultimately implementing federal EPR laws. The New York Product Stewardship Council, along with at least 6 other state-wide and multi-state product stewardship councils that have been established in North America, is part of this product stewardship initiative and is working to help implement the principles of product stewardship in New York State and the nation

The Electronic Equipment Recycling and Reuse Act of 2010 is an example of EPR legislation in New York that has helped divert discarded electronic equipment (commonly referred to as e-waste) from landfill disposal without imposing a cost burden on local solid waste programs or municipalities. Instead, the e-waste legislation adopted in New York requires manufacturers of covered electronic equipment to take back discarded e-waste without charging a fee for such services. As part of a grass roots effort to see more EPR legislation adopted in New York, the NYPSC is encouraging local governments to adopt resolutions in support of a uniform set of product stewardship principles that are embodied in a two-page document entitled "Product Stewardship and Extended Producer Responsibility: Definitions and Principles" dated April 11, 2012 (see Appendix XX).

Electronics collection in Syracuse sponsored by OCRRA.

COMPOSTING SYSTEMS

While composting of organic waste can be an effective method of low-technology recycling that can reduce the stream of landfilled waste, collection of these materials on a household basis can prove both difficult and expensive. Another option for encouraging the removal of these wastes from the waste stream is to implement a backyard composting program, through which residents are provided information regarding the methods of backyard composting. Backyard composting programs have been known to boost waste diversion rates and collection cost savings.

Single Stream Recycling

Single-stream recycling allows residents to set out all of their recyclable paper and commingled containers together in one recycling bin, for processing at a single-stream recycling facility that is designed to separate the materials into marketable commodities. In a single-stream recycling system, the collection vehicles no longer need to keep paper products and recyclable containers in separate compartments of a truck.

The shift from dual stream to single stream recycling systems has been growing, as technological improvements during the past five to ten years have substantially improved the effectiveness of single-stream recycling facilities. In Central New York, for example, Onondaga County and Oswego County have both transitioned from a dual stream to a single-stream recycling program – and both utilize a privately operated single-stream recycling facility located in Liverpool.

The advantages of a single-stream system are associated with slightly higher recycling rates, due to added convenience for residents, and reduced collection costs associated with more efficient hauling of a single stream of materials. The main disadvantage of converting to a single-stream system is the substantial capital investment that could be involved if a new single-stream recycling facility is developed. The Oneida-Herkimer Solid Waste Authority, for example, recently converted its 20-year old dual stream recycling facility to a single-stream recycling facility at a cost of approximately $9.5 million. However, Oswego County implemented its single-stream system after entering in to a contract with an existing single stream recycling facility. This contractual option could be considered by other planning units in the region if they should decide to evaluate the costs and benefits that would be associated with transitioning to a single-stream recycling program.

Backyard composting

According to the U.S. EPA, food residuals make up to 60 percent of residences' garbage. In addition, less than 3 percent of food scraps (which comprise 20 percent of the discards in landfills) are currently being diverted.

As shown in Figure 10, the EPA's Food Recovery Hierarchy shows that composting is a preferred technology to incineration or disposal in landfills. Properly composted, food and other organic matter can be repurposed as a fertilizer and soil amendment. Local governments have discovered composting as a recycling technology that significantly reduces waste management costs and volumes.

FIGURE 10–U.S. EPA Food Recovery Hierarchy

Construction and Demolition Recycling

As noted in the **Beyond Waste** plan, C&D debris is defined as uncontaminated solid waste resulting from the construction, remodeling, repair and demolition of utilities, structures and roads and includes landclearing debris. Construction and demolition (C&D) debris can be a significant portion of a region's waste stream, and diverting it from landfills can help achieve and maintain diversion goals. The estimated composition of C&D debris generated statewide before recycling or other diversion is presented in Figure 11. The concrete/asphalt/rock/brick (CARB) and the soil/gravel material categories are by far the greatest material segments at approximately 35 percent and 27 percent respectively, with wood a distant third at 15 percent.

As of May 2012, there were 79 permitted C&D processing facilities and 279 registered C&D processing facilities within New York State. Permitted C&D processing facilities are able to receive and process uncontaminated

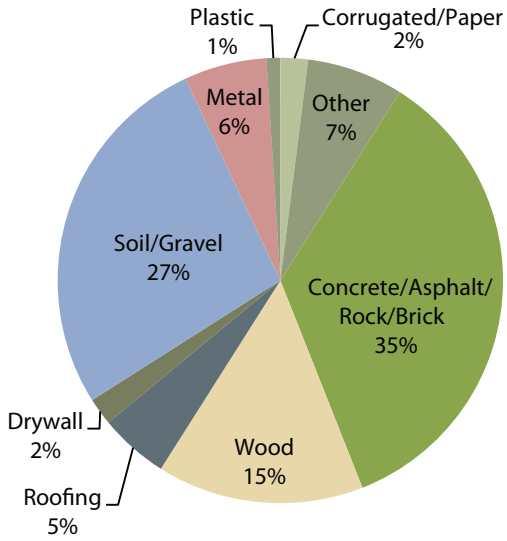


FIGURE 11–Estimated C&D Debris Generated in NYS, By Weight

and unadulterated wood, recognizable uncontaminated concrete and other masonry waste (including steel or fiberglass reinforcing embedded in concrete), asphalt pavement, brick, soil or rock that has not been in contact with a spill from petroleum product, hazardous waste, or industrial waste, and that is not commingled with other solid waste

Few outlets exist in Central New York for the processing of construction and demolition (C&D) debris in to recyclable materials. One or more C&D Processing/Recycling Facilities could, however, be developed in unused buildings within the region that could be converted to C&D processing facilities where materials could be separated from C&D debris to be recycled or to be reused. One specific facility within Oswego County where such a development would be possible would be the former Oswego County Materials Recycling Facility located at its Bristol Hill Landfill site. Through financial support, the conversion of this facility could be realized. Other sites within the five county region may also be available for this type of facility.

Adoption and implementation of a C&D recycling ordinance could be an effective method for diverting C&D debris from disposal facilities. A C&D recycling ordinance is a publicly adopted local law that gives an enforcement agency authority for the diversion activities required in the ordinance. Before adopting and implementing a C&D diversion ordinance, the process should begin by first researching local conditions related to C&D waste, and include local stakeholders throughout the development of the ordinance.

Public Education and Awareness Programs

Public outreach and education regarding waste diversion programs, reuse, and recycling, composting, and responsible disposal of special wastes is a key component of local solid waste management and recycling programs. Each county in Central New York has existing recycling and waste diversion programs that include different levels of funding and staff resources with regard to public outreach and educational activities. If, however, there are opportunities to enhance current public outreach and educational activities then improved recycling and waste diversion could result from increased participation in existing programs.

Potential enhancements to current public awareness and outreach activities could include the following initiatives: a concerted effort to increase the awareness of opportunities at large public gatherings; outreach targeted to increase recycling and waste diversion at local schools, colleges, business establishments and institutional facilities; and development of a recycling curriculum for use by teachers at local elementary and secondary schools.

CONSTRUCTION AND DEMOLITION DEBRIS RECYCLING FACILITY; LEE COUNTY, FLORIDA

FIGURE 12–C& D facility in Lee County, Florida

In May 2011, Lee County commissioned its Construction and Demolition Debris Recycling Facility (CDDRF). This $3.27 million facility has a processing capacity of 500 tons per day and compliments the County's efforts to divert materials from landfills and support its successful Business, Multi-Family, and Construction Debris Recycling Ordinance (implemented in 2008).

BIG BELLY SOLAR TRASH AND RECYCLING COMPACTION SYSTEM; ALBANY, NY

One option that may prove economical in high-traffic areas such as downtown Syracuse are solar-powered trash compactors, known as the Big Belly Solar Trash and Recycling Compaction System. Each of the trash disposal units costs about $4,000 while the recycling units cost about $9,000 each. While they take up as much space as an ordinary trash can, the capacity is five times greater so they have to be emptied less often, and require fewer pickups. The unit's solar panel extracts energy from the sun and stores it in a battery, which powers onboard controls software that takes fullness input from a photo eye that triggers compactions automatically. When the compactor reaches predetermined fullness levels that indicate a pickup is required, the unit's status is visible and trackable from any web-enabled computer and external LED indicators are triggered. The new solar compactors permit up to an 80 percent reduction in collection frequency, saving time and work and greatly increasing the efficiency of the collection process.

More than 100 installations were completed in Albany in 2011, including 93 trash compactors and 20 recycling bins, using a using grant funds obtained from the U.S. DOE. According to Dan DiLillo, assistant commissioner of General Service for the City of Albany, staff now only make three or four pickups each day, down from 100 before the installation of the Big Belly units. City officials and neighbors also report much less trash on the street.

Convenient recycling drop-off containers in public spaces and/or at public events

In many cases, increased recycling awareness and volume depends on ease of availability to the public. Although public education and awareness is an important component to waste diversion and increased recycling, making it easier for the public to find and use recycling receptacles is also important. A few key steps to follow to make recycling in public spaces and/or public events a success, include: make recycling as convenient as possible, provide clearly-marked recycling containers, and use containers which can be easily serviced and quickly placed back in to service.

Compressed natural gas (CNG) waste/recyclable trucks

In recent years, some waste haulers have converted portions of their waste collection truck fleets from diesel to CNG. Increased use of clean, domestically produced fuels helps reduce our reliance on oil from overseas, which is good for our nation's energy security. According to the U.S. DOE, nearly 87 percent of compressed natural gas used in the U.S. is domestically produced. CNG produces 60-90 percent less smog-producing pollutants, gives off 30-40 percent less greenhouse gas emissions, and also extends engine life. Consisting mostly of methane, CNG is odorless, colorless and tasteless. Strict safety standards make CNG vehicles as safe as gasoline-powered vehicles.

Materials Exchange Program

A Materials Exchange (Mat-Ex) program can facilitate the exchange of materials or wastes from one party, which has no use for that material, to another party that views the materials as a valuable commodity. Such programs foster waste reduction efforts through the reuse of materials, thus eliminating the need to process the materials for recovery or disposal. One such program that currently exists in Upstate New York is Mat-Ex. Mat-Ex is a reuse program that was started by the GLOW Region Solid Waste Management Committee and two other counties in 1992 to provide businesses, institutions and 9 government agencies with a means of disposing of scrap or surplus items without landfilling or incinerating them. The program now encompasses 14 counties including: GLOW (Genesee, Livingston and Wyoming), Allegany, Broome, Chautauqua, Monroe, Oneida-Herkimer, Seneca, Steuben, Tioga, Wayne and Yates. The program is available via the Internet at www.mat-ex.org or by a hardcopy catalog, which is published three times per year. Items can be listed under "Materials Available" or "Materials Wanted". Listed materials must be non-hazardous items that would otherwise be destined for a landfill or incinerator.

Industrial Ecology

Industrial Ecology (IE) is an approach to sustainability in which industrial processes and products are considered integral parts of the complex global ecosystem. This philosophy - applying the fundamentals of 'ecology' to industry - seeks to discard the concept of 'waste' by optimizing and economizing flows and exchanges in material and energy to increase the circularity of the material and energy economies. The concept of IE can be summed up in the idiom, "one man's trash is another man's treasure".

The concept has many immediately practical applications. At its core, it seeks to improve process and material efficiencies, which frequently reduce energy use and pollution, often proving benefits to a company's bottom line. To this end, Lifecycle Costing (LCC), Lifecycle Assessment (LCA), Material Flow Analysis (MFA), and Integrated Chain Management (ICM) are well known, frequently applied parts of the IE toolkit. Rarer are aggregations of industries whose mutually beneficial networks of exchange create what is described as an Industrial Symbiosis (IS).

IS is a relatively new framework for sustainable practices. There are few locally established pilot projects and no prevailing methodology for implementing IS. One thing is clear though from previous attempts to establish ground-up eco-industrial parks in the U.S.: IS cannot be planned from start to finish. IS must be opportunistic, capitalizing on existing industries and infrastructure. Typically, IS grows starting with a few key exchanges or out of a single large industry or facility that is constantly improving its operational efficiency. Early relationships that may lead to fertile industrial symbioses exist in CNY and should be cultivated.

A number of global and local case studies in which IS has been deployed effectively were reviewed and are described in depth in the Technical Appendix x.x. The focus was on projects that have quantified reductions in GHG output, energy use, and landfill tonnage. As summarized in Table 6 below, seven case studies of relevant IS were evaluated and are ordered from broad topical relevance to specific applicability to CNY. The first two case studies - Kalundborg and PRIOS - are examples of well-documented Industrial Ecosystems. They are instructional because researchers have quantified the significant economic and environmental benefits of these fully realized IS networks. NISP and Pennsylvania Waste Reporting illustrate the utility of state interaction in facilitating waste reduction and symbiotic relationships. The NISP case shows that a publicly-funded, pro-active organization can help remove the overhead cost for companies to develop their own waste-recovery policies. The long-term effects of Pennsylvania's waste reporting requirements have

COMPRESSED NATURAL GAS (CNG) TRUCKS

Waste Management, Inc. (WM), recently announced that it has opened thirteen CNG stations across the country in the first half of 2012, of which 9 have publicly accessible fueling stations. This brings WM's natural gas fueling stations to 31 with another 17 either in operation or in construction by the end of 2012. In 2012, natural gas vehicles will represent 80 percent of WM's annual new truck purchases. Based on the fact that WM is in the process of converting to CNG, it is likely that other waste haulers are also contemplating the conversion. However, not all waste haulers, including municipalities, have access to CNG fueling stations nor do they have the resources to convert to CNG. CNG engines require special fueling facilities as well as special maintenance facilities, both of which are expensive. The cost and availability of a network of CNG fueling stations would be an important consideration when waste/recycling truck owners assess the feasibility of such a conversion to CNG.

not been as closely monitored as NISP, but, what is clear is that the availability of data will increase the number of opportunities to realize sustainable, mutually beneficial material management practices. The Pennsylvania requirements contrast with those of New York State, where fragmentation in reporting and lack of specific reporting requirements for commercial hauling limit the ability of managers and researchers to analyze regional reuse potential. The final three case studies illustrate IS opportunities developing in the northern United States: KIPC demonstrates the redevelopment of a former brownfield site; Silver Bay is an eco-park driven by meeting regional needs for quality affordable food and economic development; and the Genesee Valley Agri-Business Park shows that shovel-ready sites with expedited permitting are a major draw for prospective tenants and also provides an example of a successful industrial park development centered on the regional dairy industry. Each of these lessons is relevant to the environment in CNY.

TABLE 6–Summary of Case Studies

	Industrial Exchange Network	Number of Type of Industries & Number of Exchanges	Types of Sponsorship (Gov/Priv)
Establish Examples of Industrial Symbiosis	Kalundborg, Denmark	30 industries coordinating exchanges, including: Oil refinery, Power plant, Gypsum plant, Farms (Fish, Pig, etc.) Pharmaceutical manufacturing	Private; Initially informal, leading to formal organization
	PRIOS (Puerto Rico Island of Sustainability)	14 industries coordinating exchange, including: Pharmaceutical manufacturing, Wastewater treatment, Petro refinery, Power plant, Paint Manufacturing	Private, with government direction (e.g., requiring a power plant to use non-potable water)
State Sponsored IS Programs	Pennsylvania Waste Reporting Standards	All waste generators over 1 long ton/month must report.	Government directed
	NISP (National Industrial Symbiosis Programme), United Kingdom	Over 10,000 member organizations participating.	Government directed; support from government and subscription funding
Relevant Regional Pilots	Keystone Industrial Port Complex (KIPC) Bucks County, PA	Over 20 total tenants: primarily Renewable Energy technology manufacturers. Methane-to-electricity production, Concrete and asphalt crushing for reuse, Coal-fire residue used for shingles and sand-blasting.	Public-private partnership
	Silver Bay Eco Park Silver Bay, MN	6+ exchanges, including: Fish farm, Greenhouse for produce, Algal biofuel troughs, Wood pellet boilers.	Local Government
	Genesee Valley Agri-Business Park Batavia, NY	2 yogurt production facilities. Additional food-related businesses in consideration.	Public-private partnership

Lessons Learned	Significant Results
+ Social connections and the trust of community relationships helped establish partnerships. + Companies benefit from inputs that are: + Limited (e.g. available groundwater) + Can be supplied reliably (e.g. fly ash), + Cheaper (lower transportation costs and avoided waste).	+ Reduced 272,000 tons CO2e/yr + Reduced 870 million gallons of water/yr + Over 1 million gallons of ethanol produced from straw + 150,000 tons of gypsum produced/yr from flue gas (SO2) + $15m annual savings on $90m investment in shared infrastructure
+ Benefits are regionally-specific: + Single-industry dominated clusters benefit from aggregating their needs and waste streams. + Multiple-industry clusters benefit from internally sharing resource streams.	+ Reduced 99.5 tons SO2/yr + Reduced 95.3 tons PM10/yr + Reduced 92.4 m gallons of water/yr + $10.3m in savings/yr for avoided energy, water, and discharge costs
+ Publicly-directed efforts are well-spent on information gathering and sharing	+ Saved 13 PJ of primary energy/yr + Reduced 900,000 tons of CO2e/yr + Reduced 4,300 tons of SO2e/yr + Reduced 4,200 tons of NOx/yr
+ A publicly-funded, pro-active organization can help remove the overhead cost for companies to develop their own waste-recovery policies	+ Reduced 6.8 million+ tons CO2 + Diverted 7.6 million+ tons of waste from landfills + Members saved over $260m
+ Proper incentives can fuel the development of a brownfield site into a major contributor to the local economy. + Individual localized operations such as energy derived from landfills and material recycling provide seeds for potential IS growth	+ $1b in economic growth and 3,000 jobs from renewable manufacturing and supporting sectors + Generates 40 MW electricity from captured methane
+ Rapid development of an ag/energy based, planned IS park possible with commitment of local stakeholders. + Meeting regional needs for quality affordable food and economic development are major drivers.	+ Created 95-135 jobs from the wood-pellet boiler and supporting logging activities + Reduced 127,500 tonnes CO2e/yr
+ Shovel-ready sites with expedited permitting are a major draw for prospective tenants. + New York's dairy industry continues to show major growth in the yogurt market.	+ Plans identify 236 new jobs at the two plants

The Müller Quaker Dairy structure in the foreground will open in 2013; in back at left is the Alpina Foods plant.

Source: James Cavanaugh Photography

GENESEE VALLEY AGRI-BUSINESS PARK; BATAVIA, NY

This 212-acre park in Western NY was recently developed and dedicated to attracting food processing companies in order to stimulate local economic growth. Thus far, the Park has been successful in attracting two large yogurt processing facilities. In April 2011, the Genesee County Economic Development Center (GCEDC) announced that Alpina Foods, a leading dairy company in South America, had selected the park as the location for its first specialty yogurt manufacturing plant in the U.S. The Alpina facility opened in September 2012. In addition, PepsiCo and Muller Quaker Dairy plan to build another $206 million yogurt manufacturing facility. Several food digesters that would convert waste streams to energy may be added once the yogurt facilities are up and running. Reportedly, there is also interest from Genesee Valley Mushroom in building a 70,000 square foot mushroom growing facility that would employ approximately 100 workers. According to GCEDC, at least five other active projects are also considering the park.

KEY ISSUES AND OPPORTUNITIES

In developing this plan, CNY sought to capitalize on the region's strengths, identify a path to overcome the region's challenges, and seize the near-term and longer-term opportunities by anticipating and tracking the trends and drivers of change affecting the region. Opportunities were assessed to reduce energy consumption and GHG emissions associated with the production, processing and deposition of municipal solid waste and industrial waste in the region.

The VisionCNY Planning Team began by engaging its Technical Advisory Committee to identify these strengths, challenges, opportunities and drivers of change with respect to material and waste handling. Opportunity identification in waste management was also conducted through direct contact with the solid waste planning units, review of available reports including NYSDEC documents, and the Planning Team's knowledge of local conditions and the solid waste industry in general.

Waste management systems are an important aspect of the industrial ecosystem. Products that may be usefully upcycled often end up in waste management and are sorted to be recycled or landfilled. The quality of reporting of this information in many ways affects the ability of material flows to be usefully managed and planned. Additionally, transfer stations, incinerators, and landfills are sites in which material and energy may be productively exchanged in an environment amenable to industrial activity.

The CNY region has several existing recycling programs with high participation rates. As shown in the case studies above, the region has also pursued a progressive approach to waste management with each county actively engaged in a piece of the material and waste handling arena. In addition, the region has a resource in the Environmental Finance Center at Syracuse University, which provides education and advice on waste and other opportunities to achieve sustainable gains.

Not surprisingly, the region's opportunities lie at the intersection of its strengths and challenges. Despite the region's robust existing recycling programs, the expansion of curbside recycling and composting programs can provide a significant increase for waste diversion from landfills. Farming and agricultural industries, in particular, dairy farming provide a distinct advantage in terms of using biodigesters which also can garner support from NYSERDA funding. Existing landfills can be harnessed for their renewable energy potential whether in the form of landfill methane recovery or the siting of solar powered generation. There is also interest in conducting a de-construction recovery pilot to better gauge the potential for the region. Most notably, the region recognizes that the "zero waste" movement and the use of industrial ecology systems provide additional drivers for change.

With regard to Industrial Ecology opportunities, an evaluation of major industry, agriculture, and waste streams were compared against pilot projects from the IE literature to identify promising exchanges. Additionally, relevant projects and existing organizations important to the development of IS are highlighted, as described in the Technical Appendix.

Agriculture

Agriculture is a major industry in Central New York. Regionally, agriculture is dominated by corn and dairy, with the largest revenue generators being dairy farms, including milk-product sales and the sale of cattle and calves. The non-grain agricultural products, corn for grain, other grains, and cow, hogs, broilers, eggs and dairy sold are all products that leave the region, as indicated by their respective arrows. The most significant material in terms of tonnage is corn for silage or greenchop, which is consumed within the region. Similarly, the agricultural waste and excrement produced stays within Central New York.

Historically, agriculture has had a circular material flow pattern. However, as one follows the modern-day farm-to-table supply chain, circularity diminishes, and there is a general downstream flow of nutrients that results in losses to landfills and waterways. Regulation of farm wastes to improve waterways has had a great effect on closing the loop on nutrient loss upstream. Composting and organic collections programs, like those undertaken in Onondaga and Oswego, help close the loop downstream. Unfortunately, it is difficult to gain participation. State-organized programs such as the Massachusetts "land ban" program can yield significant increases in organic composting rates.

Pilot projects exist that demonstrate possible improvements at other points in this food delivery chain. NISP, for example, has demonstrated the feasibility of recycling dairy waste to anaerobic digestion from farm and processing facilities. OCCRA's organics composting efforts have returned many thousands of tons of nutrients to the region. Other potential symbiotic relationships exist between aquaculture and greenhouse operations, as evidenced in the Silver Bay Eco Park, as well as with milling plants for ethanol, which produce a dried grain byproduct that can be used as livestock feed.

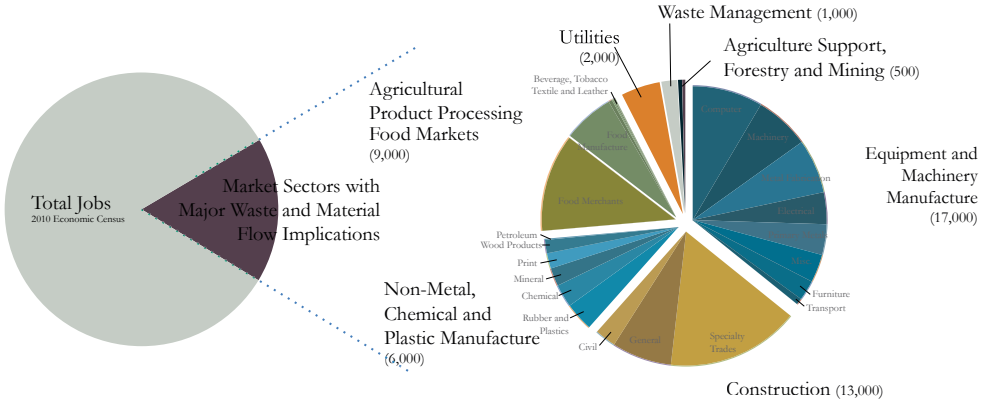
Considering the quantity of materials that flow through agriculture and food processing facilities in the region, agricultural processors, agricultural waste processors, and food processing facilities should be target "anchor tenants" for an industrial park. Agricultural inputs include many items that other industries may consider waste. For example, non-potable water can be used for irrigation, or for smaller projects like aquaculture (see the Silver Bay case study). Waste like gypsum from C&D facilities can be used as compost or fertilizer.

Agri-industrial parks are extensions of the industrial park model, with an emphasis on agricultural production and its supporting activities. The opportunity for profitable byproduct-flows between tenants is particularly high within the biomass, energy, and water-intensive food processing industry. Agri-industrial parks can benefit from heat and steam derived from combined heat and power plants, or from co-locating with a biomass energy facility or anaerobic digester that can utilize farming byproducts or animal waste. Locating such digesters near large farms, wastewater treatment plants, or other institutions with large organic waste streams can reduce off-site waste hauling demand while providing renewable energy. Locating them near compost facilities can help to create high-end fertilizers from the resulting digestate, which can be applied back onto farms. Other potential agri-industrial park tenants include ethanol fermentation plants that use crop and food wastes or specific bioenergy crops (such as willow). The latter is the subject of research at the SUNY College of Environmental Science and Forestry for its potential as a regionally produced dedicated energy crop.

Several opportunities exist in the region to develop or expand agri-industrial park activities. The aforementioned ARE Park serves as a promising example, and with the addition of aquaculture and a greenhouse it could mirror the success of the Silver Bay case study. A number of other agricultural kernels of industrial symbiosis exist in CNY such as the Riverview Business Park and are described in the Technical Appendix.

Industry

Central New York has a wide range of large and small companies that represent a diverse mix of industries. There is ample opportunity for interaction between industries, and IS opportunities exist using both the cluster and dominant single-industry models described by PRIOS. Additionally, there are a number of organizations in place with the connections and industry recognition to pilot IS activities.



a Data from 2010 US Census Bureau Economic Census
b Represents a subset of major waste producing sectors not all sectors represented

FIGURE 13–Employment Statistics for Selected Waste Generating Industries in CNY

Figure 13 on page 219 shows employment figures in selected waste generating industries (excluding farming). Industrial manufacturing and construction are the largest employment sectors, followed by non-metal/plastic/chemical manufacturing and food processing/food markets. While the material and energy data related to these employment statistics is not publicly available, the compositional diversity and relative scale of industries is apparent. The economic census shows that there are clusters of mid-size firms in manufacturing, many smaller firms in construction and agriculture, and a few very large firms in diverse industries. Large firms are particularly important players for IS, both for their scale and for the expertise and process knowledge they represent.

Adjacent or co-located industrial facilities provide the greatest opportunities for IS, as evidenced by the case studies cited in this report. Not only do they reduce the need for transporting water, heat, and other byproduct materials and their requisite infrastructure (roads, pipes, etc.), but they also foster the critical social relationships necessary to IS. Given these benefits, it makes sense to target the industrial parks in Central New York that already exhibit seeds of promise for IS growth. A few Industrial Parks in CNY exhibit kernels of IS including the Auburn Technology Park, Riverview Business Park, and the Finger Lakes East Business Park. Further details on these and other opportunities are presented in the Technical Appendix.

The CNY region is not without its challenges too. In the waste area, most are tied to economics. The cost of Transport & Disposal (T&D) in particular poses a significant financial challenge. Every ton of MSW and C&D material that is reduced, reused, recycled, repaired or composted locally will represent a reduction in the environmental and fiscal impact of T&D. The cost of export represents a large portion of community operating budgets and continues to rise.

Many counties lack the necessary funding to support staff or make the capital investment to initiate more effective materials management programs. More collaboration and sharing of resources such as public education materials and strategies between counties in the region would be a cost-effective strategy to improve participation rates in recycling programs.

The economic viability of building deconstruction, which is largely a function of the material yield followed by access and proximity to reuse and recycling markets, has been a challenge. While many materials can be reused or reprocessed into useful products, the development of a viable, large-scale market for these materials continues to remain a challenge at all levels.

Other challenges involve regulatory enforcement and data collection and management. The issue of regulatory enforcement is perhaps best summarized in Beyond Waste: "Although most municipalities did adopt the requisite local source separation laws or ordinances before the statutory deadline of September 1992, in some cases, local laws still lack fundamental and important provisions such as requiring source separation in all generating sectors and providing for enforcement. In many cases where the laws include enforcement provisions, municipalities have not effectively used them, particularly for commercial and institutional generators." While there are multiple municipal and state laws mandating the separation of materials and prohibiting the disposal of recyclables in MSW and C&D waste streams, many municipalities lack an effective system of enforcement of these laws. Inconsistent definitions, tracking mechanisms, reporting, and data management render materials accounting very difficult.

The more urbanized counties of Onondaga and Oswego have disproportionately large organic components in their solid waste streams due to disposal of yard waste. Removing organics from the waste stream (either at the source or after collection) has multiple benefits such as reducing the volume of waste to be landfilled and reducing GHG emissions from transport of waste and anaerobic decomposition at landfills. Other organics, such as food scraps and biosolids from wastewater treatment plants, are predominantly sent to landfills or incinerated. The separation of these types of organics should be more aggressively implemented to allow for local disposal or beneficial reuse. Combining food scraps and yard waste can create an ideal mixture for compost.

IMPLEMENTATION

It is often said, "What gets measured gets done." Regular measurement and reporting keeps the focus on progress. When the measures are not headed in the right direction – or the progress is not happening at the desired pace - this information can be used to make decisions designed to improve results.

However, measurement though necessary is not sufficient to drive results. It must be combined with targets (or goals) that describe the desired future state. And even that combination will not suffice, in the absence of defined strategies – the actions that will enable progress. The three – indicators, goals and strategies work in tandem – strategies when pursued drive the achievement of the goals as proved by measuring the indicators. CNY has determined its measures of progress as outlined below.

GOALS

CNY has determined that the goal of this plan with respect waste management will be to:

REDUCE GREENHOUSE GAS EMISSIONS AND THE OVERALL ENVIRONMENTAL IMPACT OF THE REGION'S WASTE STREAM BY REDUCING THE PRODUCTION OF WASTE, THE ENERGY INTENSITY OF THE MATERIALS MANAGEMENT SYSTEM AND THE AMOUNT OF WASTE REQUIRING LANDFILL DISPOSAL.

Indicators and Targets

Total solid waste generated per capita is an indicator that encompasses all of the waste disposal use within the region on a scale that is highly relatable. Understanding how much waste is generated per capita can be very effective in illuminating the need to reduce waste generation regardless of its source. To calculate the value for this indicator, data for all sources of waste (e.g., municipal solid waste (MSW), industrial, construction and demolition (C&D), biosolid and hazardous waste) are needed.

Calculation:

Total regional solid waste generated per year =

Σ (MSW + Industrial + C&D + Bio Solids + Hazardous) per municipality per year

TABLE 7–Solid waste generated per capita = total regional solid waste generated per year / regional population

Source: NYS Department of Environmental Conservation

Total region waste (tons) - 2010	868,610
MSW	490,842
C&D	75,685
Hazardous*	214,305
Transfer stations + recycled waste	79,441
Industrial **	8,337
Total region population	791,939
Total Solid Waste Generated per capita (tons):	1.1

*the hazardous waste total includes all of Region 7, which includes 4 counties not included in the Central NY REDC region; the accuracy of allocating this total to CNY is limited without facility-specific information

**due to limited reporting and tracking of industrial waste data, regional estimates that do exist were reported, but they are likely understated and misleading

NYSERDA also required that each region choose Sustainability Targets for their plan. Targets are to be selected based on the Indicators.

CNY has established the following target for waste management:

REDUCE THE TOTAL SOLID WASTE GENERATED PER CAPITA BY 75 PERCENT (BELOW 2010 LEVELS) BY 2030.

Strategies and Recommendations

Based on the baseline data presented above, substantial reductions in the generation of waste needs to be an integral part of the region's climate change initiatives. This will take close coordination and strong partnerships between the region's citizens, major industries, the agricultural community and county and municipal solid waste managers. In addition, all of the region's public facilities, fleets and operations should take an active leadership role in evaluating, implementing and demonstrating ways to help meet sustainable materials management goals as part of these climate change initiatives.

With this foundational understanding of some of the drivers for undertaking a comprehensive planning effort, the VisionCNY Planning Team worked to assess the current state and the projected future state of waste management, the climate-related emissions from current waste management regime, catalogue the already-identified plans, identify the potential opportunities and challenges and make recommendations on the indicators to track, the targets to set, the strategies to be pursued, and the potential projects to be implemented to achieve the desired future state.

In line with the goals of Beyond Waste, CNY has set an overarching goal to reduce the amount of waste requiring landfill disposal in the five County Region. The strategies and project recommendations described below can help achieve this goal. In order to chart a course to effectively and efficiently achieve this target, the CNY region has articulated a series of strategies that will enable waste reductions. These strategies address the various components that will facilitate change addressing policies, programs and procedures, capital projects, education and outreach. They also are aimed at the broad spectrum of sectors that can drive change: government, business and industry, residential and non-profit. The strategies are supported by programs and projects that the region can implement to make the materials and waste management sector more sustainable.

Strategies

1. Support and implement policies and programs that reduce waste generation, encourage reuse and increase recycling to close the loop on material flows within the region.
2. Develop additional reuse and recycling infrastructure.
3. Encourage composting and other organic material recycling technologies.
4. Reduce the environmental impacts of the waste management system itself, including collection, processing and deposition.
5. Develop regional Industrial Ecology programs such as waste material audits for local industries to help identify IE opportunities and a waste materials exchange program to facilitate the use of waste materials as inputs.
6. Sponsor "kernels" of Industrial Symbiosis and support regional networks between industries to foster trust and establish the conditions in which businesses organically find partners that have usable waste streams.
7. Improve the collection and reporting of accurate information regarding the generation, collection, and processing of residential and non-residential waste.
8. Develop approaches to address specialized waste streams such as hazardous waste and construction & demolition debris to reduce the amount of material requiring landfill disposal.

9. Engage in solid waste management facility planning on a regional basis

10. Support regional collaboration and participation in updates to the Solid Waste Management Act.

Project Recommendations

1. Develop a model waste generator "green fee" system.

2. Enact local resolutions in support of the Principles of Extended Producer Responsibility.

3. Establish Environmentally Preferable Purchasing programs and enact local policies that require municipalities and counties to integrate life cycle cost analysis in the procurement of products.

4. Expand existing public education and awareness programs, and encourage collaboration and resource sharing between counties.

5. Purchase recycling containers, waste "toter" receptacles, and automated collection vehicles as part of an expansion of publicly controlled curbside collection programs and single stream recycling throughout the region to reduce the number of trucks on the road and to provide cost savings to residents that had been hiring curbside collection services on their own.

6. Provide funding for municipalities to purchase and place convenient trash and recycling drop-off containers in public spaces and/or at public events.

7. Develop anaerobic digesters for agricultural and other organic wastes that can be paired with gas recovery systems that either convert the digester gases into CNG or that beneficially use the digester gases in other ways, such as to produce electricity.

8. Support the expansion of OCRRA's food waste composting facility to handle approximately 9,600 tons per year of food waste plus the processing of up to approximately 68,000 tons per year of yard waste.

9. Develop backyard composting programs.

10. Develop an active landfill gas collection and control system at the Cortland County landfill that will reduce greenhouse gas emissions and which may ultimately lead to development of a landfill gas to energy project.

11. Convert the fuel systems of the waste/recyclable truck fleet to compressed natural gas (CNG).

12. Implement renewable energy projects at solid waste management facilities, including solar panel temporary capping at landfills as was completed at the Madison County Landfill.

13. Develop reporting standards for commercial and private haulers throughout the region to assist businesses and local decision-makers to identify currently untapped recoverable resources and enable the effective expansion of waste and byproduct material exchanges.

14. Develop a web-based software system for use by non-residential waste generators to report data on waste materials they generate and dispose of off-site.

15. Create a Waste to Biogas Mapping Tool, similar to that developed by the U.S. EPA in Region 9, to connect large organic waste producers of high energy materials like fats, oils and grease with

potential users such as dairy biodigesters or wastewater treatment plants.

16. Complete infrastructure development required for the Madison County Agricultural and Renewable Energy (ARE) Business Park in the Town of Lincoln to leverage as a "kernel" of Industrial Symbiosis.

17. Support regional networks between industries through workshops and charettes to identify material flows that can be improved or reused and provide funding for Industrial Ecology applied research and pilot projects to assist industries who must clear research hurdles before making capital investments.

18. Develop permanent household hazardous waste collection facilities throughout the region.

19. Develop a model C&D Recycling Ordinance to promote reuse of construction and demolition debris.

20. Develop facilities for the processing and recycling of construction and demolition debris, including conversion of the former Oswego County Materials Recycling Facility located at its Bristol Hill Landfill site.