Interim Report, Version 3

Region of Durham

Anaerobic Digestion Implementation / Organics Plan Development

FINAL

April 1, 2016

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1 Introduction

This Interim Report presents the results of the initial tasks identified as supporting activities for the Region of Durham Anaerobic Digestion (AD) implementation plan / Organics Management Plan, including work completed to date related to:

- Preparation of updated baseline organic material projections
- AD technology assessment as completed through the RFI process undertaken by the Region as well as the outcome of a facility tour conducted to follow up on the RFI process
- Initial recommendations of a procurement approach that could be used to implement AD in the Region.

1.1 Background

Anaerobic digestion (AD) is the biological decomposition of organic materials in the absence of oxygen under controlled conditions producing biogas (e.g. can be used as fuel for electricity generation and/or heating), compost, liquid wastes and solid residue.

In 2013 a pre-feasibility study was completed for the Region of Durham regarding the use of AD to process source separated organics (SSO) and other biodegradable materials produced in the Region, and to address how AD could increase waste diversion and produce green energy. The study excluded leaf and yard waste materials which are not suitable for some AD processing technologies (wet AD), and focused instead on the range of other organic material streams that could be directed to AD in order to supplement/boost the performance of the Region's existing organics diversion program. Various options were assessed, to determine the feasibility of processing SSO and other additional materials (pet waste, diapers and sanitary products) from single family and/or multi-residential sources.

The pre-feasibility study concluded that there was no strong rationale for inclusion of diapers and sanitary products in the SSO program, but that there may be an opportunity to incorporate pet waste into the SSO stream regardless of processing technology. It also concluded that an AD facility with a capacity greater than 50,000 tonnes was the only option considered viable from an economic standpoint. This size of facility would require that all SSO generated in the Region be processed by the facility in-lieu of the current processing system.

It was concluded that if the Region were to pursue an AD option where it would own the AD facility, partnerships should be considered to augment the amount of materials processed in order to reduce the capital and operating costs.

In November 2013, Regional Council adopted the recommendations of Report No. 2013-J-38 regarding the 2014 Annual Solid Waste Management Servicing and Financing Study. Among other recommendations included in this report, were recommendations related to the need to develop a comprehensive organics management plan beyond 2018. The report identified the need to potentially expand organics processing options to address current diversion program expansion constraints and include other potential source-separated organics materials and organics received from multi-residential dwellings to facilitate higher diversion in addition to Green Bin organics. Staff were directed to provide options, analysis and recommendations to move forward with a comprehensive organics management plan beyond 2018, and to continue to investigate anaerobic digestion (AD) technologies in order to form a future business case and develop recommendations for Regional Council. The plan includes capturing more organic materials from the remaining waste stream in the Region.

Increased diversion of organic materials in the Region either through source separation or mixed materials processing and integration of AD processing of some or all organics in the Region's waste management system has the potential to:

1. Allow the Region to capture a higher value for carbon credits/GHG emission reduction performance associated with diversion of organics and generation of bio-energy;
2. Address the pressure on the waste management system associated with population growth. Without increased diversion, within the next 15 years population growth will result in the Region exceeding the available disposal capacity of the Durham York Energy Centre (DYEC);
3. Address changing demographics in the Region as more of the population shifts to multi-family housing that is difficult to serve with source separation programs;
4. Supplement the performance of the current source separated organics program through targeting materials remaining in the mixed waste stream, without changing/increasing the level of effort required from householders;
5. Address diversion of organic materials that may be subject to future Extended Producer Responsibility (EPR) programs (e.g. branded organics).

The viability of AD processing as a part of a comprehensive organics management plan in the Region is contingent upon:

1. The volume and quality of the organics material supply which affects economies of scale;
2. The potential for partnerships in the development and implementation of an AD facility, influencing both the material supply and the implementation approach (procurement, investment, energy distribution and ownership) that works the best for the Region;
3. Selection of an AD processing technology with a reasonable range of capital and operating costs;
4. Selection of an AD processing technology that is capable of managing the SSO stream that is expected to be available in the Region, which includes SSO from multi-residential generators that tends to have higher non-organic contamination rates; and
5. The availability of a viable market and market partners for the biogas energy that is produced that recovers the maximum value of this energy.

HDR was retained to support the Region in the development of an AD Implementation Plan/Organics Management Plan (hereinafter called the Organics Plan), working in conjunction with Regional Staff to address the matters noted above.

1.2 Current Region of Durham Organics System

The Region is comprised of eight area municipalities including the Cities of Pickering and Oshawa, the Towns of Whitby and Ajax, the Municipality of Clarington and the Townships of Scugog, Brock and Uxbridge. The Region is responsible for providing collection services (garbage, recycling, source separated organics (SSO)) to all municipalities except Whitby and Oshawa that provide their own garbage and SSO collection. The Region is also responsible for disposal and processing services including recycling and SSO processing.

The Region of Durham currently collects SSO excluding leaf and yard waste (LYW) materials via its Green Bin Program, collecting LYW separately. The SSO stream includes all food waste, compostable paper fibre and other organic material (e.g. pet bedding) but excludes diapers, sanitary products, kitty litter and pet waste. Residents are allowed to use liner bags that meet ASTM D6400 certification for biodegradability.

Table 1.1 provides a summary of material quantities managed by the Region in the past five years

Table 1-1: Region of Durham, Reported Residential Waste Quantities[1]

Material	2010	2011	2012	2013	2014
Blue Box	51,609	53,157	51,689	50,464	49,532
Food Waste	27,594	26,865	26,899	27,486	27,007
Yard Waste	23,074	23,744	25,473	25,268	32,123
Backyard Composting and Grasscycling	9,839	9,887	10,516	10,494	10,650
Reuse	6,146	7,226	6,763	6,385	6,295
Garbage	108,000	107,670	107,722	109,641	110,417
Total	**226,262**	**228,548**	**229,061**	**229,739**	**236,024**

As of 2014, the Region estimated that it achieved 55% diversion, serving a total population of 652,790 residents, 195,690 single family homes and 23,690 multi-family residences.[2]

The Region estimates continued population growth, such that by 2031 there would be in the order of 960,000 residents, and 356,610 households that would be served, with an increased proportion of residents living in multi-family households.

Figure 1-1 below presents moderate and high population growth projections for Durham Region based on the Growth Plan for the Greater Golden Horseshoe, Updated Forecasts, by Hemson Consulting, November 2012[3] which provided low and high estimates of population for Durham Region in 5 year intervals to 2041.

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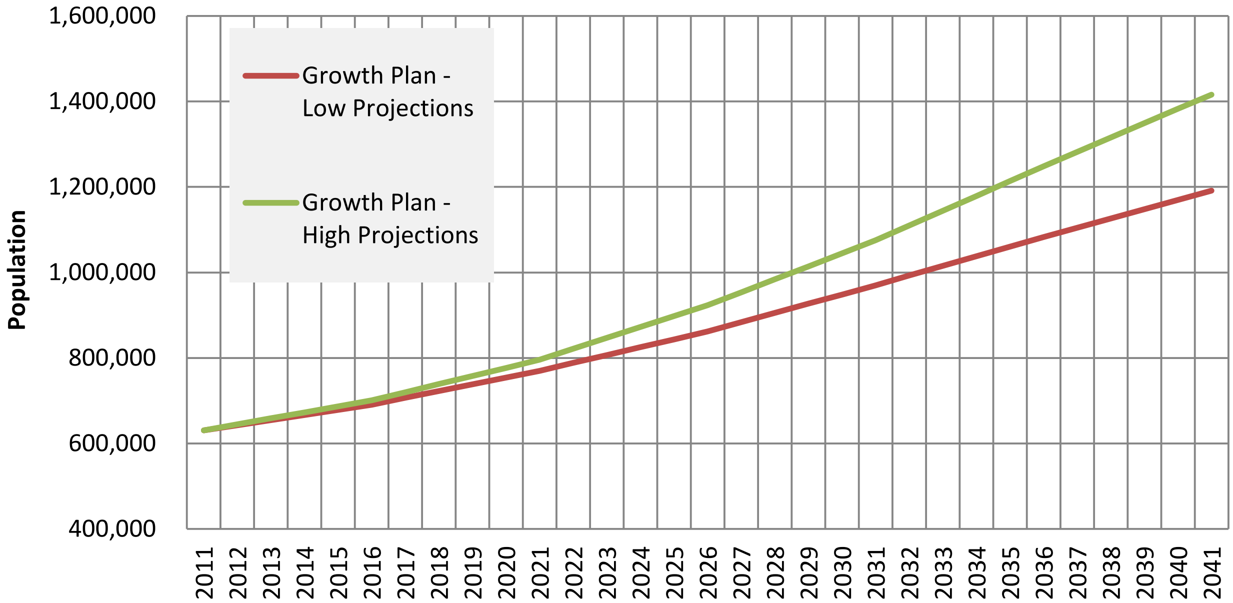
[1] Region of Durham, Waste Management Services webpage

[2] Region of Durham, Waste Management Annual Report 2014

[3] http://www.hemson.com/downloads/HEMSON%20-%20Greater%20Golden%20Horseshoe%20-%20Growth%20Forecasts%20to%202041%20-%20Technical%20Report%20-%20Nov2012.pdf

Figure 1-1 Durham Region Population Projections



One of the key items for discussion in development of the Organics Plan, are the projections for increased population growth and changes in the proportion of single family to multi-family housing. Implications related to organic diversion include:

a) Residential waste diversion will have to continue to grow at a pace that is equal to or that outpaces population growth in order for the tonnes of waste sent to disposal to remain the same over time. Otherwise in the near future the quantity of waste that remains after diversion will exceed the available capacity at the newly commissioned Durham York Energy Centre and additional disposal capacity will have to be sourced for the Region's longer term needs. Figure 2-1 illustrates the potential growth of the Region's residential waste stream based on population projections and assuming no change in overall diversion performance over time.

b) Experience in Ontario and elsewhere clearly indicate the difficulties in achieving higher diversion from multi-family households, particularly SSO diversion. Multi-family households consistently demonstrate lower rates of recycling and SSO participation and material capture. As demographics shift there is a potential that the proportion of residential organic materials diverted from the waste stream could decline. New technological solutions related to mixed-material processing, which can extract the organic fraction for diversion may offer a reasonable solution.

1.3 Existing Region of Durham Organics Processing Contracts

The Region contracts the processing of SSO separately from LYW. Miller Waste has a 10 year contract for aerobic composting of SSO which ends on March 31, 2016. The SSO processing technology used by Miller is the Ebara wide-bed aerobic processing technology. Essentially the high-rate processing of organic material is completed at this facility, and from this site material is hauled to the Miller outdoor facility in Clarington for low-rate composting and curing. Regional staff have been authorized based on the approved recommendations of Report 2013-J-38, to negotiate an extension of the existing contract until the end of the Region's current business planning period (2018). Negotiations are ongoing.

The Region also holds a 5-year contract with All-Treat farms for additional processing capacity for SSO that began in 2009 with two additional one-year renewal terms, which would be fully-expired in 2016. SSO at this facility is composted using the Gore™ Covered System that involves forced aeration of covered windrows. Revenues from finished compost are retained by both contractors, the Region is provided with up to 500 tonnes annually of finished compost for its public Compost Giveaway events. The total contracted processing capacity for SSO is 40,000 tonnes.

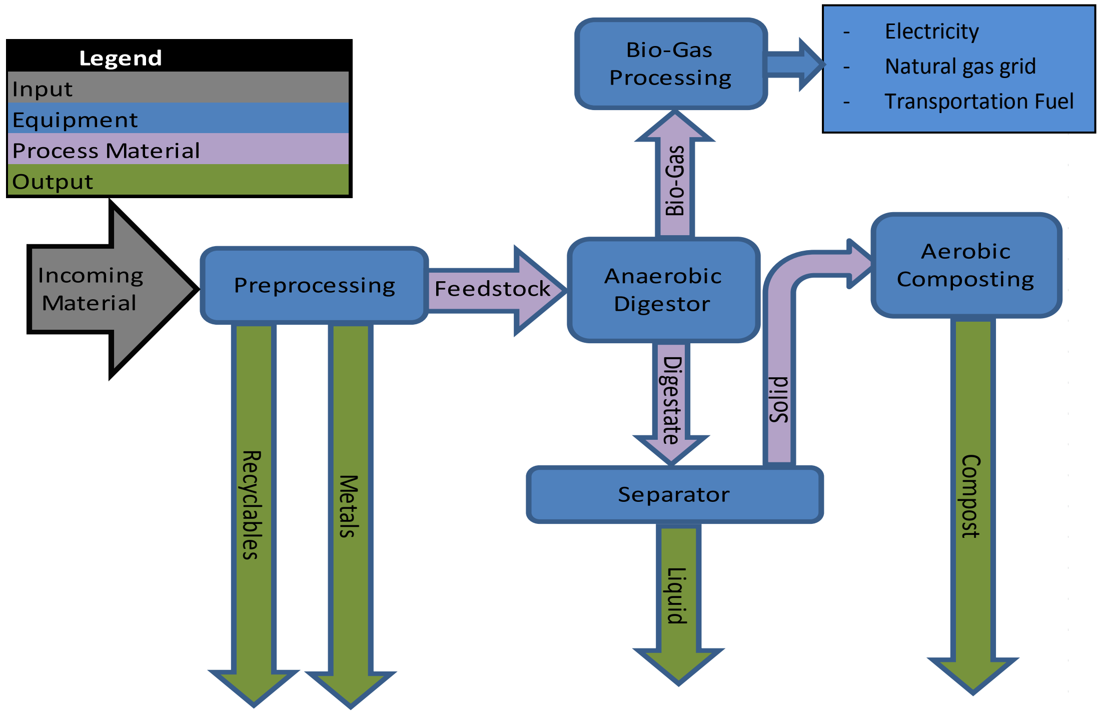
1.4 Overview of Anaerobic Digestion

The following provides a brief high-level overview of typical anaerobic digestion processes, including a generic flow diagram.

Anaerobic Digestion – Generic Description
Description: Anaerobic digestion (AD) is the biological decomposition of organic materials in the absence of oxygen under controlled conditions producing biogas (mostly methane, water, and carbon dioxide), some solid residues and impact liquids, and a reduced volume material. The reduced volume material is then undergoes aerobic composting to produce a soil amendment.
Inputs: Waste streams with high organic content (e.g. source separated organics, segregated Industrial, Commercial & Institutional (IC&I) organics such as agricultural and food processing wastes, biosolids
Outputs: Compost, biogas (e.g. can be used as fuel for electricity generation and/or heating), liquid wastes, solid residue
Size: Unit sizes for an AD process can range from pilot and demonstration-scale facilities (<25 tonnes per day (tpd)) to as large as 900 tpd facilities.
Status: Proven. AD is widely used on a commercial-basis for organic wastes, such as source separated organics (SSO), agricultural wastes, food wastes and biosolids. There have been commercial-scale applications of processing organic wastes using AD in North America. The City of Toronto has been utilizing this technology for many years and is in the process of commissioning their second facility.
Commercial Considerations: AD facilities require anywhere from two to 10 hectares of land, depending on the design throughput of the facility. Utility requirements include water and power and possibly sewer. Marketability of compost depends on local conditions, compost quality, and availability of competitive alternatives.
Environmental Implications: The largest environmental impact associated with AD technologies is odour. The impact of odour is mitigated through design considerations and operational controls. Air emissions are minimal. Some solid residue requiring disposal is produced.

Anaerobic Digestion – Generic Description
Types of AD: Generally, there are two types of AD processes; wet AD and dry AD. Wet AD involves adding moisture to the feedstock to create a low-solids solution (typically around 5% solids) which is pumped to digestion tanks. Dry AD can either be undertaken by adding less moisture to the feedstock to create a slurry of around 20% solids or more which is pumped to digestion tanks or alternatively even less moisture is added and the material is managed through more of a batch process where material is loaded into individual vessels, a liquid solution is applied to the pile at regular intervals and the material undergoes processing for a set time (e.g. 28 days).
Process Overview: First, incoming material requires separation to remove the inorganic fraction before entering the AD vessel. Sorting can involve a variety of technologies including screens, air classifiers, and magnets. After sorting, the remaining organic material is typically reduced to a smaller and more consistent size with a shredding machine. The resulting AD feedstock is then typically mixed with water, but not necessarily, before entering a digester vessel. The lack of oxygen in the vessel allows specific microorganisms (anaerobic) to grow, reproduce, and break down the organic fraction of the waste. Conditions within the vessel are kept optimal for process efficiency, but the process occurs naturally. The material remains in the sealed vessel until microorganisms have completely, or nearly completely, degraded the organic fraction. The resulting products are a solid digestate material, liquid, and biogas consisting mainly of methane and carbon dioxide. The low- to mid- energy content biogas can be utilized in a reciprocating engine or gas turbine to produce electricity, it can be cleaned and put into the natural gas network, or it can be compressed into a vehicle fuel. The solid and liquid fraction may then enter a separator, depending on the liquid content, where the liquid fraction is pressed out of the solid fraction. The requirements for separation depend on the moisture content required for the process and the type of solid/liquid product which is generated. The liquid fraction is either used in the process again, marketed as a fertilizer depending on the quality, or disposed of in a sanitary sewer. The remaining solid material can be treated further with aerobic composting to produce compost that can be marketed as a soil amendment. Before marketing the soil amendment, additional screening is often required to remove contaminants such as small bits of plastic and other impurities.

Anaerobic Digestion – Generic Description



Strengths: Proven, wide range of facility sizes, minimal air emissions, marketable products, well suited for processing SSO

Weaknesses: Odour management is necessary, requires specific type or pretreatment of feedstock to ensure high organic content and minimal contaminants

Diversion: Contributions to diversion include metals and recyclables recovered from pre-processing and finished compost product

Estimated Costs: The capital costs associated with implementing an AD process are in the order of $200,000 to $300,000 per daily tonne of feedstock throughput capacity installed. Operating and maintenance (O&M) costs are highly variable depending on the facility size and type of process.

2 Tonnage Projections

To support the Organics Plan, HDR has developed population and residential waste projections to 2041 using information supplied by the Region of Durham and through sources found on the internet.

The following documents were used to support the development of the population and organic waste projections:

- Region of Durham, Large Blue Box Container Study / Waste Audit (AET Group Inc.) - 2011
- Region of Durham, Multi-Residential Waste Composition Study (AET Group Inc.) – 2013
- Region of Durham Annual Report 2011
- Region of Durham Annual Report 2013
- Growth Plan for the Greater Golden Horseshoe, Updated Forecasts, by Hemson Consulting, November 2012.

Estimates for population growth in the Region were applied to the quantities of waste generated in single family and multi-residential homes in order to estimate future quantities of waste requiring management. HDR used information from the Growth Plan for the Greater Golden Horseshoe, Updated Forecasts, by Hemson Consulting, November 2012[4] which provided low and high estimates of population for Durham Region in 5 year intervals to 2041. This was presented previously in Figure 1-1.

Table 2-1 presents the tonnes of residential waste managed in 2011 and Table 2-2 presents the tonnes of waste managed in 2013 as documented in the Region of Durham Annual Reports for 2011 and 2013.

While 2014 year end waste quantity data is available, the most recent Durham Region waste audit data available for the development of detailed projections for additional organics and recyclables diversion were the single family Large Blue Box Container Study / Waste Audit completed in 2011 and the Multi-Residential Waste Composition Study in 2013, and thus the material quantities from these years were used to develop the baseline estimates.

Results of the Multi- Residential Waste Composition Study were used to estimate the quantities of organic waste and recyclables in Multi-Residential waste as presented in Table 2-3.

Results of the Large Blue Box Container Study / Waste Audit were used to estimate the composition of organic waste and recyclables in single family residential waste. That audit consisted of two seasonal audits, one held in June 2011 and the other in November 2011. For the purposes of estimating organic waste and recyclables generated in single family residences, the audit results were averaged as presented in Table 2-4. The percent composition of organic waste present in the various waste streams was applied to the 2011 waste quantities managed (see Table 2-1) to calculate the tonnes of organic waste potentially available in single family waste (i.e. in garbage, and recycling). The estimated tonnes of organic waste available from single family homes are presented in Table 2-5.

For baseline comparison, projections were developed for the overall residential waste stream for the period up to 2040, for the high and low population forecast. Figures 2-1 and 2-2 present the estimated quantities of residential waste generated, diverted and disposed in the Region based on existing programs under the high and low population forecasts. These estimates assume no change in

[4] http://www.hemson.com/downloads/HEMSON%20-%20Greater%20Golden%20Horseshoe%20-%20Growth%20Forecasts%20to%202041%20-%20Technical%20Report%20-%20Nov2012.pdf

performance for the existing waste diversion programs in the Region and no additional/new diversion initiatives over the planning period. These estimates demonstrate that:

a) With high population growth, and assuming that the overall residential diversion rate remain in the order of 53% to 55%, the amount of residential curbside garbage and apartment waste will exceed the 110,000 tonnes per year (tpy) of Durham's capacity at DYEC in approximately 2021 and under low population growth in approximately 2023.

b) The total quantity of residential curbside garbage and apartment waste is anticipated to increase to between 168,000 and 203,000 tonnes as of 2041. Bulky waste quantities are anticipated to increase to between 37,000 and 45,000 tonnes.

c) The Region would have to divert up to an additional 60,000 to 93,000 tonnes of material each year, to stay within the available capacity at DYEC for curbside garbage and apartment waste as of 2041 (this assumes that bulky waste would be disposed through other means). This would require the addition of new diversion programs, maximizing material capture through existing programs and/or processing of the curbside garbage and apartment waste to divert materials.

Figure 2-1 Residential Waste Projections: High Population Growth, Status Quo Diversion

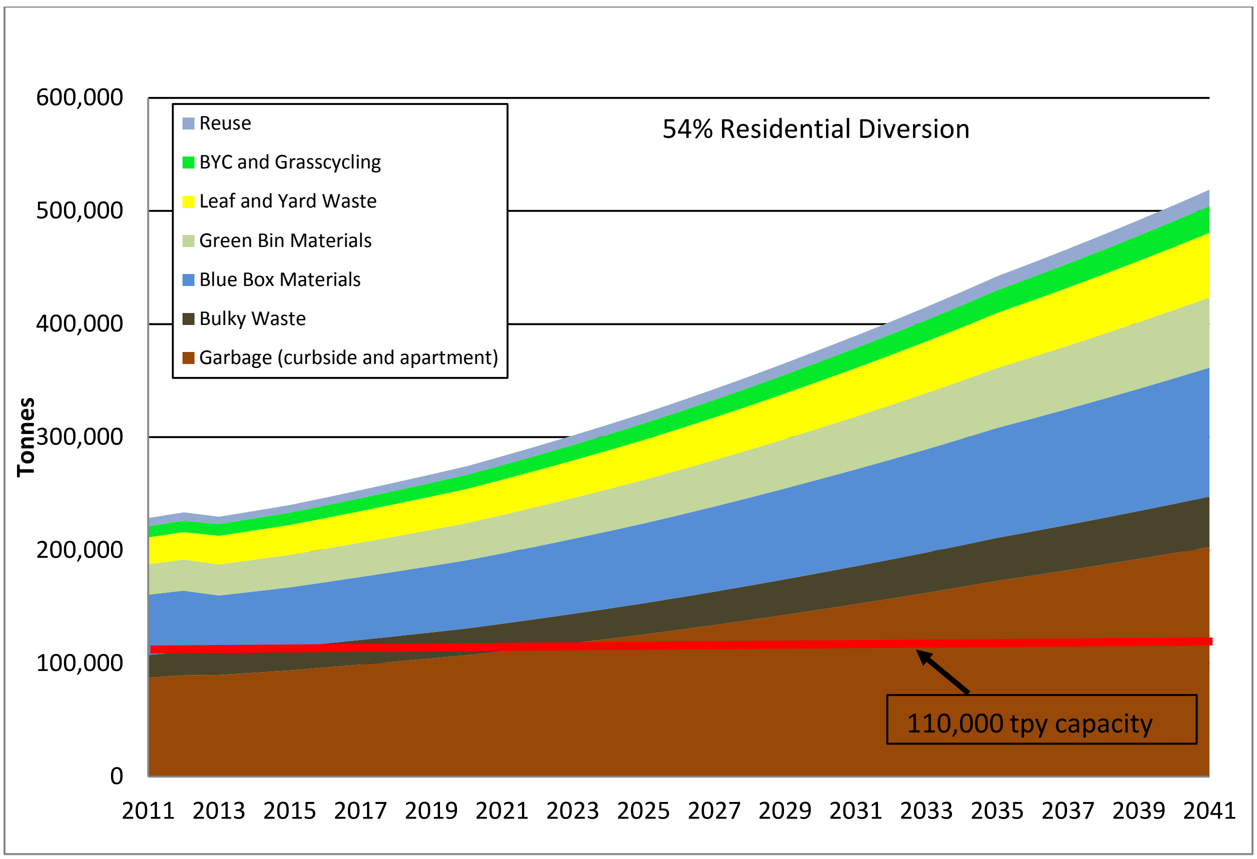
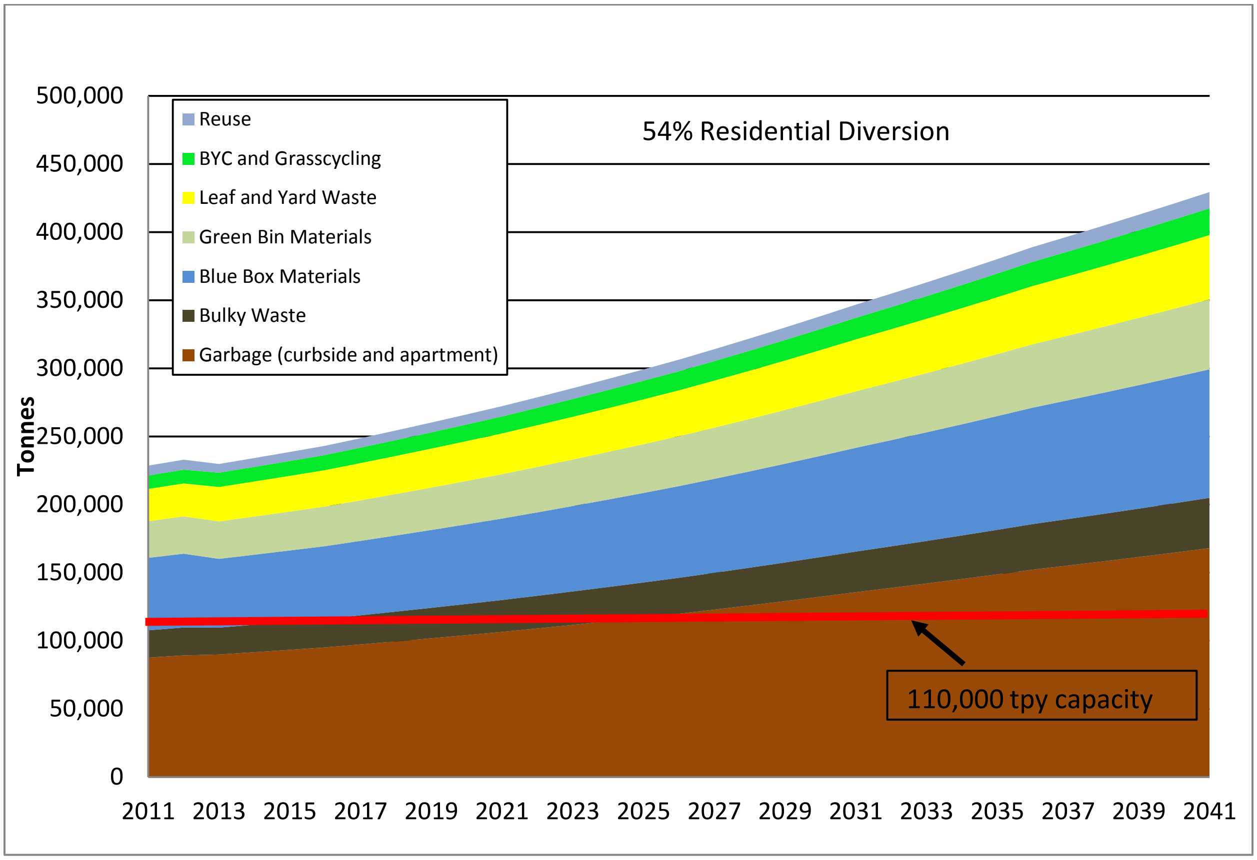


Figure 2-2 Residential Waste Projections: Low Population Growth, Status Quo Diversion



HDR used the following assumptions to estimate future quantities of additional organics and recyclable materials that could be diverted either through adjustments or improved performance of the existing Green Bin or blue box program, or through processing of residential garbage:

1. For the purposes of these projections, the organic waste materials examined, consisted primarily of food waste (Green Bin material including food waste, compostable paper fibre, houseplants) and pet waste. Pet waste is currently not included within the residential Green Bin program. The pre-feasibility study concluded that there may be an opportunity to incorporate pet waste into the SSO stream regardless of processing technology. In the event that some form of mixed material pre-processing is undertaken, an estimated recovery rate of 85% by weight was assumed.

2. Leaf & Yard waste (LYW) was not included in the organic waste material projections as the majority of LYW is collected and processed separately from the Green Bin materials. It is anticipated that LYW would continue to be collected and processed separately from the organic material destined for AD processing.

3. The pre-feasibility study concluded that diapers and sanitary products should not be added to the SSO program as this material stream contributes little to AD performance. No capture of this material stream was assumed for the Green Bin program. However, in the event that some form of mixed material pre-processing is undertaken, some of this material stream may contribute to

the organic mass recovered. An estimated recovery rate of 25% by weight of diapers and sanitary paper products was assumed for mixed waste processing technologies.

4. Total quantities of organic waste potentially available in the Green Bin, garbage and recycling were based on 2011 data and increased by the annual change in population.
5. Estimated quantities of Green Bin food waste captured were based on 2011 data for single family homes, with a capture rate increasing by 1% annually from 61% to 70% in 2020 which was assumed to be the highest capture rate achievable. In order to achieve increases in capture rates for the single family sector, the Region will have to sustain or increase public education and promotion of the organics program. Low Projections were also developed assuming no change in the single family capture rate for Green Bin material of 61% over the planning period.
6. The Region has two alternatives for diverting organic materials from multi-family units:
    - A Green Bin program could be rolled out to multi-residential buildings at the earliest by 2018. Organic material capture rates for multi-residential programs are typically much less than for the single family sector and are difficult to sustain over time. The maximum capture rate for multi-family Green Bin organics would be 35% at the start of a program, increasing to a possible maximum of 50% capture rate over time with a significant level of promotion by the Region and involvement of building owners/managers. It is estimated that between 1,500 (as of 2017) and 4,600 tonnes per year (as of 2041) of organic material could be recovered from a multi-family Green Bin program. To achieve these results the Region would have to implement a significant (and costly) comprehensive organics promotion and education program for the multi-family sector.
    - Multi-family waste could be processed to extract the organic fraction in lieu of source separated diversion. For mixed waste processing, an 85% extraction rate can be assumed for typical green bin material and pet waste, with the remaining 15% being non-extractable or lost to evaporation. A 25% extraction rate would apply to diapers and sanitary products. Under these assumptions, between 4,700 (as of 2017) and over 9,500 (as of 2041)tonnes per year of organic material could be recovered from the multi-family sector.
7. In order to reflect the potential for mixed material processing to extract additional organics from residential garbage, quantities of Green Bin material potentially available from processing mixed waste were calculated by subtracting the amount of Green Bin material captured through the Region's Green Bin program from the total quantities of Green Bin organic waste potentially available. For mixed waste pre-processing, an 85% extraction rate was assumed for green bin material and pet waste with the residual being non-extractable, or lost to evaporation etc. A 25% extraction rate was assumed for diapers and sanitary products.
8. In order to reflect the potential for mixed material processing to extract additional recyclables from residential garbage, quantities of recyclable materials potentially available from processing mixed waste were calculated by subtracting the amount of recyclables captured from the Blue Box program from the total quantities of recyclables potentially available based on the single family 2010 audit and the 2013 multi-family audit. Note: based on these audits, PET, HDPE, Ferrous Metals and Aluminum made up 2.75% of the single family garbage, and 3.14% of the multi-family mixed waste. An 85% extraction rate for PET, HDPE, Ferrous Metals and Aluminum left in the mixed waste was assumed for a mechanical sorting system.

Projected material quantities for the period up to 2041 were developed for the high and low population forecasts assuming mixed waste processing was integrated into Durham Region waste system as of 2018, processing all mixed waste produced by single family and multi-family residences in the Region (Figures 2-3 and 2-4).

Figure 2-3 Residential Waste Projections: High Population Growth, Mixed Waste Processing

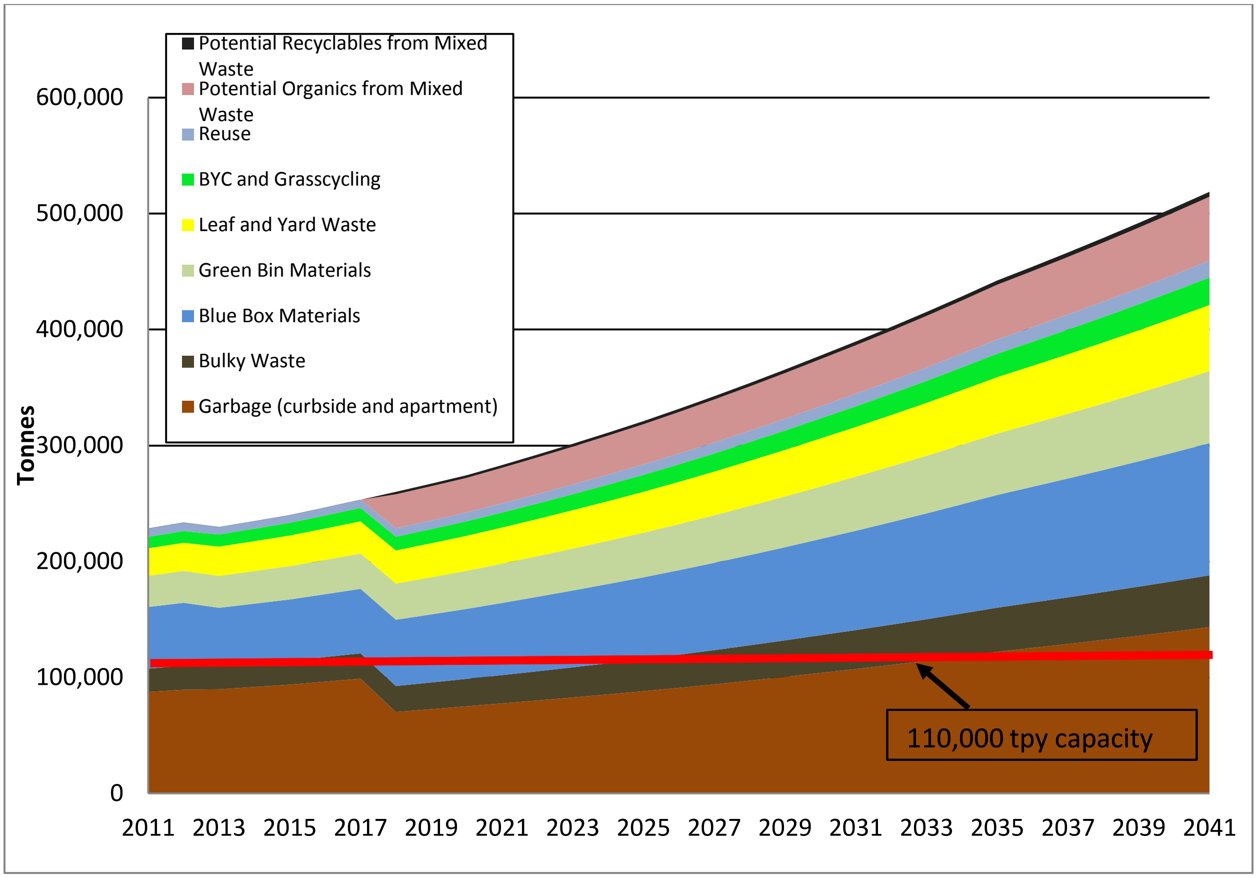
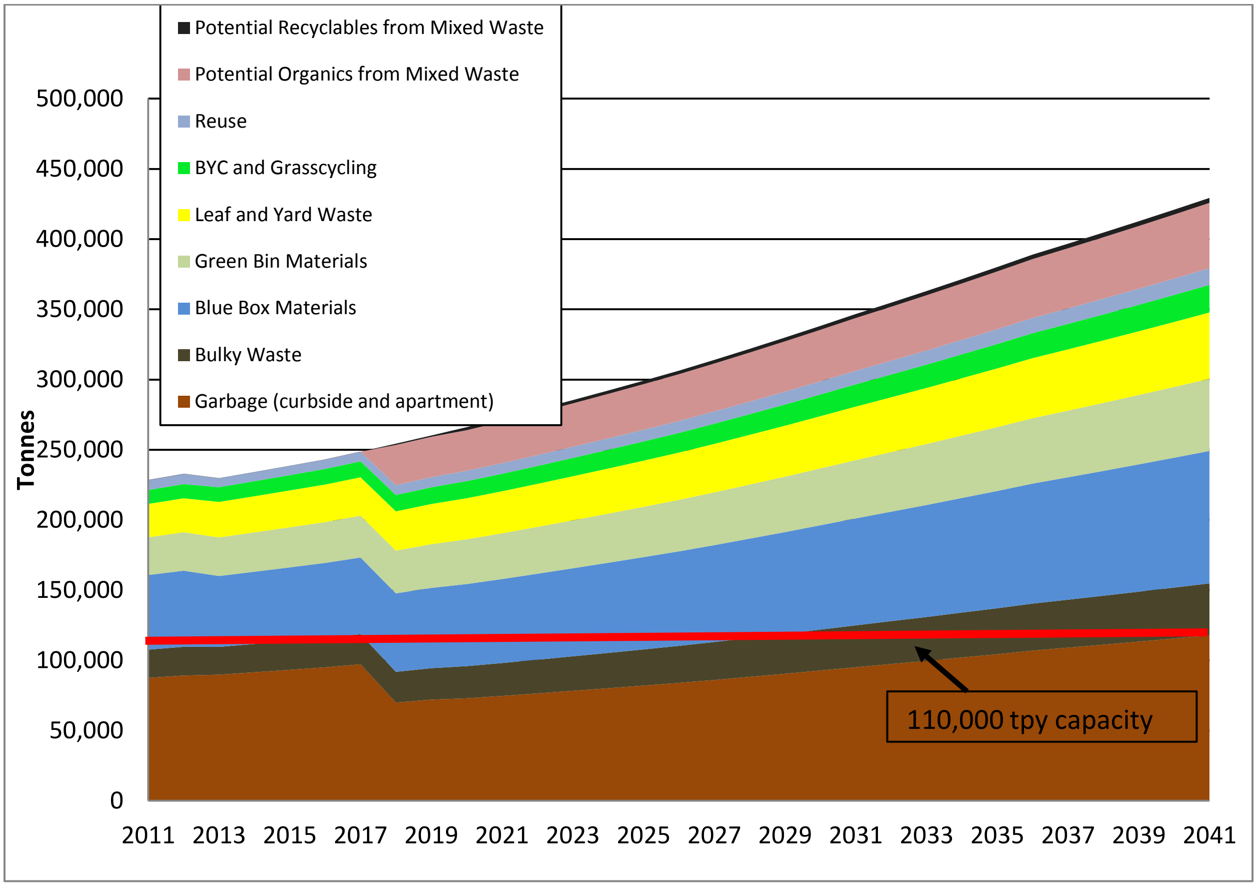


Figure 2-4 Residential Waste Projections: Low Population Growth, Mixed Waste Processing



Tables 2-6 and 2-7 present the estimated quantities of organic materials potentially available for processing for the high and low population estimates respectively, for both source separated organics and potential materials that could be extracted through processing of the mixed waste stream.

Tables 2-8 and 2-9 present the estimated additional quantities of organic and recyclable materials potentially recovered for the high and low population estimates respectively, assuming processing of the mixed waste stream.

The estimates indicate:

a) Processing of the mixed residential waste stream has the potential to increase residential diversion by around 10% from 54%/55% as of 2015 to 65%. It has the potential to increase the total tonnes of residential waste diverted by 32,000 tpy or more.

b) In the near future (between 2020 and 2025) the total quantity of single family Green Bin material is likely to exceed the 40,000 tpy of processing capacity under current Green Bin processing contract. Longer term processing contracts for the period beyond 2018 should secure more than 40,000 tonnes per year of processing capacity.

c) Projected quantities of single family Green Bin organic material will not reach the point of achieving the 50,000 tonnes per year 'economy of scale' milestone for AD until past 2025. In order to implement a cost effective AD solution in the near future, some form of mixed waste processing to extract additional organic materials would likely be necessary. Processing of mixed waste to extract the organics fraction, has the potential to increase the tonnes of organics available for processing by an additional 30,000 tonnes per year or more over time, an increase of 43% in organics tonnage.

d) Projected quantities of recyclables recovered through mixed waste processing are fairly modest, 2,000 to 3,500 tpy, assuming only PET, HDPE, Ferrous Metal and Aluminum were recovered from the waste stream, as the fraction of these materials remaining in curbside garbage is quite low (2.75% of the single family garbage, and 3.14% of the multi-family mixed waste). Further analysis is required to confirm that the range and quantity of recyclables that could be recovered from mixed waste processing is sufficient to provide a business case to include the necessary equipment to recover these materials in a mixed waste processing facility.

e) Projected organic quantities recovered through a multi-family Green Bin program are substantially lower than the quantities that could be achieved through processing of mixed waste from the multi-family sector. At reasonably high capture rate assumptions, a multi-family Green Bin program would divert from 1,800 tonnes per year at inception up to 3,800 tonnes per year by 2040. Mixed waste processing of the multi-family stream has the potential to capture between 5,000 to 9,500 tonnes of organic material per year over the planning period, more than double the performance of a multi-family Green Bin program.

f) Under both Low and High population estimates and projections, it may be possible to secure a combined organic stream from the Green Bin and mixed waste processing that could achieve economies of scale for an AD solution. By 2020, 68,000 tonnes or more of organics suitable for AD processing could be made available through the combination of the single family Green Bin program and mixed waste processing.

g) Continuation of the single family Green Bin program will ensure that around 60% of the non-LYW organic material available for processing is relatively clean and suitable for AD or Aerobic processing with lower requirements for inorganic residue removal. Systems will be required to remove the inorganic residue present in the organic fraction recovered from the mixed waste stream.

h) Under the high population projection scenario, and assuming integration of mixed waste processing in the Region as of 2018, the quantity of garbage requiring disposal would not meet the 110,000 tpy of Durham Region capacity at DYEC until 2032. Note: this does not include bulky waste. Under the low population projection scenario, it would be 2038. This would present both a problem and opportunity to the Region as the Region has a commitment to provide 110,000 tpy of materials to DYEC, and an opportunity as the capacity not required by Durham Region could potentially be made available to others.

i) The outcome of the analysis noted above is based on the outcome of the 2011 single family and 2013 multi-family waste audits. Updated waste audit data is needed to refine these projections.

Table 2-1: Estimated Tonnes of Residential Waste Managed in 2011

2011	Curbside Garbage	Apartment Garbage	Bulky Goods	Curbside Recycling	Apartment Recycling	Food Composting	LYW	Backyard Composter Credits	Grasscycling Credits	Reuse Programs	Total Waste	Waste Diversion
SF Curbside & MFD Waste	73,776	13,798	1,717	50,354	2,200	26,865	22,149	5,789	4,097	85	200,830	56%
Regional Waste Disposal Sites			18,378	603			1,595		-	7,026	27,602	33%
Special Events										116	116	100%
Total	73,776	13,798	20,095	50,957	2,200	26,865	23,744	5,789	4,097	7,227	228,548	

Source: Region of Durham, Annual 2011 Report

Table 2-2: Estimated Tonnes of Residential Waste Managed in 2013

2013	Curbside Garbage	Apartment Garbage	Bulky Goods	Curbside Recycling	Apartment Recycling	Food Composting	LYW	Backyard Composter Credits	Grasscycling Credits	Reuse Programs	Total Waste	Waste Diversion
SF Curbside & MFD Waste	76,125	13,739	1,851	47,737	2,124	27,486	23,593	5,820	4,365	301	203,140	55%
Regional Waste Disposal Sites			17,926	604			1,675		310	5,988	26,503	32%
Special Events										96	96	100%
Total tonnes	76,125	13,739	19,777	48,341	2,124	27,486	25,268	5,820	4,675	6,385	229,739	

Source: Region of Durham, Annual 2013 Report

Table 2-3: Estimated Organic Waste Disposed in Multi-residential Waste (2013)

Stream	Sub-category	% of waste stream	Total Generated (based on 2013 year-end tonnages)
Garbage	Food Waste	30.34	4,168
	Yard Waste	4.97	683
	Pet Waste	5.02	690
	Diapers/Sanitary	5.61	771
	Tissue/Towelling	2.68	368
Recycling - Fibers	Food Waste	0.3	7
	Yard Waste	0.01	0
	Pet Waste	0	0
	Diapers/Sanitary	0	0
	Tissue/Towelling	0.05	1
Recycling - Containers	Food Waste	0.94	25
	Yard Waste	0	0
	Pet Waste	0.01	0
	Diapers/Sanitary	0.25	7
	Tissue/Towelling	0.11	3
Total Food Waste in Garbage + Recycling			4,200
Total Pet Waste in Garbage + Recycling			690
Total Diapers/Sanitary in Garbage + Recycling			778

Source: 2013 Multi-Family Waste Audit, Table 3-10, updated based on 2013 year-end tonnages.

Table 2-4: Estimated Organic Waste Remaining in Single Family Garbage Stream (2011)

	Garbage	
Average of June and November 2011 Audits	kg/wk	%
Food Waste	141.7	23.06
Pet Waste	69.2	11.25
Diapers & Sanitary	53.8	8.76
Molded Pulp	1.3	0.21
Total Organic (non Yard Waste) Material	**266**	**43.3**
Yard Waste	24.8	4.01

Source: Large Blue Box Container Study / Waste Audit (AET Group Inc.) - 2011

Table 2-5: Estimated Tonnes of Organics Available from Single Family Homes (2011)

Organic Material (SF only)	Tonnes
Green Bin Program	
Food waste	26,865
Garbage	
Food waste	17,009
Diapers	6,463
Pet Waste	8,296
Other Organic Material (molded pulp)	155
Total (not including diapers)	**52,325**

Source: Large Blue Box Container Study /
Waste Audit (AET Group Inc.) - 2011

Table 2-6: High Estimates of Available Organics (tonnes) – Based on High Population Projection, an increase in SF Organics Capture Rate to 70% as of 2020 and Mixed Waste Processing

	Green Bin Material Generated		Diapers Generated		Pet Waste Generated		Total Organic Material Generated (Green Bin material, diapers/sanitary, pet waste, other)		Projected SF Organics Captured by Existing Green Bin Program	Projected MF Organics Diverted if MFD Green Bin Program Implemented	Organics Potentially Extracted by Processing Garbage (85% of food and pet waste, 25% of diapers)		Total Organics Diverted if Mixed Waste Processing included in System	Total increase in Organics Diversion (tonnes) through Processing Garbage	% increase in Organics Diverted
	A	B	C	D	E	F	G=A+C+E	H=B+D+F	I =A x SF Capture Rate	J =B x MF capture rate	K=(((A-I) + E) x 0.85) + (C x 0.25)	L=((B+F) x 0.85) + (D x 0.25)	M=I+K+L	N = K + L	O = N / M
	SF	MF	SF	MF	SF	MF	SF	MF	SF	MF	SF	MF			
2015	51,951	4,773	7,056	805	9,057	721	68,064	6,299	33,768	-	-	-	-	-	-
2020	59,383	5,456	8,065	921	10,353	824	77,801	7,200	41,568	2,019	25,959	5,568	75,114	31,527	42%
2025	69,481	6,384	9,437	1,077	12,114	964	91,031	8,425	48,637	2,554	30,373	6,515	88,078	36,888	42%
2030	81,699	7,506	11,096	1,267	14,244	1,133	107,039	9,906	57,189	3,303	35,714	7,660	103,867	43,375	42%
2035	95,722	8,795	13,001	1,484	16,689	1,328	125,412	11,607	67,006	4,222	41,845	8,975	122,047	50,820	42%
2040	109,319	10,044	14,847	1,695	19,059	1,516	143,225	13,255	76,523	5,022	47,788	10,250	139,583	58,038	42%

Table 2-7: Low Estimates of Available Organics (tonnes) – Based on Low Population Projections, no increase in SF Organics Capture Rate (61%) and Mixed Waste Processing

	Green Bin Material Generated		Diapers Generated		Pet Waste Generated		Total Organic Material Generated (Green Bin material, diapers/sanitary, pet waste)		Projected SF Organics Captured by Existing Green Bin Program	Projected MF Organics Diverted if MFD Green Bin Program Implemented	Organics Potentially Extracted by Processing Garbage (85% of food and pet waste, 25% of diapers)		Total Organics Diverted if Mixed Waste Processing included in System	Total increase in Organics Diversion (tonnes) through Processing Garbage	% increase in Organics Diverted
	A	B	C	D	E	F	G=A+C+E	H=B+D+F	I =A x SF Capture Rate	J =B x MF capture rate	K=(((A-I) + E) x 0.85) + (C x 0.25)	L=((B+F) x 0.85) + (D x 0.25)	M=I+K+L	N = K + L	O = N / M
	SF	MF	SF	MF	SF	MF	SF	MF	SF	MF	SF	MF			
2015	51,309	4,773	6,969	805	8,945	721	67,223	6,299	33,351			-	-	-	-
2020	57,234	5,456	7,773	921	9,978	824	74,985	7,200	40,064	2,019	25,019	5,568	67,102	30,587	46%
2025	64,342	6,384	8,739	1,077	11,218	964	84,298	8,425	45,039	2,554	28,127	6,515	75,720	34,642	46%
2030	72,735	7,506	9,879	1,267	12,681	1,133	95,294	9,906	50,915	3,303	31,796	7,660	86,013	39,456	46%
2035	81,753	8,795	11,103	1,484	14,253	1,328	107,109	11,607	57,227	4,222	35,738	8,975	97,186	44,713	46%
2040	90,534	10,044	12,296	1,695	15,784	1,516	118,614	13,255	63,374	5,022	39,576	10,250	107,972	49,827	46%

Table 2-8: High Estimates of Organics and Additional Recyclables Recovered – Based on High Population Projection, an increase in SF Organics Capture Rate to 70% as of 2020 and Mixed Waste Processing

	Projected SF Organics Captured by Existing Green Bin Program	Organics Potentially Extracted by Processing Garbage (85% of food and pet waste, 25% of diapers)		Total Organics Diverted if Mixed Waste Processing included in System	Total increase in Organics Diversion (tonnes) through Processing Garbage	% increase in Organics Diverted	Total PET, HDPE, Ferrous and Aluminum Potentially Extracted from Garbage, 75% extraction rate		% increase in Recyclables diverted	Total Tonnes Diverted from Other Programs	Total Residential Waste Generated	Total Potential Diversion with Mixed Waste Processing
	SF	SF	MF				SF	MF				
2020	41,568	25,959	5,568	75,114	31,527	42%	1,872	386	4%	143,440	274,390	64.59%
2025	48,637	30,373	6,515	88,078	36,888	42%	2,190	452	4%	167,832	321,050	64.59%
2030	57,189	35,714	7,660	103,867	43,375	42%	2,575	532	4%	197,345	377,506	64.59%
2035	67,006	41,845	8,975	122,047	50,820	42%	3,017	623	4%	231,219	442,303	64.59%
2040	76,523	47,788	10,250	139,583	58,038	42%	3,446	711	4%	264,060	505,126	64.59%

Table 2-9: Low Estimates of Organics and Additional Recyclables Recovered – Based on Low Population Projections, no increase in SF Organics Capture Rate (61%) and Mixed Waste Processing

	Projected SF Organics Captured by Existing Green Bin Program	Organics Potentially Extracted by Processing Garbage (85% of food and pet waste, 25% of diapers)		Total Organics Diverted if Mixed Waste Processing included in System	Total increase in Organics Diversion (tonnes) through Processing Garbage	% increase in Organics Diverted	Total PET, HDPE, Ferrous and Aluminum Potentially Extracted from Garbage, 75% extraction rate		% increase in Recyclables diverted	Total Tonnes Diverted from Other Programs	Total Residential Waste Generated	Total Potential Diversion with Mixed Waste Processing
2020	40,064	25,019	5,568	67,102	30,587	46%	1,815	375	4%	139,110	266,106	64.59%
2025	45,039	28,127	6,515	75,720	34,642	46%	2,041	421	4%	156,387	299,156	64.68%
2030	50,915	31,796	7,660	86,013	39,456	46%	2,307	476	4%	176,787	338,179	64.77%
2035	57,227	35,738	8,975	97,186	44,713	46%	2,593	535	4%	198,705	380,107	64.86%
2040	63,374	39,576	10,250	107,972	49,827	46%	2,872	593	4%	220,048	420,935	64.94%

3 Anaerobic Digestion (AD) Technology Review

The Kelleher AD Pre-Feasibility Study conducted in 2013 provided technical information regarding the AD process, requirements for pre-treatment of AD feedstock, AD process design elements and AD technology vendors. The information as presented in that report, is consistent with the AD design and technical information held by HDR and applied in projects undertaken by HDR such as the completion of procurement and vendor selection for AD in the City of Surry B.C. and projects such as the Zero Waste Energy facility in the City of San Jose California. The information in the pre-feasibility study can continue to inform the development of the Organics Plan as background information.

In the two years since 2013, there has continued to be growth in the development of AD processing capacity in North America and Europe, and there continues to be flux in the design and success of mixed waste processing approaches, organic material pre-processing and AD processes as well as changes in the activities/interests of technology vendors within North America.

In order to develop an updated body of information to support Durham's Organics Plan, the Region with assistance from HDR developed and issued Request for Information #677-14 to determine both applicable technologies and vendor interest in future development of organics diversion capacity in the Region.

3.1 Request for Information

The Regional Municipality of Durham (the Region) issued a Request for Information for Organic Technologies (RFI-677-2014) in October, 2014 (Appendix A). The RFI was issued to gather information from vendors about options for diverting organic materials; and potentially other materials from waste generated in the Region.

In addition to being able to manage the current stream of source separated organics (SSO) currently diverted from single family households; the Region indicated interest in technologies that could divert an expanded stream of organics (e.g. diapers, pet waste). Of particular interest are those technologies capable of processing mixed waste or heavily contaminated source separated organic waste from multi-family (MF) buildings. Waste diversion from MF buildings is problematic due to physical constraints, contamination, and lack of participation/understanding of the program by management and residents. Additional diversion of waste, particularly organics, from both the single family and multi family residential sectors has potential to recover additional material (e.g. recyclables, organics) and potentially energy and would make a significant contribution to the Region's goal of increasing waste diversion rates and avoiding/reducing the need to find additional residual disposal capacity beyond that available at the Durham York Energy Centre.

Eleven responses to the RFI were received from vendors of aerobic composting and anaerobic digestion (AD)processing technologies, mixed waste processing technologies and other technologies which could increase the diversion of organic materials. Table 3-1: presents a summary of the technology providers, the type of technologies they can provide (aerobic composting, anaerobic digestion, mechanical-biological treatment (MBT) or a combination thereof), if they have a proprietary preprocessing technology and where their reference facilities are located. Additional details on the RFI submissions can be found in Appendix B.

Table 3-1: Summary of RFI Submissions

Technology Provider	Aerobic Composting	Anaerobic Digestion	MBT	Preprocessing Technology
Lafleche Environmental	✓ Ontario			
Aim Environmental Group	✓ Ontario	✓		
Veolia Water Solutions and Technologies Canada	✓	✓Germany		
Orgaworld Canada Ltd.	✓ Ontario	✓ Netherlands	✓ United Kingdom	
Harvest Power Inc.	✓	✓ Ontario		✓
CCI Bioenergy		✓ Ontario		
CHFour Biogas		✓ Ontario		
Organic Waste Systems		✓ Belgium, Germany, Netherlands		
Anaergia, Inc.		✓ England, Latvia, Germany, Italy		✓
Miller Waste Systems		✓ Germany, Austria		✓
3WAYSTE	✓		✓ France	✓

All technology providers, with one exception, provided reference information for facilities processing a similar feedstock as proposed by the Region (SSO, MSW or both) which process 25,000 metric tonnes per year or more of material. The two reference facilities identified by CHFour Biogas were significantly smaller facilities, and processed a different feedstock than the Region's.

It should be noted that AD is typically followed by aerobic composting of the solid portion of the digestate that remains; most technology providers referenced some sort of aerobic composting process for digestate; however, this was not considered the same as aerobic composting of SSO.

The submission from Lafleche Environmental provided information about aerobic composting at their facility located in Moose Creek which is capable of processing an expanded SSO stream. The submission from Aim Environmental Group referenced their aerobic composting facilities in Hamilton and Guelph. Their brochure, included in the submission, indicated they also have experience with AD, however; no other details were provided. It is assumed that aerobic composting was the technology being proposed for the Region. Similarly, Orgaworld indicated they have experience with both AD and aerobic technologies and proposed a trial at their aerobic composting facility in London. They indicated that if the trials were successful, local tunnel composting facilities could be designed and constructed.

The remainder of the submissions proposed some sort of anaerobic digestion technology as the primary processing technology to manage the Region's organic waste. Wet AD technologies were proposed by CCI Bioenergy (BTA), CHFour Biogas, Anaergia (OREX), Miller (FITEC). Dry AD technologies were proposed by Veolia (Kompogas), Organic Waste Systems (Dranco).

Mixed waste processing technologies (MBT) were proposed by 3WAYSTE and Orgaworld for MSW although some technology providers indicated that their technologies could be used at mixed waste processing facilities (e.g. Anaergia).

Harvest Power did not propose any one technology for the Region; their response indicated experience with both wet and dry AD as well as aerobic composting. Harvest Power is not affiliated with any particular technology; they indicated they can match technology to meet individual needs of their clients.

In general, the majority of technologies proposed, particularly the AD technologies, indicate that they are able to manage either an expanded SSO stream and/or highly contaminated waste streams. Although the aerobic composting technologies can manage an expanded SSO stream, management of highly contaminated waste streams through aerobic composting would be more problematic in our experience. Many of the technology providers indicated that they have specialized pre-processing technologies to manage contamination and/or packaged goods in the waste stream. Harvest Power uses the Doda Bio-separator. Two submissions provided details on extrusion-like processes to separate out organics; Anaergia uses the OREX system and Miller Waste's FITEC system uses a Biosqueeze process. The submission from Miller Waste also provided additional options to divert additional organic materials; primarily through the use of a tri-sorter system which could be installed in multi-residential buildings, potentially increasing the amount of material diverted and energy recovered and potentially at a significantly greater system cost.

Based on the review of the submissions, the following Table 3-2 outlines HDR's recommendations for those technologies that were carried forward for further consideration by the Region, and included in a facility tour to collect additional information. The criteria/considerations used to identify the need for additional data collection through a technology tour included:

a) Is there a unique aspect of the technology that cannot be clearly understood based on the current and accessible facilities/processes located in Ontario or surrounding states/provinces?
b) Is the technology provider less established in North America, such that access to information regarding the technology/facility would be difficult through any other means outside of a facility tour?
c) Are there aspects of the technology/facility that should be better understood beyond the written materials provided in the RFI, in order to be able to develop technical RFP specifications that are able to assess/evaluate the application of the technology in Durham Region?
d) Are the reference facilities accessible so as to undertake an efficient/cost effective tour, making the best use of Regional time and resources?

Note in many cases a tour of specific reference facilities was not recommended as the technology proposed was already clearly understood by the Region and HDR. The choice to undertake a tour of any given facility would not influence consideration of the vendor/technology through any future procurement (RFP) process.

Table 3-2: Summary of RFI Recommendations

Technology Provider	Aerobic Composting	Anaerobic Digestion	MBT	Preprocessing Technology	Recommendations
Lafleche Environmental	✓ Ontario				• Retain on a list of potential aerobic technology providers • No tour of the Ontario facility is required to address current information needs
Aim Environmental Group	✓ Ontario	✓			• Retain on a list of potential aerobic technology providers • No tour of the Ontario facility is required to address current information needs • No specific AD facility has been identified
Veolia Water Solutions and Technologies Canada	✓	✓Germany			• Retain on a list of potential aerobic and anaerobic technology providers • Could include German AD facility in facility tour pending itinerary and schedule
Orgaworld Canada Ltd.	✓ Ontario	✓ Netherlands	✓ United Kingdom		• Retain on a list of potential aerobic and anaerobic technology providers • Could tour existing facilities in Europe to obtain additional information to consider regarding the ability of this facility to pilot dry AD for the Region • Could include Netherlands AD and UK MBT facilities in facility tour pending itinerary and schedule
Harvest Power Inc.	✓	✓ Ontario		✓	• Retain on a list of potential aerobic and anaerobic technology providers • Could tour existing facility in London to obtain additional information regarding their operations in Ontario. However this information would be limited as the London Ontario facility does not accept materials with similar contamination rates as potential Durham SSO materials.

Technology Provider	Aerobic Composting	Anaerobic Digestion	MBT	Preprocessing Technology	Recommendations
CCI Bioenergy		✓ Ontario			• Retain on a list of potential anaerobic technology providers • Could tour existing facility in Toronto to obtain additional information regarding their operations in Ontario. While members of the Durham Region staff are familiar with CCI and the older CCI facilities in Ontario, a tour of the new Disco facility would allow for viewing operations post-commissioning of the new plant.
CHFour Biogas		✓ Ontario			• Retain on a list of potential anaerobic technology providers – however it should be noted that this company has no direct experience with SSO similar to Durham, and does not currently have experience with operating plants of sufficient capacity for the Region's needs. • No tour of the Ontario operations of CH Four is recommended at this time, as the nature of the operations does not align with the Region's needs.
Organic Waste Systems		✓ Belgium, Germany, Netherlands			• Retain on a list of potential anaerobic technology providers • Include one or more OWS European facilities on a facility tour. Would be helpful to tour facilities with which both HDR and Durham region team members are familiar, to observe the state of these existing facilities in the seven years since the last time these facilities were observed.
Anaergia, Inc.		✓ England, Latvia, Germany, Italy		✓	• Retain on a list of potential anaerobic and pre-processing technology providers • Include one or more Anaergia European facilities on a facility tour.

Technology Provider	Aerobic Composting	Anaerobic Digestion	MBT	Preprocessing Technology	Recommendations
Miller Waste Systems		✓ Germany, Austria		✓	• Retain on a list of potential anaerobic and pre-processing technology providers • Include one or more European facilities on a facility tour.
3WAYSTE	✓		✓ France	✓	• Retain on a list of potential aerobic, MBT and pre-processing technology providers. • Include French facility on a facility tour.

3.2 Organic Waste Processing Facility Tour

In person investigations were recommended for specific facilities/technologies, as determining the potential suitability of the various technologies to meet the Region's needs requires more than a review of documents submitted by the technology vendors. It required examination of the facilities that have been identified as being similar to that which would suit the Region including observations of the feedstocks processed, the operations of the facilities and the success of these facilities in managing materials with contamination rates similar to those identified by the Region, discussion with facility designers/developers/operators regarding their experiences, and observations regarding the finished products generated by these facilities.

This type of physical investigation is invaluable in regards to observing how these facilities interact with the local environment and community, including the odour management technologies and approaches that have been employed.

The following table summarizes the technologies and facilities identified for further investigation, and the itinerary followed by the Region.

The majority of the tour was completed between April 20th and 29th, 2015, with the final facility visit of the IREP facility in Montgomery Alabama completed on June 10th, 2015.

Table 3-3: Summary of Technologies and Facilities for which further Investigations were undertaken

Technology Provider	Processing Technologies	Preprocessing Technology	Facility Location	Recommendations Specific to Further Technology Investigations
Orgaworld Canada Ltd.	Aerobic Composting, Anaerobic Digestion	MBT	• SBI-Omrin, MBT and Dry AD Facility, Oudehaske, Netherlands (230,000 MTPY mixed waste processing, AD of organic fraction) • Owned and operated by Municipal Solid Waste Corporation (waste utility)	• Facility accepts and processes mixed solid waste – front end technology could be suitable for Regional MSW and/or processing highly contaminated SSO • Combination of dry sort facility followed by wet

Technology Provider	Processing Technologies	Preprocessing Technology	Facility Location	Recommendations Specific to Further Technology Investigations
				'washing' process to extract organic stream • Dry AD technology suitable for processing Durham organic material. No similar facilities operating in Canada – although similar AD technology is being developed for Surrey, B.C.
Organic Waste Systems (OWS)	Anaerobic Digestion		• Munster AD Plant, Munster, Germany (dry AD of organic fraction of MSW and industrial waste, processes 80,000 tpy of MSW, 38,000 tpy of organics sent to digester) • Owned and operated by Municipal Solid Waste Corporation (waste utility)	• Processes organic fraction extracted from residual MSW • Dry AD technology (DRANCO) suitable for processing Durham organic material. No similar facilities operating in Canada
Miller Waste Systems	Anaerobic Digestion	FITEC	• Rothmuhle Biogas Plant, Rothmuhle, Bergrheinfled, Germany (30,000 MTPY, FITEC pre-processing and wet AD process) • Owned and operated by Municipal Solid Waste Corporation (waste utility)	• Unique front end pre-processing unit and modifications to Wet AD process, no operating examples in North America • Designed to process highly contaminated organic streams
Anaergia, Inc.	Anaerobic Digestion	OREX	• Kaiserslautern facility, Kaiserlautern, Germany (uses OREX to extract organics from 100,000 MTPY of MSW) • Owned and operated by Municipal Solid Waste Corporation (waste utility)	• Unique front end pre-processing unit – no larger scale examples in operation in North America • Designed to process highly contaminated organic streams
Veolia Water Solutions and Technologies Canada	Anaerobic Digestion (Kompogas)		• Passau AD Facility, Aussernzell, Germany (39,000 MTPY green and biowaste, wet AD) • Owned and operated by Municipal Solid Waste Corporation (waste utility)	• More conventional front-end pre-treatment process • Horizontal Dry AD process, few examples of this type of AD in North America

Technology Provider	Processing Technologies	Preprocessing Technology	Facility Location	Recommendations Specific to Further Technology Investigations
3WAYSTE	Aerobic Composting, MBT	MBT	• ALTRIOM MBT Facility, Polignac, France (120,000 MTPY MBT process) • Contracted DBOOM by local Municipal Solid Waste Authority	• Recently commissioned • Next generation of Mixed waste processing facility • Unique and patented bag-breaker at front end for MSW • Successfully extracts organic fraction which is processed through aerobic composting and generates marketable product
Organic Waste Systems (OWS)	Anaerobic Digestion		• Chagny AD Plant, Chagny, France (dry AD, 81,000 MTPY of organic fraction of MSW and green waste) – southeast of Paris, south of Dijon • Owned and operated by Municipal Solid Waste Corporation (waste utility)	• Plant commissioned in spring 2015 • Most recent OWS digester installation • Front end MSW processing to extract organic fraction and additional recyclables
Bulk Handling Systems (BHS)	Aerobic Composting	MBT	• IREP Montgomery Plant, Montgomery, Alabama (MBT with aerobic processing of organic fraction • Owned and operated by private company, long term waste supply contract with Montgomery Alabama	• Most recent mixed waste processing plant in eastern US • New MBT equipment installed for MSW processing

3.3 Facility Details from Organic Waste Processing Facility Tour

The following section summarizes the key information gathered through the facility tour for each facility and provides representative photos of the facility components. Additional supporting documentation is provided in Appendix C.

3.3.1 Orgaworld: SBI-Omrin, MBT and Dry AD Facility

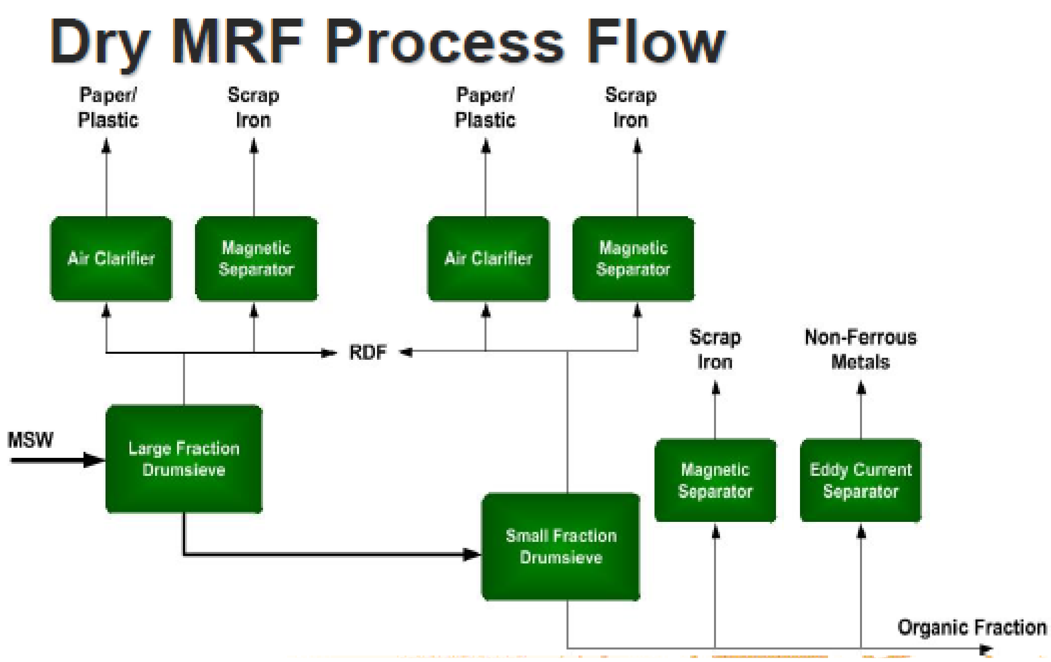
The following provides information and photographs of the SBI-Omrin facility.

SUMMARY Orgaworld: SBI-Omrin, MBT and Dry AD Facility
General Description: This facility processes 220,000 metric tonnes of mixed waste and commercial waste annually, through a mechanical/biological treatment (MBT) process using anaerobic digestion with biogas recovery to treat the organic fraction, and has been operating since 2002.
Ownership: Municipal Corporation, serves 26 Cities and municipalities in the Province of Fryslan
Location: De Dolten 11, 8465 SB Oudehaske, The Netherlands
Inputs: Mixed municipal solid waste (post recycling and green bin collection), commercial waste, green waste, organic waste
Outputs: 17,000 tpy Recyclables, 72,600 tpy liquid digestate/nutrient, 43,000 tpy mineral grit, 5.8 MW Electricity, Refuse Derived Fuel (RDF). AD generates 100 Nm3 biogas per input ton to digester. Approx. 15% of incoming material is recovered as recyclable, 12% is recovered as inert/grit material, 6% is recovered as biogas used to generate electricity, 25% is recovered as digestate which is dewatered and the solid digestate is combined with remaining 45% of incoming materials to become RDF.
Capacity: Demonstrated Operating Capacity: Tonnes per day (tpd): 635 MSW/544 AD; Tonnes per year (tpy): 218,000 MSW/113,000 AD
Site Size: 11 acres
Status: **Proven**. In continuous operation since 2002
Commercial Considerations: The SBI OMRIN Facility is governmental owned and utilizes the Omrin MBT technology. Omrin entered into a partnership agreement with Orgaworld which entitles Orgaworld to use the rights to market and use the Omrin technology. There is an economic incentive to recover recyclables with front end dry pre-processing – plastics market value between 400 and 900 euros/tonne ($600 to $1,340 CAD per tonne).
Environmental Implications: All site buildings have an air exchange rate of approximately 3 times per hour. The air refreshment helps reduce odour and dust levels inside as well as outside the buildings. The air is sucked in the ventilation system from various places inside the buildings, specifically areas near equipment and areas with higher dust and odour emissions, including the digester mixers, the process water tank, dewatering presses, washing screen, and the OWF storage hall. The ventilation system conveys all air from the Dry MRF area through a dust filter. The air from the wet MRF and anaerobic digestion system is treated in an organic media biofilter. This biofilter is a perforated and moistened media bed inoculated with bacteria that remove odorous compounds. Treated air is then vented into the atmosphere.
Type of AD: Wet AD, 12% solids, Thermophilic. Material is retained in digester for approx. 12 days. Within digester top mounted paddles mix material. A portion of liquid digestate is recirculated back to blend with new incoming feedstock. AD generates 100 Nm3 biogas per input ton to digester.

SUMMARY Orgaworld: SBI-Omrin, MBT and Dry AD Facility

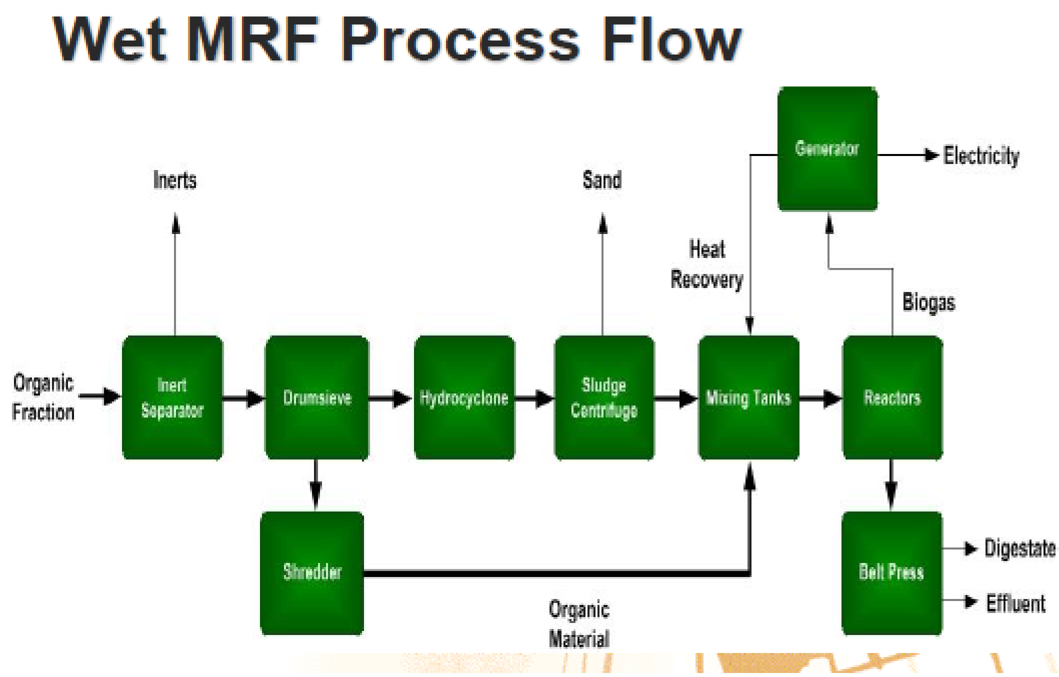
Process Overview:

DRY MRF – Incoming MSW is first processed in DRY MRF to recover recyclables, separate organic fraction for wet 'washing' and generate RDF. Major equipment includes: bag rippers, 200 mm drum screens, 65 mm drum screens, near infrared (NIR) sorting units, magnetic separators, ballistic separators.



Organic stream to wet 'washing' facility to prepare input stream to AD using: de-stoners, wash screens, vibrating screens, screw conveyors, hydrocyclone and a sludge centrifuge. Following AD the digestate is dewatered via a belt press.

SUMMARY Orgaworld: SBI-Omrin, MBT and Dry AD Facility



AD process and Biogas Treatment: Clean organic 12mm minus fraction processed through wet AD including: feed tanks, digester vessels, digestate/biogas buffer tanks, boilers, H2S scrubber/biogas dryers, blowers, CHP units (5) and flare. Digester vessel includes de-foaming system, nutrient and acid/base dosing system. Have plans to decommission the CHP units and install an upgrader to upgrade biogas to natural gas quality and inject into the grid, as this would recover higher value for the energy versus electricity generation.

Strengths: Proven technology. Facility appears to have minimal external air emissions. Marketable products are recovered. Overall system suited for processing MSW and recovering organic fraction for further processing.

Weaknesses: Odour management is necessary. Requires the Dry MRF pretreatment of feedstock to ensure high organic content in AD feedstock. Metals content in incoming organic feedstock is too high to generate marketable compost product, instead is dewatered and blended with other non-recyclable outputs from the Dry MRF to produce RDF.

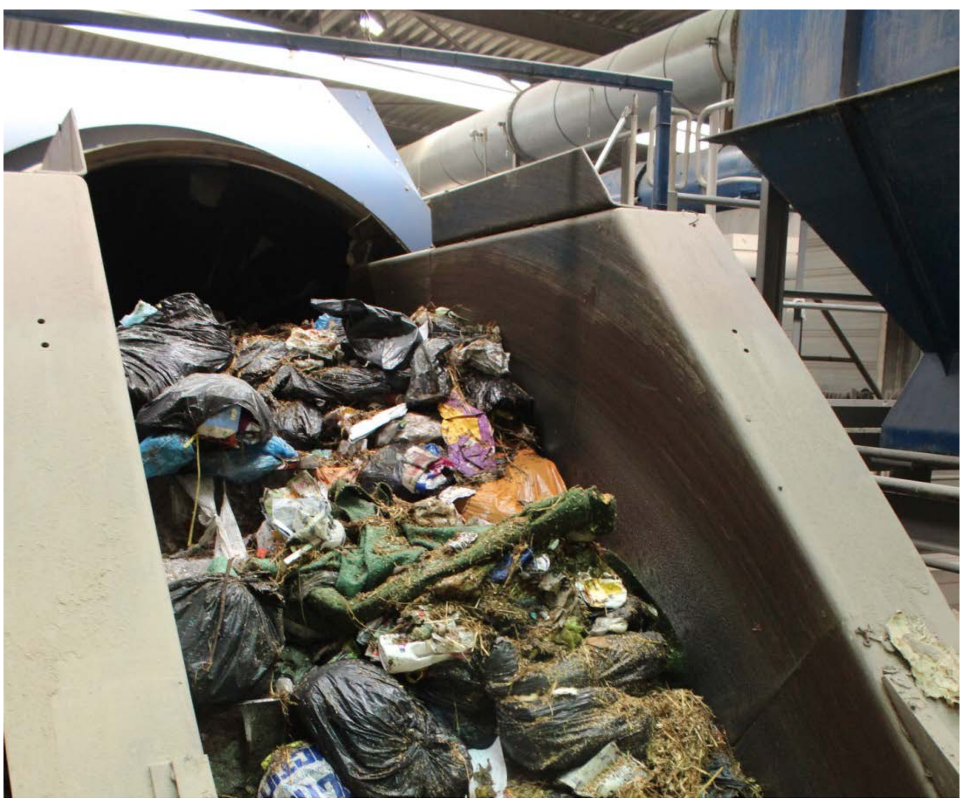
Diversion: Contributions to diversion include metals and recyclables recovered from pre-processing.

Estimated Costs: 90M euro (new) ($134 million CAD). Operate facility with 5 shifts, 9 staff/shift. Have not had any major equipment replacement/upgrades after 12 years of operation.

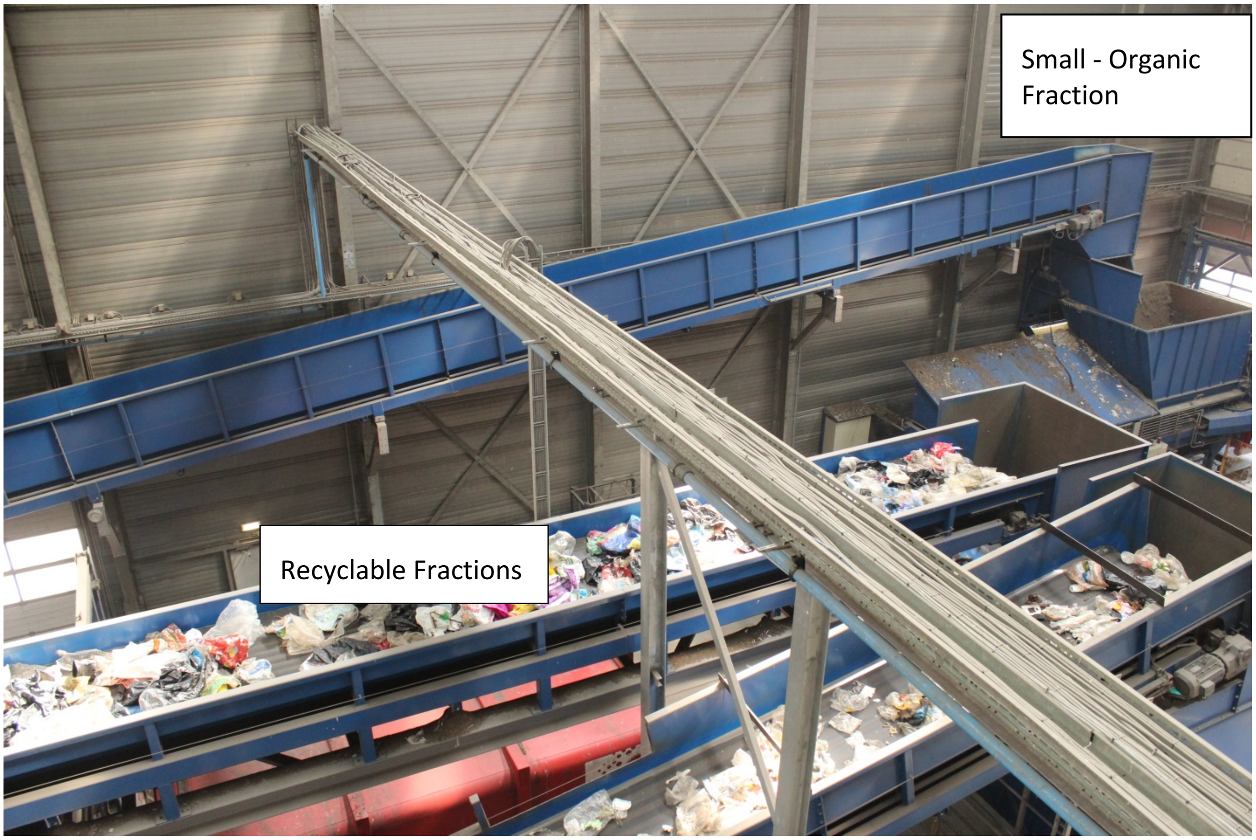
Figure 3-1 SBI-Omrin Photos

3-1-1 SBI-Omrin Samples of Recovered Recyclables

3-1-2 SBI Omrin: Incoming Material Stream, Entering Large Fraction Drum



3-1-3 SBI-Omrin: Dry MRF Process



3-1-4 SBI-Omrin: Small Organic Fraction from Dry Pre-processing

3-1-5 SBI-Omrin: Wet Organic Processing – Inert Separation

Applicability in Durham

The SBI-Omrin facility requires installation of a relatively complex suite of front end equipment to recover recyclable materials and an organic material fraction suitable for AD or composting. The size of the installation is not suitable for application within a constrained site, such as inclusion as part of a dedicated centralized Regional transfer facility. Market forces in Ontario do not offer the same value for recovered plastics, ranging from $301 to $458 for mixed PET from March 2014 to August 2015, and $513 to $751 for mixed HDPE, well below the $600 to 1,340 CAD per tonne applicable in the Netherlands, which would support a successful business case for such an installation. The wet processing of the organic fraction is also a relatively complex multi-step process, suitable for the front end of a wet AD facility.

3.3.2 Organic Waste Systems (OWS): Muster AD Plant

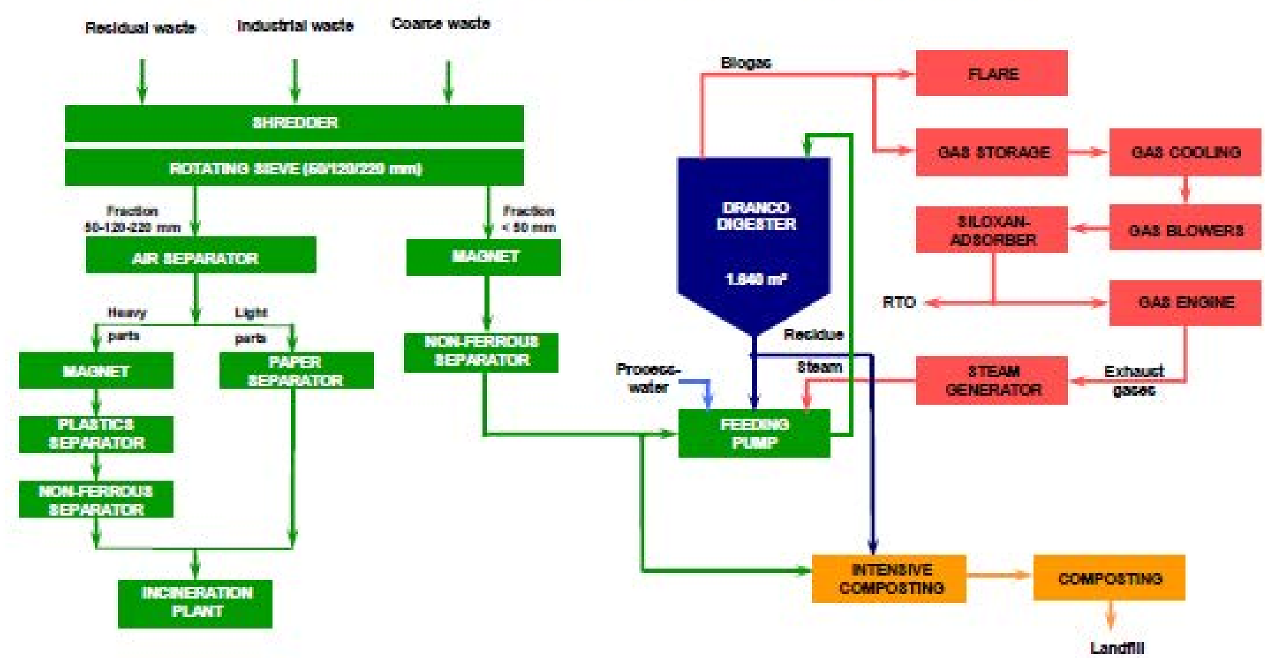
The following provides information and photographs of the OWS Munster AD facility.

Organic Waste Systems (OWS), Munster AD Plant
General Description: OWS DRANCO facility for the anaerobic digestion of 38,000 tonnes/year of the organic fraction from MSW. Biogas is used for electricity production, steam production and some biogas is used for the RTO on the site. Digestate is aerobically co-composted after being mixed with non-digested organic fraction (partial stream concept). A mechanical pretreatment system sorts out the “organic fraction” of the MSW.
Ownership: Municipal Corporation, REMONDIS GmbH & Co. KG
Location: Zum Heidehof 52, D-48157 Münster, Germany
Inputs: Mixed municipal solid waste (post recycling and green bin collection)
Outputs: Stabilized compost material is sent to landfill. Electricity (some steam and biogas used on-site). Biogas production 100 to 200 m3 of biogas per tonne of incoming waste. Recovers metals, plastics and RDF.
Capacity: 80,000 tpy MSW and industrial waste, 38,000 tpy to AD
Site Size: 1 acre for AD facility, size range for AD reactor of 1,640 m^3
Status: Proven. In continuous operation since March 2005. 2 years to construct.
Commercial Considerations: OWS was sub-contractor for design/build of the AD component of the facility, contract from 2004 to 2006. Facility is limited to producing only 500 Kwh of electricity, could produce up to 1 MW. Because of mixed waste origin of incoming material, compost digestate cannot be sold as compost – it is either land-applied or sent to EFW – no market value. OWS does not own/operate facilities. Contracts to design/build/maintain. Offers services to optimize AD reactor performance over the first few years of operation including regular weekly sampling and testing.
Environmental Implications: Odour management for incoming material pre-processing area, digestate management and aerobic composting. Can’t market finished compost, sent to landfill as cover.
Type of AD: < 55 mm particle size from pre-processing directed to AD. Dry AD, average solids between 18% and 40%. Average retention time 20 to 30 days. Single Phase Thermophilic process, 48 to 57 degrees C (achieves pathogen kill).

Organic Waste Systems (OWS), Munster AD Plant

Process Overview:

Pre-processing: incoming residual waste, industrial waste, through rotating sieve to separate large and small <50mm fraction (organics). Recovery of plastic, metals, paper – majority of materials used to generate RDF. Larger organic fraction directed to aerobic composting, smaller fraction to AD.



Key principles of digester:

- Vertical fermenter – feed through top and extract at bottom, gravity flow
- Single phase digestion, with extensive recycling of digestate
- Can be operated thermophilic or mesophilic – extensive testing to determine optimal temperature for best performance and gas generation rates
- Minimal heating requirements (steam added to mixer operations)
- Minimal space requirements
- Lower wastewater generation
- Use piston pump commonly used for pumping concrete to circulate materials from in-feed to top of digester, through three tubes that run vertically inside the AD vessel

Aerobic composting:

- Tunnel composting
- Aerated plenum in floor – process air and air from other buildings directed to biofilter

Strengths: Proven technology, DRANCO digesters have been used for many years in multiple applications. Minimal air emissions. Overall system suited for processing MSW and recovering organic fraction for further processing. Process can use mixed paper residue in AD – generates higher biogas average 300

Organic Waste Systems (OWS), Munster AD Plant
Nm3/tonne. No moving parts in digester/very robust. Minimal heat and space requirements. System allows for wide variation in dry matter content of input material
Weaknesses: System unable to generate marketable compost product as regulations do not permit marketing compost from mixed waste origins.
Diversion: Some recovery of recyclables through pre-processing. RDF to EFW, reducing landfill requirements.
Estimated Costs: 6 to 10 million euros for AD unit ($9 to $15 million CAD).

Figure 3-2 OWS Munster Photos

Figure 3-2-1 OWS Munster: DRANCO Digester

Figure 3-2-2 OWS Munster: Material Receipt

Applicability in Durham

The front end of the OWS Munster facility requires installation of a relatively complex suite of front end equipment to recover recyclable materials and an organic material fraction suitable for AD or composting. The size of the front end portion of the installation is not suitable for application within a constrained site, such as inclusion as part of a dedicated centralized Regional transfer facility. It is unclear as to whether revenues from the sale of recovered materials would contribute to a positive business case for the front end of the facility as no market revenues were provided. The AD component of the facility would be more applicable in Durham. It is a robust technology, suitable for processing a range of organic feedstock material. The process can be optimized to maximize biogas production based on process analyses (e.g. the process can be modified to operate at the optimal temperate range to produce biogas based on the material feedstock).

3.3.3 Miller, FITEC, Rothmuhle Biogas Plant

The following provides information and photographs regarding the FITEC Rothmuhle, Biogas Plant.

Miller, FITEC, Rothmuhle Biogas Plant
General Description: implementation of a pre-processing and wet digester system to treat the output from a dry, high solids digester and improve the biogas production. The high solids dry digestion system operated for seven years and was not delivering the intended biogas production and was causing odour issues for the municipality due to the considerable amount of undigested food waste coming out of the dry system. This material still needed to be composted once it was removed from the dry system. Contraries present in the end compost product were also reducing its marketability and price.
Ownership: Municipal Corporation, Abfall und Energie Schweinfurt Land GmbH (AES)
Location: Rothmühle 2, 97493 Bergrheinfeld, Germany

Miller, FITEC, Rothmuhle Biogas Plant
Inputs: Municipal biowaste materials including food, grass, LYW, pet waste.
Outputs: 1.6 MW Electricity generated, energy balance for the facility is unavailable. 15,000 to 20,000 tpy of liquid digestate hauled to farms for land application, while no revenues are currently received for this material, based on NPK it has potential value of $12 to $15/m3. Operator currently pays 100 euros ($150 CAD) per tonne for EFW disposal of solid digestate.
Capacity: 30,000 tpy to FITEC system and wet AD.
Site Size: AD was retrofitted within the existing facility, 2 tanks 13m diameter, 8 m high (with skimmer/scrapers), plus surge tank 32.5 m diameter, 8m high.
Status: Proven. Contract award in 2012, plant was commissioned in early 2014, facility in operation as of 2015.
Commercial Considerations: FITEC has been retained by AES for the Rothmühle project as the design engineer providing a turn-key solution including: planning approval and detailed engineering, construction, equipment installation, delivery, and commissioning. In addition, FITEC will be providing support services to AES under an ongoing plant and biological support contract. The contract comprised the addition of a FITEC wet anaerobic digestion process followed by a 30 month support agreement.
Environmental Implications: Odour management for incoming material pre-processing area, digestate management and aerobic composting. Finished compost cannot be marketed under current regulations, is sent to EFW.
Type of AD: < 12 mm particle size from pre-processing directed to AD. Wet AD, average solids between 5% and 6%. Average retention time 45 to 50 days. Single Phase Mesophilic process, 45 degrees C.
Process Overview: The plant has been designed to accept 30,000 metric tonnes per annum, feedstock is composed of organic municipal waste, consisting of LYW and food waste from private households. The collection program allows for plastic and compostable bags as part of the incoming feedstock. The plant also accepts by-product waste from a food processing plant. FITEC has designed a system that includes two FITEC digester tanks, each 13 meters in diameter and eight meters in height, in addition to a final storage tank of 32.5 meters in diameter and eight meters in height. The pre-processing design includes a shredding and pulverizing process for the incoming material followed by two FITEC Biosqueeze units to press the liquid organics out of the feedstock, and one FITEC heat exchanger to achieve pathogen kill before feeding into the digester. The digester tanks have two FITEC designed floor scrapers, two skimmers, and one FITEC designed sediment trap. Capacity of Biosqueeze units is 3 m3/hour. FITEC AD digester maintains TS of 5 to 6% (Wet AD), light fraction floats and is skimmed off and screened (at 1 to 2 mm) to removed small plastic fraction, heavy fraction drops to bottom and is scraped off the floor of the AD vessel.

Miller, FITEC, Rothmuhle Biogas Plant
Material flow through the system is as follows: o Incoming materials processed via FITEC Biosqueeze units; o 1/3 solid fraction to in-vessel composting – product is screened, residues to EFW and compost to market; o 2/3 slurry to wet AD – plastic and grit fractions to disposal, digestate is pressed, solid digestate to EFW and liquid to fertilizer (to farmers free of charge). The biosqueeze is a piston press where main piston head and shaft compress incoming material against a closed gate valve. During compression, the piston is travelling within a cylindrical screen where the organics are squeezed through circular holes in the screen. The remaining plug of material left is comprised of 'contraries' (i.e. undigestable content) such as plastic, bones etc. Approximately 2/3 of incoming content is extracted as an organic slurry for AD, 1/3 is left as the solid fraction sent to composting. AD process steps: o FITEC double-tube heat exchanger for Pasteurization to 70 degrees C – using waste heat from power generation – for 1 hr; o Moves to holding tanks, blended with liquid digestate to seed process; o Into AD vessels (2) – 45 to 50 day retention time;
Strengths: Proven technology. Minimal air emissions. Overall system suited for processing contaminated organic municipal waste, with removal efficiency of 95% or more non-organic contaminants.
Weaknesses: The system recovers less monetary value for recovered organic materials as the solid digestate is being sent to EFW at a cost based on regulatory requirements.
Diversion: Some recovery of recyclables through pre-processing. Solid digestate to EFW, reducing landfill requirements.
Estimated Costs: Capital $5.9 million (CAD) for the installation, Operating Cost for processing the organic fraction of the waste stream is in the order of 40 euros/tonne (Approx. $60 per tonne CAD).

Figure 3-3 FITEC, Rothmuhle Biogas Plant Photos

Figure 3-3-1 FITEC, Rothmuhle Biogas Plant: Overhead View of the Two AD Vessels

Figure 3-3-2 FITEC, Rothmuhle Biogas Plant: Incoming Organic Material Stream

Figure 3-3-3 FITEC, Rothmuhle Biogas Plant: Biosqueeze Unit

Figure 3-3-4 FITEC, Rothmuhle Biogas Plant: Extruded Solid Fraction from Biosqueeze Unit (to Composting)

Figure 3-3-5 FITEC, Rothmuhle Biogas Plant: Composting Area

Figure 3-3-6 FITEC, Rothmuhle Biogas Plant: Light and Heavy Fractions Removed from Digester

Applicability in Durham

The FITEC system was relatively robust and straightforward, although it should be noted that the application of the technology was to contaminated organic feedstock, not mixed municipal waste. It was effective at directing inorganic contaminants to the solid fraction of material extracted, however, there was still a fraction of inorganic solid materials directed to AD and removed in the AD process (light and heavy fractions). If the front-end FITEC technology were applied at a Regional transfer facility to process MSW, it would result in generating a contaminated solid fraction that could be directed to composting (if there was a high organic content) or to the DYEC as an RDF, and a liquid organic slurry that could be hauled offsite to an AD facility. The FITEC AD technology appeared functional, and has been used in many applications to digest food waste and organic material similar to the Durham SSO stream.

It should be noted, that the application of the FITEC technology proposed in the RFI process by Miller Waste Systems, was to process source separated organics and not municipal solid waste. It was proposed that an organic fraction be separated for multi-family buildings through use of a tri-sort system. However, as indicated in section 2, it is unlikely that the quantity of organics that could be source separated by the multi-famiy sector would reach even 4,000 tonnes per year, which would not support a business case for AD that focuses solely on source separated organics. The technology has not been applied to MSW to-date.

FITEC has indicated that the biosqueeze unit is available for stand-alone installation.

3.3.4 Anaergia, OREX, Kaiserslautern Facility

The following provides information and photographs regarding the OREX installation at the Kaiserslautern waste management centre.

Anaergia, OREX, Kaiserslautern Facility
General Description: The plant in Kaiserslautern uses the Organic Extrusion (OREX) Press to extract organics from mixed municipal solid waste. This is the same system that Anaergia is proposing for pre-processing of the organic waste streams for Durham. The installation at Kaiserslautern is operating on mixed solid waste which has a high level of contamination. The combined OREX and Organic Polishing (OPS) technologies provide a pre-treatment system is robust and flexible to handle virtually any level of contamination.
Ownership: Municipal Corporation, ZAK Kaiserslautern
Location: Kapital 1 67657, Kaiserslautern, Germany
Inputs: Municipal Mixed Solid Waste, includes waste from U.S. military base (60,000 servicemen).
Outputs: RDF with energy content of between 11,000 to 13,000 kj/kg. Biogas between 70 and 80 cfm/tonne used to generate electricity. Stabilized digestate material used for landfill cover. System recovers ferrous and non-ferrous metals, recovery rate of 93% ferrous metals, 90% non-ferrous, 85% other metals.
Capacity: 100,000 tpy mixed solid waste, currently receiving 40,000 tpy
Site Size: Small footprint within larger existing integrated waste processing site.
Status: Proven. Commissioned in 2006, 8 years in operation.
Commercial Considerations: Anaergia has a contract for Design, Build and Maintenance of the system. Full service maintenance contract. Guaranteed feed rate for the OREX press is 35 tonnes per hour
Environmental Implications: Odour management for incoming material pre-processing area, digestate management and aerobic composting. The facility currently cannot market finished compost under existing regulatory environment, used for landfill cover.

Anaergia, OREX, Kaiserslautern Facility
Type of AD: < 16 mm particle size from OREX directed to AD. Dry AD technology (DRANCO), average solids between 35% and 40%. Average retention time 17 to 22 days. Single Phase Mesophilic/Thermophilic process – right on edge, 45 to 48 degrees C. The OREX system replaced the original front end pre-processing system for the digester.
Process Overview: Municipal waste is unloaded in the reception area and directly fed into the hopper of the OREX. The OREX separates the input waste into two fractions: a dry and a wet fraction. The dry fraction, which has 75-80% solids concentration and a calorific value of 11,000-13,000 kJ/kg is sent directly to energy from waste plants. The wet fraction with 35-40% solids concentration is conveyed to a dry anaerobic digestion plant. First step is organic polishing system where incoming material is blended with AD digestate into a slurry, which is passed through a cyclone to remove light (floating) contaminants and heavy (sinking) contaminants. The 'clean' slurry enters the digester. The digested matter is extracted from the digester (DRANCO digester), is pressed to remove excess water, and then sent to an aerobic stabilization process. During aerobic stabilization, the matter is left to rest in static biocells with air infiltration for 3-4 weeks and then matured under a canopy for 60 days. The stabilized matter obtained is used as covering soil in landfill sites. Energy balance – one incoming tonne requires 15 kwh parasitic load, generates 400 Kwh of energy.
Strengths: Proven, Minimal air emissions, overall system suited for processing contaminated organic municipal waste and MSW, with removal efficiency of 95% or more non-organic contaminants. Front end removal of inorganic contaminants can extend the digester equipment life and reduce maintenance.
Weaknesses: Recovering less monetary value for recovered organic materials, as cannot market stabilized digestate under current regulations.
Diversion: Some recovery of recyclables through pre-processing. RDF to EFW, reducing landfill requirements.
Estimated Costs: Selling power at 18 euro/Mwh ($27 CAD/Mwh), 3.6 million euros for installation of OREX press ($5.4 million CAD). 6 million euros (9 million CAD) for separate front end recycling processing system. 20 million euro ($30 million CAD) for overall system overhaul. Existing DRANCO dry digester remained in place.

Figure 3-4 Anaergia, OREX, Kaiserslautern Installation Photos

Figure 3-4-1 Anaergia, OREX, Kaiserslautern: Pre-processing Building and Digester

Figure 3-4-2 Anaergia, OREX, Kaiserslautern: Incoming Material Receiving Area

Figure 3-4-3 Anaergia, OREX, Kaiserslautern: Incoming Material Feed to OREX Hopper

Figure3-4-4 Anaergia, OREX, Kaiserslautern: Feed Hopper (right), OREX Press (bottom left)

Figure3-4-5 Anaergia, OREX, Kaiserslautern: Organics Polishing System

Figure3-4-6 Anaergia, OREX, Kaiserslautern: Dry Fraction Removed from OREX Press

Figure 3-4-7 Anaergia, OREX, Kaiserslautern: Heavy Fraction from Organic Polishing System

Figure 3-4-8 Anaergia, OREX, Kaiserslautern: Base of the Digester

Applicability in Durham

The OREX front end processing system was a relatively robust and straightforward system used to effectively extract the organic fraction from mixed solid waste. The system is available as a stand-alone system compatible with other front end pre-processing systems. It produces an organic fraction suitable for dry or wet AD processing depending on the amount of moisture added pre or post the organic polishing stage. The dry fraction from the OREX press is suitable for further material recovery processes.

The dry AD process, used at the Kaiserslautern facility is the DRANCO dry AD process which is a well proven dry AD process.

3.3.5 Veolia, Passau AD Facility

The following provides information and photographs regarding the Veolia Passau AD facility.

Veolia, Passau AD Facility
General Description: Dry AD processing facility for processing of residential biowaste.
Ownership: Municipal Corporation, ZAW Donau-Wald
Location: Gerhard-Neumüller-Weg 1, DE-94532 Aussernzell, Germany
Inputs: Biowaste (residential kitchen/garden materials). Average percent contamination is 5%
Outputs: Biogas production at 115 Nm3/tonne, 12 MW power at 14 euro ($21 CAD) per Kwh. Compost (bagged and bulk sales).
Capacity: 44,000 tpy Biowaste
Site Size:
Status: **Proven**. In operation since 2004. Constructed in less than one year.
Commercial Considerations: Revenue from energy sales range from 18 to 38 euro/tonne ($27 to $57 CAD).
Environmental Implications: Odour management for incoming material pre-processing area, digestate management and aerobic composting.
Type of AD: < 50 mm particle size directed to Dry AD. 30 to 40% solids, thermophilic (58 degrees C).
Process Overview: Pre-treatment process: o Biowaste tipped into receiving pit o Grapple feeds hopper to conveyor, to bag opener o Manual sort to remove contaminants o Magnetic separator o Shredder to 50mm particle size o 50 mm particles to second shredder – to 30 mm particle size o Mix with water to get to 30% TS – some of the mixing liquid is liquid digestate AD treatment and composting: o Thermophilic AD – optimal temperature at 58 degrees C o Retained for 11 o 12 days in digester o Longitudinal agitator o Digestate to screw presses (5) – some liquid digestate distributed to farmers o Over winter paid for liquid digestate use by farmers – moving to fee of 1 euro per tonne o Of 40,000 incoming tonnes – roughly 50% solids coming out of AD (20,000 tpy) and directed to existing in-vessel compost facility (aerobic tunnels) o Following composting – product is screened to develop marketable products of various types

Veolia, Passau AD Facility
o Took 7 to 10 years to develop high quality markets for solid products o Sell compost product in bags, and have bulk sales o Biogas to CHP engines o Recover waste heat to heat digester and facility o Built plant at site to dry biosolids prior to EFW – plan to use waste heat from AD power generation for this purpose o Aerobic composting (secondary) for 5 weeks
Strengths: Proven. Minimal air emissions. Overall system suited for processing organic municipal waste, strong compost marketing approach.
Weaknesses: Unlikely to be able to handle mixed waste processing, pre-processing/screening not designed for higher incoming material contamination rates. However, Veolia has designed built and operated MBT facilities in other jurisdictions.
Diversion: Successful marketing of compost – reduces waste to disposal
Estimated Costs: 10.6 million euros ($16 million CAD) invested in 2003. Operating cost approximately 48 euros/tonne ($72 CAD).

Figure 3-5 Veolia Passau Photos

Figure 3-5-1 Veolia Passau: Overview of Facility

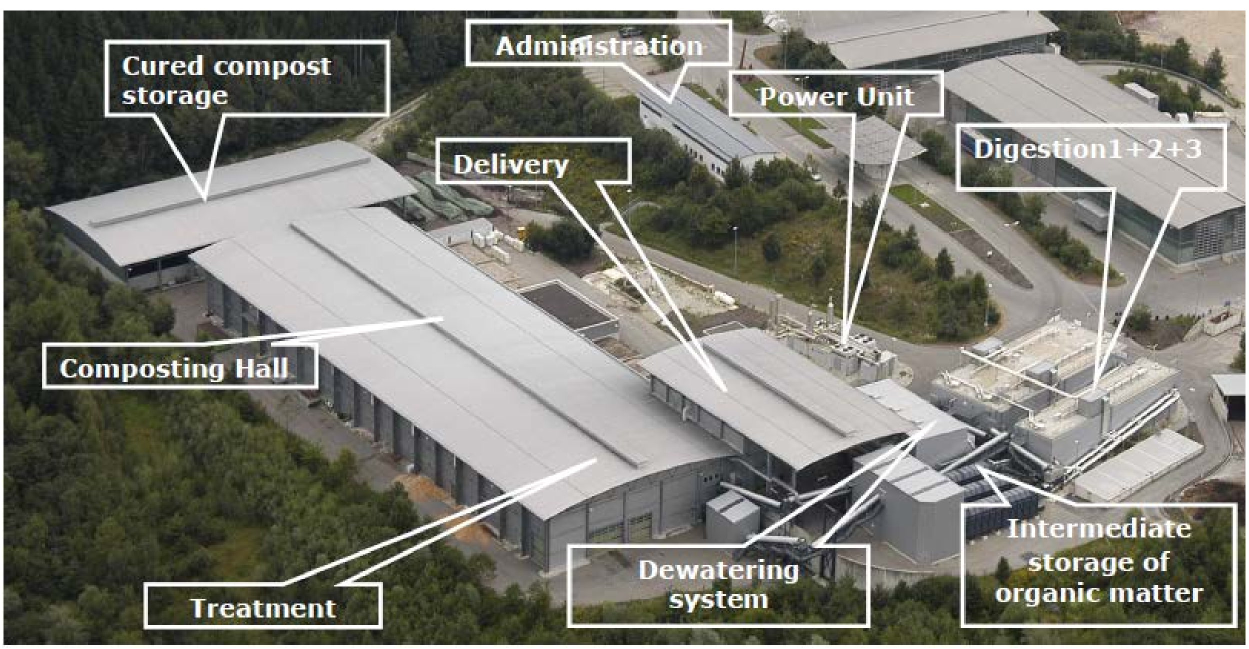


Figure 3-5-2 Veolia Passau: Compost Product Promotion

Figure 3-5-3 Veolia Passau: Bulk Compost Sales

Figure 3-5-4 Veolia Passau: Organic Material Feedstock

Figure 3-5-5 Veolia Passau: Horizontal Dry AD Units (3)

Figure 3-5-6 Veolia Passau: Compost Hall

Applicability in Durham

The pre-processing and AD technology applied at the Passau facility, was designed to successfully process contaminated source separated organics (approximately 20% inorganic content) however, it is unlikely to be able to handle mixed waste processing. The pre-processing/screening system is not designed for higher incoming material contamination rates.

3.3.6 3WAYSTE Altriom, MBT Facility

The following provides information and photographs regarding the 3WAYSTE Altriom, MBT facility.

3WAYSTE ALTRIOM MBT Facility, Polignac France
General Description: MBT processing of mixed MSW
Ownership: Private corporation, ALTRIOM
Location: Polignac, France
Inputs: Residential mixed MSW.
Outputs: Recyclables (HDPE, PET, PP, Paper, Ferrous, Non-ferrous metals). Compost. RDF. 10 to 20% of input sent to landfill disposal
Capacity: 120,000 tonnes of MSW, 20 tph, currently processing 40,000 tpy, 6 hour days, 5 days per week. Contract was designed to ramp-up as contracts expire for local host jurisdiction members.
Site Size: 3 to 4 ha
Status: Proven. In operation since June 2014. Construction took 14 months.

3WAYSTE ALTRIOM MBT Facility, Polignac France

Commercial Considerations:

- Planning process took 7 years to determine solution to reduce waste to disposal
- Driving factors behind decision for facility are: economics, energy recovery, soil quality in area and potential market/need for soil amendment
- Procurement process resulted in 4 proposals, 3 large companies, 1 small company Group Vacherie - 3WAYSTE technology won the process
- 3WAYSTE approach was more cost effective solution to recover more recyclables and organics from mixed waste stream
- Construction took 14 months – privately funded under DBOOM
- The area has a 'yellow bag' for recycling – similar to blue box program, these materials are processed separately within the same site used for the 3WAYSTE facility – 16% recovery/diversion from this program. Yellow bag results indicate 5% contamination rate
- Grey cart (waste) – 3WAYSTE guaranteed 80% recovery of recyclable materials from the waste stream, currently captures 94% including RDF
- Contract arrangement is DBOOM – they have a 15 year contract under which 3WAYSTE has the primary risk and liability for plant operations
- Guaranteed only 20% to disposal year 1, and 19% to disposal year 2
- Guaranteed 60% recovery not including RDF

Environmental Implications: Odour management for incoming material pre-processing area and aerobic composting.

Type of AD: Not an AD facility – processes organic fraction with aerobic composting.

Process Overview:

- Pre-processing starts with a sort on the tip floor to remove large items
- Material then fed to a proprietary bag opener that has a conical chamber lined with teeth and a vertical shaft with knives that self cleans by reversing direction every 20 mines. Is cleared 2 times per week.
- Contract arrangement is DBOOM – they have a 15 year contract under which 3WAYSTE has the primary risk and liability for plant operations
- Downgraded value for HDPE, PET, PP, and Paper. Also recover ferrous and non-ferrous metals
- Compost sold for 10 euros ($15 CAD)/tonne
- Results provided for compost quality – meets standards for contaminants like plastics, metals and glass; meets agronomic standards for NPK etc.; within trace contaminant standards for metals and other organic chemicals.
- Small fraction sent for composting is largely organic (80%), with 20% contamination – removed during process.
- Multi-step optical sort process to recover recyclables.
- Also uses optical sorting to remove small metal items including button batteries from small fraction sent to compost.

3WAYSTE ALTRIOM MBT Facility, Polignac France

- Value for recyclables: 120 euro ($179 CAD)/tonne ferrous; 1,400 euro ($2,090 CAD) /tonne non-ferrous; 314 euro ($468 CAD)/tonne foil; 50 to 70 euro ($75 to $105 CAD) /tonne paper; 20 euro ($30 CAD)/tonne for RDF
- Landfill cost 100 euro ($149 CAD)/tonne
- Process description:
  - Small crane feeds waste into hopper – removes larger items (e.g. mattresses, which are used to wipe floors)
  - Hopper to patented bag-breaker – bag-opening system capable of processing between 16 to 20 tonnes per hour
  - Has tilting system and flexible attrition chamber
  - Very little maintenance
  - No grinding or size reduction of incoming material – just tears open bags
  - After bag breaking materials sent through sorting/ through a rotary drum which separates: small fraction to compost, large fraction (oversized packaging) to manual sort and small packaging to automatic sorting
  - Larger packaging – sent into separate hall for manual sorting of steel, Al, paper, cardboard, HDPE, PP, PET PVC
  - Small fraction from screens (dry organics) sent to feed hopper for dry organics, and into the composting process – which composts the organics along (20% non-organic contaminants)
  - In vessel composting process includes recirculation of leachate and use of rainwater as necessary
  - After 6 weeks the material is refined/screened and then sent to final composting/maturation area
  - Screening removes materials with size larger than 4 cm, as well as lightweight plastics, next step is use of densimetric equipment to remove iron and heavy materials that are between 0 and 4 cm in dimension – inert residue to disposal
  - Compost maturation over 4 weeks
  - Materials removed through screening of compost >4 cm, as well as residues from automatic sorting of small packaging and manual sorting of large packaging – are sent to crushing/RDF process
  - Biofilter to control odour from primary compost area and rest of facility
  - Small container stream sort starts with ferrous and non ferrous separation at beginning of process (alternating magnetic current and eddy current systems)
  - Following ferrous/non-ferrous metal removal, screen separates flexible (paper) and stiff (container) packaging
  - Small sized container and paper streams run through separate Infrared detectors for sorting
  - Separates plastics/ paper but these streams are sent for further refining at the existing recycling plant – only bale steel, aluminum, tetrapack
  - Remainder of material (final waste) from both manual sort, automatic sort and > 4 cm from compost screening/refining, is ground, metals are removed (magnet), fine particulate removed

3WAYSTE ALTRIOM MBT Facility, Polignac France
up to 1.1 cm, air sorting system used to trap heavy materials (including batteries etc.) o Final RDF consists of wood, non recyclable paper and plastic o Overall of incoming materials ▪ 44% small fraction to fermenting tunnels, refining stage (screening) to remove inorganic contaminants ▪ 26% recyclable material fraction removed using NIR, magnets etc. ▪ 30% to RDF – fraction of this (non-combustible) is sent to disposal ▪ 10 to 20% sent for residue disposal
Strengths: Proven. Minimal air emissions. Overall system suited for processing mixed municipal waste.
Weaknesses: Does not recover any energy from the organic stream.
Diversion: Recovery and marketing of compost improve municipal diversion rate
Estimated Costs: 25 million euro ($37 million CAD) for Capital.

Figure 3-6 3WAYSTE Altriom Photos

Figure 3-6-1 3WAYSTE Altriom: Incoming Waste Stream

Figure 3-6-2 3WAYSTE Altriom: Interior of Bag Breaker

Figure 3-6-3 3WAYSTE Altriom: Organic Fraction

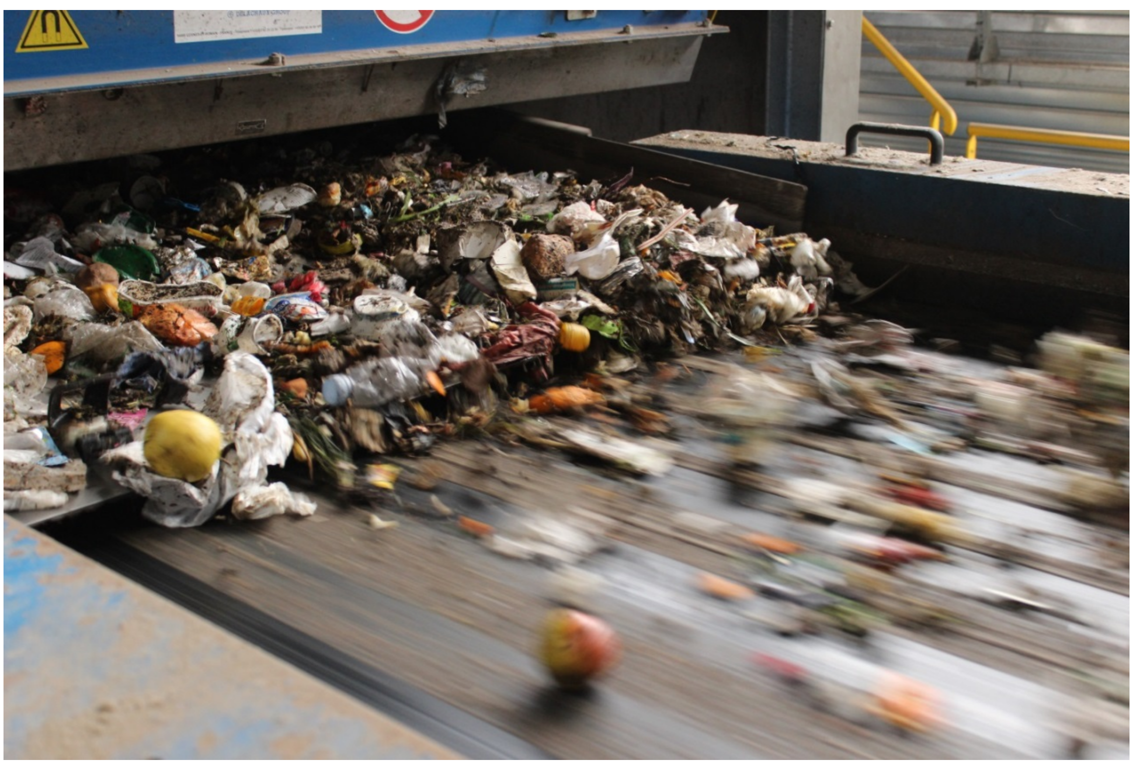


Figure 3-6-4 3WAYSTE Altriom: Materials Sorting

Figure 3-6-5 3WAYSTE Altriom: Compost Hall

Figure 3-6-6 3WAYSTE Altriom: Finished Compost Product

Applicability in Durham

The pre-processing technology employed at 3WAYSTE was relatively complex. It is unclear as to whether there would be a business case for employing the full set of technologies used at the 3WAYSTE facility to recover the remaining recycling fraction from the MSW stream in Durham. The aerobic composting technology used for the organic fraction was relatively robust, and generated a reasonable product, however, additional steps (screening, de-stoning to remove glass and inerts) was required to generate a marketable compost. The most applicable technology for Durham, for a front end system (depending on the configuration of the system) could be the bag breaker which employed an advanced technique to open, but not shred, the large majority of all bags.

3.3.7 OWS Chagny, AD Plant

The following provides information and photographs regarding the OWS Chagny, AD Plant.

OWS Chagny, AD Plant, Chagny France
General Description: Mixed Waste Processing facility
Ownership: Municipal Utility Company, SMET
Location: Chagny, France
Inputs: 73,000 tpy Residential mixed MSW, 8,000 tpy Green Waste
Outputs: Recyclables (HDPE, PET, PP, Paper, Ferrous, Non-ferrous metals). Compost. RDF – 10 to 20% of input sent to landfill disposal. 2.6 million m3 of biomethane to grid.
Capacity: 81,000 tpy
Status: Start-up in 2014. Construction took 14 months.
Commercial Considerations: o OWS is sub-contractor to TIRU SA o TIRU has 5 year operating contract (DBOM), municipal corporation owns facility
Environmental Implications: Odour management for incoming material pre-processing area and aerobic composting. Air extraction and treatment from process areas, 2,000 m3/min air movement – directed to scrubber (ammonia removal, humidification) and biofilter.
Type of AD: DRANCO Dry-AD system
Process Overview: o Incoming material is fed to commuting drum (ALFYMA), in the drum for 3 days. Moisture is added to drums to encourage size reduction. o Materials coming out of drum are directed to multi-function sieve/rotary screen: large fraction to multi-step material sort and 10 mm fraction to AD, following metals removal and screen to remove inert fraction. o No up front shredding. o At full scale operation of full facility operates 5 ½ days per week, 2 shifts, 13 hours per day. o Good gas production from incoming organic fraction to AD at 160 cm3/tonne – gas production rate of 150 to 165 Nm3. o Approx. 45% solids coming in – blended with liquid digestate to get to 35% solids. o Destoner is used pre feed mixing – some issue with plastic particulate in feedstock. o Thermophilic AD 52 degrees C, average retention time 3.5 weeks. o Similar to other OWS facilities – 1/8 to 1/9 of material flow out of digester is removed while remainder is recirculated to be blended with incoming material. o Air extraction and treatment from process areas, 2,000 m3/min air movement – directed to scrubber (ammonia removal, humidification) and biofilter. o Designed to include two 1,500 m3 digesters – would have been more efficient to have one larger digester – however client specified redundancy.

OWS Chagny, AD Plant, Chagny France
Strengths: Proven. Minimal air emissions. Overall system suited for processing mixed municipal waste.
Weaknesses: Commuting drum at front end is likely to result in organic material losses to other components of the waste stream (e.g. organic materials can pack and fill containers like a tuna can during commutation). This would result in organic material losses that should be directed to the AD component as well as affecting the quality of the recovered recycling stream.
Diversion: No recycling material diversion numbers were available.
Estimated Costs: Overall capital cost of 50 million euro ($75 million CAD). SMET 71 facility received financing from European Investment Back and Credit Agricole – 250 M euro fund for development of biomass fed energy schemes.

Figure 3-7 OWS Chagny AD Plant Photos

Figure 3-7-1 OWS Chagny AD Plant: Material Receipt and Loading Area

Figure 3-7-2 OWS Chagny AD Plant: Commuting Drum for MSW (start of process)

Figure 3-7-3 OWS Chagny AD Plant: Material Sorting

Figure 3-7-4 OWS Chagny AD Plant: Organic Fraction for AD

Figure 3-7-5 OWS Chagny AD Plant: Recovered Metal with Organic Content (output from commuting drum)

Figure 3-7-6 OWS Chagny AD Plant: AD Digesters

Figure 3-7-7 OWS Chagny AD Plant: Composting Hall

Applicability in Durham

The pre-processing technology employed at OWS Chagny was relatively complex. It is unclear as to whether there would be a business case for employing the full set of technologies used at the Chagny facility to recover the remaining recycling fraction from the MSW stream. The use of a good bag breaker, would likely achieve better separation of materials, than the commuting drum, and would avoid the potential for contaminated recyclables. The AD technology used at Chagny, is the relatively robust OWS process (also discussed above). Various features of the AD technology including its ability to process a more contaminated feedstock, would suit the Region`s needs.

3.3.8 BHS IREP Montgomery, Alabama

The following provides information and photographs regarding the BHS IREP mixed waste processing facility.

BHS IREP Montgomery, Alabama
General Description: Mixed Waste Processing facility that aerobically composts organic fraction.
Ownership: IREP, private company under contract to City of Montgomery.
Location: 1551 Louisville St, Montgomery, Alabama.
Inputs: 300 tpd Mixed MSW, 100 tpd Single Stream recyclables.
Outputs: Recyclables. Contaminated compost material used as landfill cover.
Capacity: 185,000 tpy, 30 tph
Site Size: 20 acres
Status: Operational as of 2015
Commercial Considerations: o City of Montgomery currently pays IREP $50 USD per incoming ton o Design efficiency/recovery rate: 85% diverted , 15% residue to disposal o 110 current employees o Compete with $35 USD/ton landfill disposal cost
Environmental Implications: No biofilter in effect, organic fraction is composted in outdoor windrows, few neighbours in the surrounding industrial area, have stormwater management system.
Type of AD: Not yet developed, plans to develop horizontal Dry AD capacity

Process Overview:
o Rough breakdown:
    o 15 to 18% is the 2.5" minus stream to outdoor compost
    o 42 to 45% is recovered as recyclables
    o Remaining 40% to 50% to landfill
o Actual efficiency: less than stated based on observation
o Front-end Manual Presort – physical labor to remove materials that can harm equipment
    o Large branches/organics
    o Large materials that can interfere with initial debris screen and Nihot – bulky plastics
    o Approx. 12 primary manual sort stations/labor – prior to screen and Nihot air separator
    o 4" by 4" and materials that can tangle equipment removed
o A lot of Glass ends up in 2.5" minus fraction - organic fraction currently piled in outdoor windrows, without AD solution in effect – highly contaminated material is suitable for landfill cover
o Key equipment:
    o Metering wheel

BHS IREP Montgomery, Alabama

  - BHS Bag breaker - materials from pre-sort line can be recirculated back to the bag breaker, opens approx.. 70% of incoming bags, spiked drum with carbon tips
  - BHS OCC Separator
  - #1 BHS Debris Roll Screen – used early in the system to separate incoming mixed material streams – removes small fraction up front (2.5" minus) - separates cardboard, organics and fines from incoming material – cardboard rolls over top, other incoming materials drop and flow to Nihot and small fraction is removed
  - Materials then flow into the Nihot
  - Nihot Single Drum - Air Separator – uses air to separate light high caloric material (plastics) from heavy material (wet materials, wet paper and other heavy items) -
  - BHS Polishing Screen – used to separate flats i.e. paper (travel up) from rounds i.e. containers (fall down), and again allows for small fraction to drop
  - From this point – container and paper streams are largely separate, and proceed to
  - Fibre sorting - BHS Paper Fines Screen – DRS plus 2 optical sorters to remove film plastic from the paper stream
  - Note: conveyor widths through sorter are 8 ft
  - Manual QC sort on mixed paper stream to remove debris – including polystyrene and film plastic
  - Container sorting - NRT Optical sorters (SpydIR) – eight of these
  - NRT Color Plus
  - NRT MetalDirector
  - Eddy Current
- Residue stream goes back through a final sort pass – 8 sorting stations – can be recirculated back to system prior to product load out
- Market:
  - PET (reported recovery rate of 96%)
  - Natural HDPE (reported recovery rate of 96%)
  - Coloured HDPE (reported recovery rate of 96%)
  - Mixed Paper (reported recovery rate of 95%)
  - OCC (reported recovery rate of 97%)
  - Aluminum (reported recovery rate of 90% - Loss to small fraction and debris)
  - Steel – recovery rate not identified in public materials
  - Mixed 3 to 7 plus aseptic containers – marketed as a mixed material stream – final sort off-site by custom polymer company
  - Large bulky plastics/mixed rigids
- Details on container sort:
  - Manual sort line to remove contaminants that made it through polishing screen
  - Magnet to remove steel
  - NRT to remove PET (2), post removal stream can be recirculated to beginning of container sort line

BHS IREP Montgomery, Alabama
o Aluminum – removed via eddy current late in the sort o NRT to remove HDPE , followed by second NRT on this stream to separate natural / coloured o 3 to 7 left – no QC on this stream o Manual QC for HDPE and Aluminum streams o Note" plastic film is sent to residue stream and disposal o All products to market baled o 2.5" minus stream to compost – removed early in process o Considering smaller Nihot unit to separate out glass o Current plans to use this 'compost' stream for ADC at landfill o Looking for compost markets o Organic fraction makes up approx.. 60 tons of each 400 tons incoming – produce approx. 60 tpd 'compost' or less – demand for ADC at landfill is around 120 tpd o No compost quality information was available o Changes that IREP would consider: o Pull larger HPDE first o Bigger tip floor – keep SS recycling and clean materials separate and have by-pass to polishing screen o Add system to remove broken glass from 2.5 " minus stream
Strengths: Proven. Minimal air emission. Overall system suited for processing mixed municipal waste.
Weaknesses: Space on tipping floor insufficient to allow for separate input of clean single stream recyclables (no bypass for front end of plant).
Diversion: Currently reporting 60% overall waste stream recovery, includes recovery of contaminated organic stream for use as alternative daily cover.
Estimated Costs: o Need cost recovery in the order of $75 to $85 per incoming ton to cover costs of system o Recyclable revenue – in order of $60 to $90 per ton for basket of goods o CAPEX in order of $15/ton o Tip fee of $28 to $35/ton for disposal is too low to compete with

Figure 3-8 IREP Montgomery Plant Photos and Illustrations (from published sources)

Figure 3-8-1 IREP Montgomery Plant: Overview of Plant Operations

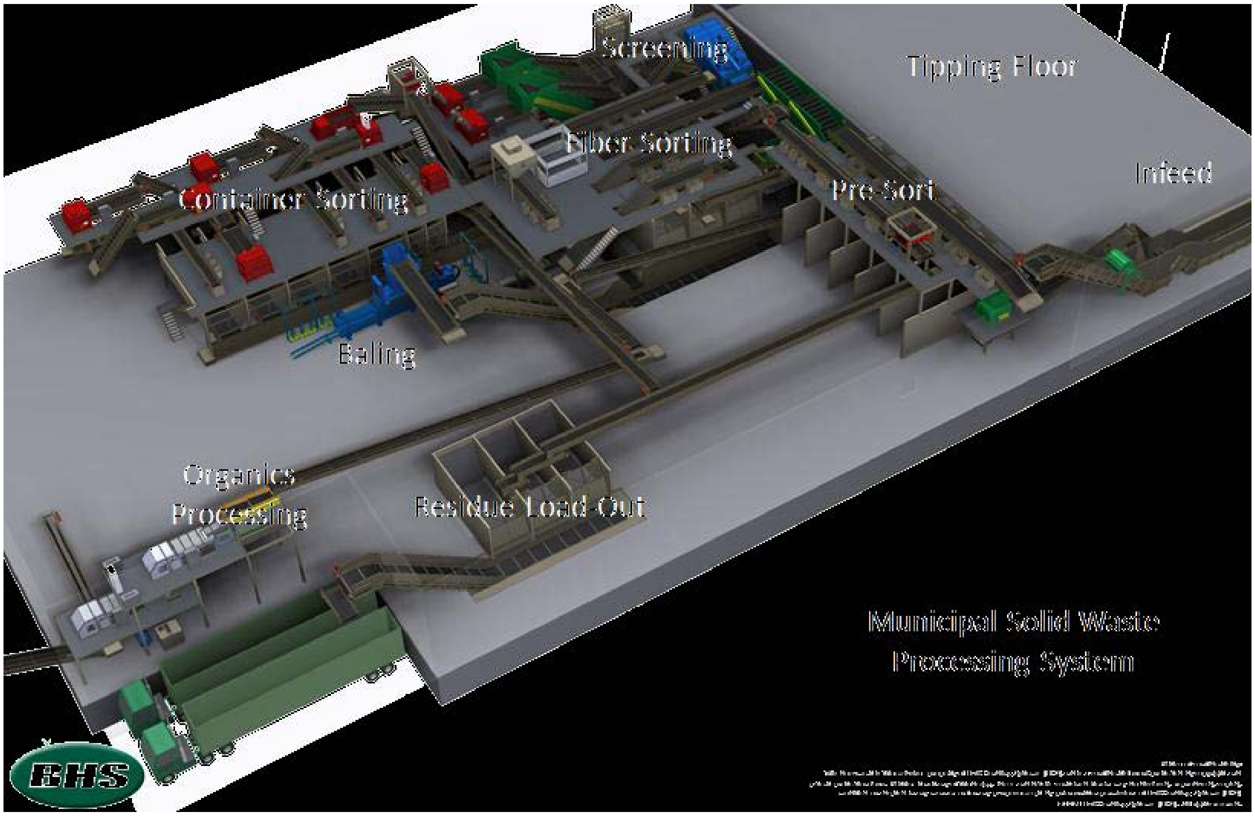


Figure 3-8-2 IREP Montgomery Plant: Incoming Material Sorting Line

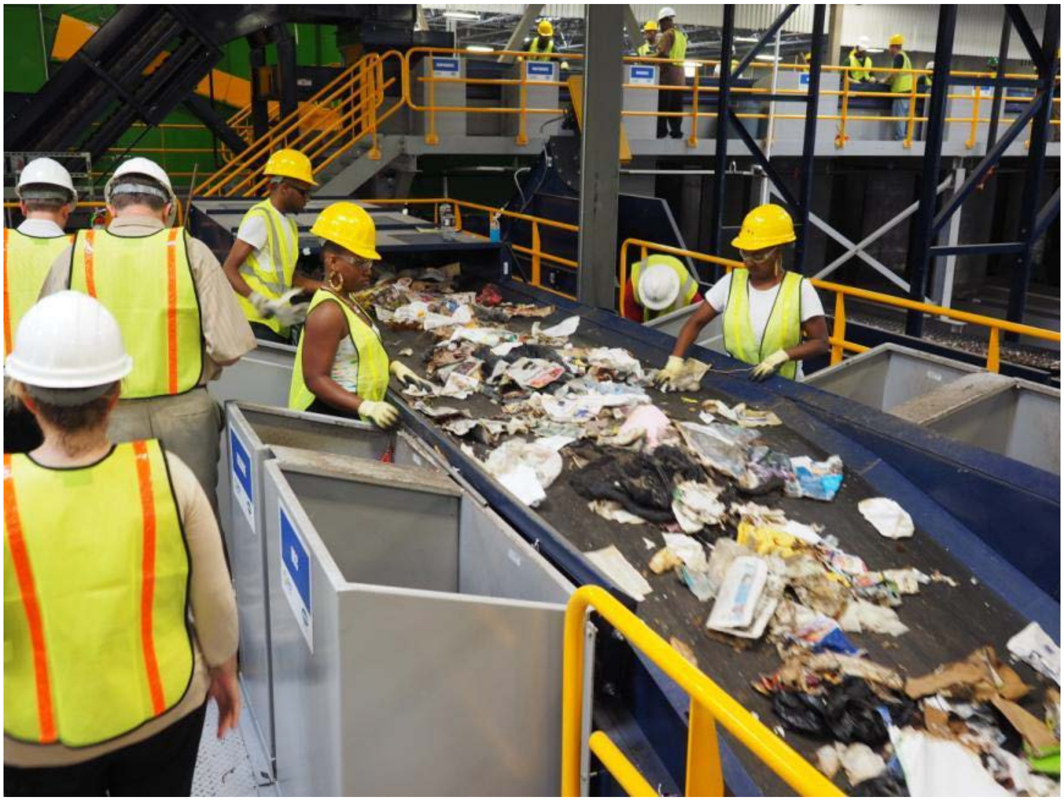


Figure 3-8-3 IREP Montgomery Plant: Disk Screen (separates flats from rounds)

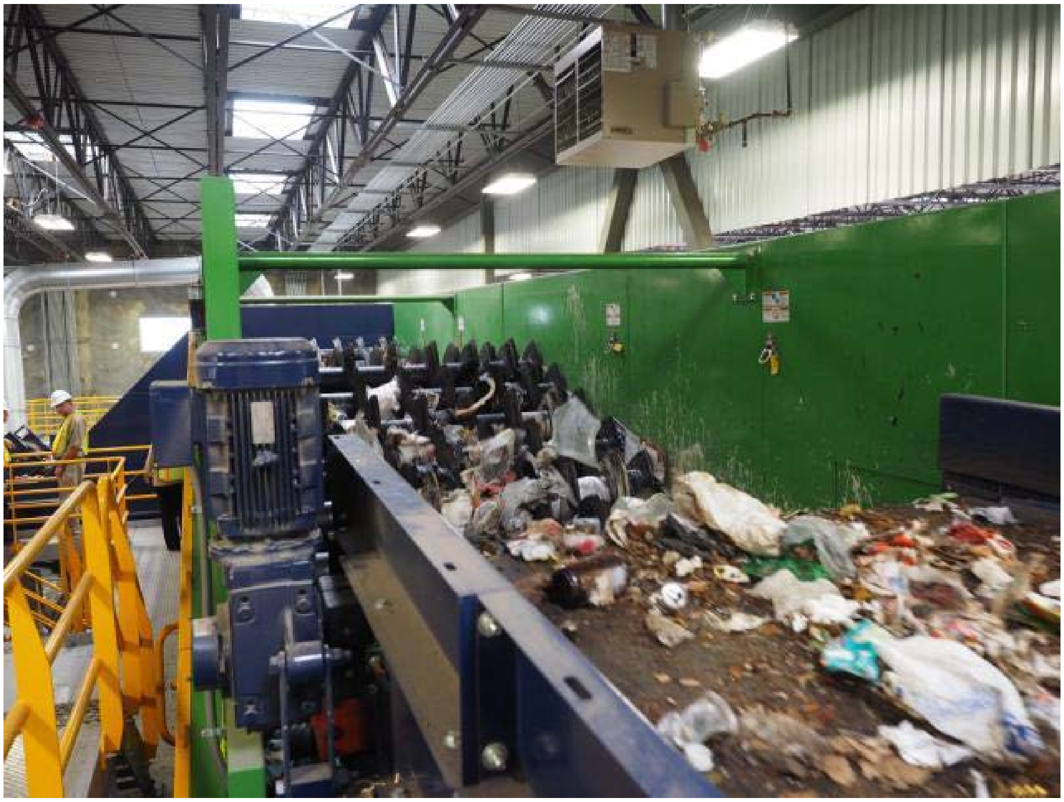
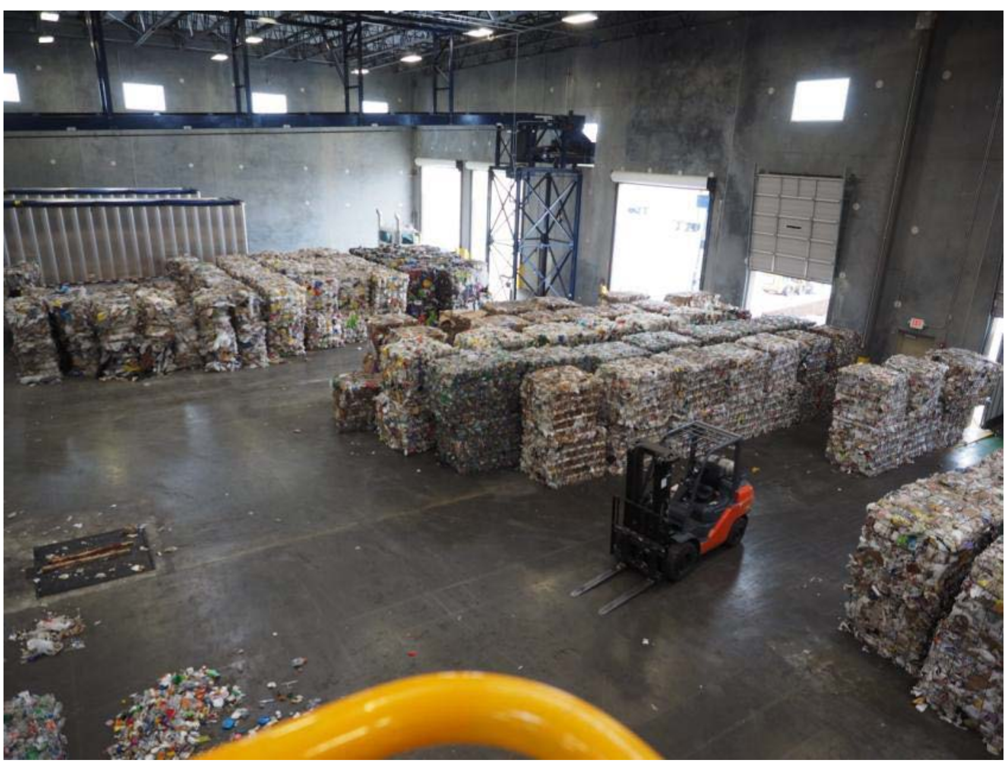


Figure 3-8-4 IREP Montgomery Plant: Recovered Material Storage, Load Out



Applicability in Durham

The pre-processing technology employed at IREP was relatively complex, involving both a significant level of manual sorting as well as sorting equipment resulting in multiple steps to recover a reasonable percentage of target material streams. It is unclear as to whether there would be a business case for employing the full set of technologies used at the IREP facility to recover the remaining recycling fraction from the MSW stream. The composting process currently applied to the organic fraction recovers little value, given that the compost material is highly contaminated with inorganics (plastic, glass). Future application of AD technology to process the organic fraction may recover more value from this material.

3.4 Additional Submissions / Facility Information

Preceding the RFI process, the Region had received some communications by a party interested in biogas opportunities in the Region. This information is summarized below:

Brock Renewable Energy Co-operative

In September 2014, the Region received a submission from the Brock Renewable Energy Co-operative (BREC), proposing to develop small scale organic waste recycling facilities (10,000 tpy) in the Region. BREC was formed in 2013 to co-develop multiple small biogas projects in Durham Region together with farmers, individuals and municipalities. BREC intends to generate electrical power from the biodigestion of residential organics from the Region of Durham (5,000 tpy), agricultural, and commercial organic waste streams, and sell the power to the Ontario Power Authority (OPA) under the terms of a 20 year feed-in tariff (FIT) contract. BREC would use available 'off the shelf' AD technology. BREC intends to source turnkey engineering, procurement and construction services to develop facilities financed by BREC, located at suitable on-farm or brownfield lands following a successful FIT application.

Applicability in Durham

The potential role of the above proposal would be best considered within the context of a Business Case exercise, followed by competitive procurement. The Region of Durham has continued to be open to receipt of information and submissions related to mixed materials processing and anaerobic digestion technologies and facilities.

3.5 Key Outcomes / Findings from Organic Waste Processing Facility Tour

Analysis of the information gathered during the technology tour indicates the following key outcomes/findings for consideration in development of the Region of Durham's Organics Plan:

a) There is a range of operating facilities that are currently successfully processing mixed solid waste streams and/or more contaminated residential organic material streams, and recovering value in the form of energy and/or diverted material streams.

b) No single facility that was toured, represents a full package of an approach that would work 'as is' in Durham, without adjustments to account for Durham specific conditions. That being said, there are specific components from several of the systems that could be incorporated into one system that could work well when applied in Durham.

   Observations regarding facility performance include:

- Some facilities did not attempt to produce a marketable solid product out of the organics processing system, as either the expense to do so was too great and/or the regulatory environment in that jurisdiction was not favourable to marketing compost from mixed waste sources. Other options such as generating landfill cover would not be of great help to Durham Region which is unlikely to have a ready market/use for a restricted use product.
- Some facilities invested considerable equipment/time/expense to recover recyclable materials, where the available basket of goods value for marketing the material was advantageous. The market for material streams such as mixed plastics in Ontario is not as robust as markets in the EU. It would be difficult to justify the complexity of some of the front end design options in the absence of favourable markets for the recovered materials.
- Advances in some equipment types appear to offer cost effective/efficient solutions to extract an organic stream and recyclables from either highly contaminated source separated organics or mixed solid waste. This equipment could be applied in Durham Region including:
    - Advances in bag breaking (3WAYSTE) that avoid the shredding/size reduction of plastic bags that can result from a shredder/grinder, while at the same time facilitating a more efficient material sort.
    - Advances in equipment that can isolate a cleaner organic stream and allow for extraction of recyclables from mixed material. Self reporting indicates that this equipment could fall within a reasonable cost range. This would include both the FITEC and OREX units.
    - Advanced optical sorting equipment, capable of recovering a broader spectrum of recyclable materials.

c) Revenues from the sale of energy from renewable sources, varies with the jurisdiction. Generally the revenues available in the Ontario market appear lower than that in European markets, which could influence the choice for example to generate CNG or vehicle fuel from AD biogas, or to condition the gas for injection to the grid, rather than generating electricity.

The application of either wet or dry AD systems, could offer the opportunity to generate energy revenues and GHG emission credits which could be comparable or better than that available through processing this material through the Durham York Energy Centre. Diverting additional organic streams away from the DYEC would offer the combined benefit to Durham of remaining within the available capacity at the DYEC for a significantly longer period of time and generating additional revenues from the sale of bioenergy either as electricity or as a substitute for natural gas. The long term viability of an AD solution as part of the Region's Organics Plan, is contingent upon there being an energy benefit for the Region. The availability of a reasonable price (16.8 cents/kWh) for biogas is constrained based on a project size limit of 500 kW under the FIT/microFIT price schedule.

d) The generation of marketable products, both in regards to recovered recyclables from mixed waste processing, and in regards to recovered organic material streams would increase the viability of a mixed waste processing and AD system.

In regards to mixed waste processing, decisions regarding the viability of including processing equipment (infrared sorters etc.) to the mixed waste processing line should be coupled to the potential to recover these costs through the sale of recovered materials. For example, the quantity of PET that could be recovered from the mixed waste stream would be in the order of 1,200 tpy. A reasonable market value for this PET is likely to offset equipment costs within a few years. The quantity of Aluminum that could be recovered from the mixed waste stream would be in the order of 500 tpy. The market value for this material would be in the order of $500,000 annually.

In regards to AD processing and recovered organic material streams, options that result in generating a marketable material, with the least amount of effort would improve the business case for AD. Cleaner material that requires less front or back-end processing, would reduce processing costs and likely gain higher revenues. Options that reduce the requirement to remove and manage waste water are also likely to have an advantage.

e) Many of the jurisdictions with advances in mixed material pre-processing and/or AD represent local waste management authorities/utilities. Application of a municipal facility/utility model to the Region is not likely in the near future. However, an alternative that could benefit the Region would be to partner with an energy partner (or partners) for the marketing and utilization of the energy derived from an AD facility.

4 Application of AD and Pre-processing Technologies in Durham Region

The Region has had strategic discussions with HDR regarding the potential application of AD and Pre-processing technologies as part of the Organic Plan development.

Key outcomes of these discussions include the following:

a) Updated tonnage projections for available organic streams, including organic streams that could be extracted from mixed waste processing, indicates that it may be possible to develop cost effective AD processing capacity for Green Bin organics plus the residential organic stream recovered from mixed waste. Mixed waste processing could also offer an opportunity to increase recovery of recyclables and organic materials from other sources such as waste collected in public spaces and public events, curbside garbage collected from mixed-use locations and from other locations/generators where the performance of source separation programs tends to be poor.

   As part of the development of a Business Case for mixed waste processing and AD implementation, HDR will develop updated facility scale assumptions, based on the residential projections in Section 2 of this report, and will identify the need/benefit that may be associated with supplementary materials for materials sourced from other Regional operations.

   However, in order to develop these projections, updated waste composition data is required as the current sources are nearing five years old and the composition of the waste stream can shift in that timeframe. Preferably this would be through a new Durham Region waste composition study undertaken in 2016 – alternatively recent audit data available from other comparable municipal jurisdictions could be used.

b) There is limited potential to implement a new organics processing solution prior to the expiry of the existing SSO processing contract in 2016. A contract extension or issuance of a short-term contract for use of available merchant capacity, would allow for more time for the Region to proceed with procurement to secure new/additional pre-sorting capacity that would extract additional organics from the waste stream and a long-term organic processing solution to manage the projected increase in quantities of organic material that could be diverted.

c) Mixed waste processing/pre-sorting offers the best solution for increasing waste diversion from the multi-family sector and has the potential to significantly increase organics recovery from the single family sector, potentially recovering 30,000 tpy or more of organic material in addition to the Green Bin organics currently recovered by the Region. For multi-family dwellings, mixed waste processing is likely to recover more than twice the quantity of organics as source separated collection.

d) The extent of sorting to remove recyclables that would be appropriate could range from removal of ferrous and non-ferrous metals which would be relatively straightforward, through to more complex multi-step sorts to recover a broader range of plastics. The Business Case is needed to determine the optimal sorting configuration at a mixed waste facility and how best to integrate recovery of material from mixed waste and the existing capacity available at the Region's recycling plant. For example, it may be reasonable to extract a mixed container stream from a mixed waste pre-sort that is then hauled to the Region's recycling plant for processing along with the curbside blue box stream.

e) The Business Case would also need to consider the effect of mixed waste processing on the quantity of waste available for processing at DYEC and options for the Region of Durham to obtain value for the capacity at the EFW that it may not require in the near term.

f) The potential facility footprint for many of the mixed waste pre-sort and/or AD technologies examined was quite small, allowing for co-location of some technologies locations such as a Regional transfer station. Co-location at a transfer facility offers efficiency in the receipt of material and the transfer of the remaining waste stream to the DYEC. The potentially available space at existing waste management facilities should be examined to determine the range of reasonable siting options. This would include the old Regional MRF facility located at 4600 Garrard Road, in Whitby.

g) The viability and cost of undertaking a pilot mixed waste processing project to extract organics and recyclables from the MSW from the Multi-family sector should be examined. The results of a pilot could be used to determine the viability of expansion for processing the entire residential waste stream. However, the economies of scale for such an installation are likely to be poor, and the equipment sizing may not be suitable for expansion/increased throughput.

   Alternatively, instead of a pilot, mixed waste processing could be phased in through the design and implementation of an initial system designed to process all of the multi-family waste stream and some single family garbage (e.g. half of the available residential garbage stream) , that could be duplicated at a future date in order to manage the rest of the single family waste stream and/or other material sources. Both approaches to implementation should be examined as part of the Business Case.

h) There is a range of Anaerobic Digestion processing technologies that could be applicable to the Region`s organic material stream. Further study is required to scope to the extent reasonable, the technology(ies) that would best meet the Region`s needs and to narrow the range of approaches that would be the subject of a future competitive procurement process. This would include examination of the most revenue positive biogas utilization approaches.

i) The Region could consider the viability of some form of partnership to include organics from other sources (agricultural, commercial) or use capacity at a non-regional facility that may co-manage the Region's organic stream with that sourced from other generators. There may be other benefits available through some from of partnership approach to processing the Region's organics, including product market development (e.g. liquid and/or solid organic process streams for agricultural application).

j) The form of contract/procurement approach for organics processing (Anaerobic Digestion, composting of digestate) should be examined in the Business Case to identify the risks and benefits of the range of contractual approaches from Design/Build/Maintain to Design/Build/Own/Operate/Maintain and partnership opportunities. The technology/facility review completed to-date indicates that there seems to be a stronger trend to ownership at the municipal level for the facilities examined, however, there were successful examples of most of the contractual approaches for facility development. One option to be considered would be for the Region to take a more hands-on role in acquiring technology, which would be provided as part of a competitive procurement (e.g. selecting a pre-sort process, and soliciting bids to develop the rest of the infrastructure around it).

k) Implementing a longer term Organics solution can be linked to the Region's decisions on competitive procurement for new long term transfer capacity.

l) The current pricing for organics processing in the existing contracts with the Region, provides room for potential implementation of alternative solutions, without necessarily seeing any change in overall organic program costs.

5 Next Steps

This interim report is prepared for the review/consideration of the Region. Following completion of that review, and the considerations noted above, HDR would proceed to more fully scope items/issues that would inform the development of competitive procurement documents for pre-sort and organic processing in the Region as well as supporting the development of a longer term Organics Plan.

The next major components of the HDR workplan include:

a) Task 4 – Development of a Procurement Strategy
b) Task 5 – Preparation of a Detailed Implementation Plan

Task 4 and 5 will help form the foundation of the Business Case for mixed waste pre-sort and AD implementation for the Region.

Mixed Waste Pre-sort and AD Business Case

In summary, a Business Case is required to examine in more depth, key matters related to the viability of implementing mixed waste pre-sorting and anaerobic digestion in the Region as follows:

a) The preferred approach to implementing mixed waste pre-sort as part of a centralized Regional transfer facility including the:
    a. Service delivery approach
    b. Target mixed material streams including multi-family waste, single family curbside garbage, waste generated in public spaces/public events, waste generated in mixed use locations
    c. Target material streams for recovery
    d. Optimal integration of the pre-sort system with other Regional facilities such as the existing Regional MRF;
b) The preferred approach to implementing anaerobic digestion as a component of the Region's waste management system including the:
    a. Service delivery approach (range of ownership, financing and development options available)
    b. Input material streams that could be directed to AD
    c. Potential energy outputs and the current and potential future market value of this energy
    d. The role of partnerships in securing maximum value for the energy output
    e. Potential material outputs and variations in the AD processing approach that could gain the highest value at the lowest processing input;

c) The potential effects on the Region's investment in the DYEC. This includes:
    a. Examining the effect associated with the change in composition/quality of the waste stream that Durham Region would haul to the DYEC
    b. Determining the potential change in material quantities that would be directed to the DYEC and determining how best to use the 110,000 tonnes per year of capacity at the facility to the best effect over the life of the plant;
d) The potential benefits associated with the increased capture and diversion of organics and recyclables including:
    a. Increasing Durham's overall diversion rate and effects related to reducing the quantity of waste requiring disposal
    b. Maximizing capture of the inherent resource value of the organic stream
    c. Contributions to Greenhouse Gas emission reductions and the potential value associated with minimizing climate change impacts, considering the value of carbon credits through cap and trade and/or other mechanisms
    d. Maximizing the potential positive effects on the Region's waste management system associated with proposed Provincial extended producer responsibility legislation
    e. Potential for social benefits associated with implementing mixed waste pre-sort as a means of increasing residential diversion, and potentially diversion from other generators for which source separation is a less viable alternative. This would consider the value to residents and Regional generators of including an option in the Region's waste management system for increased waste diversion that does not increase the demand for participation/action by individuals.

The development of the Business Case requires both significant technical analysis as well as management consulting expertise.

As noted in Section 4, as part of the development of the Business Case HDR will develop updated facility scale assumptions, based on the residential projections in Section 2 of this report, and will identify the need/benefit that may be associated with supplementary materials for materials sourced from other Regional operations. In order to develop these projections, updated waste composition data is required as the current sources are nearing five years old and the composition of the waste stream can shift in that timeframe. Preferably this would be through a new Durham Region waste composition study undertaken in 2016 – alternatively recent audit data available from other comparable municipal jurisdictions could be used.

Procurement

The procurement approach will be determined as an outcome of the Business Case development which will recommend the service delivery approach and scale/form of the mixed waste pre-sort and AD technologies. The need for a multi-step or single step procurement will be identified.

In regards to the procurement of mixed waste pre-sort technologies, criteria appropriate for a Request for Proposals would depend on the form of the contract that would be pursued and how this would be integrated into a centralized Regional transfer facility. From a technical standpoint they would generally include (but not be limited to):

a) The capability of the respondent team, for all roles identified in the form of contract (design, build, operate, maintain, finance) including reference projects;

b) Demonstration that the technology is proven for management of municipal solid waste similar to that proposed by the Region;

c) Demonstration that the technology is capable of extracting 75% or more of the targeted organic materials in the MSW stream;

d) The guaranteed capture rates for targeted recyclables;

e) The proposed facility energy, water and material flow;

f) Proposed pre-sort design, in regards to compatibility of the design with the features of the transfer site and the environment surrounding the site as put forward by the Region including (but not limited to):

    a. Traffic flow
    b. Material flow
    c. Odour control

g) Ability of the technology and facility design to accommodate variability in input material composition and volume;

h) Proposed approach to facility servicing and maintenance, in order to meet operating availability guarantees;

i) Proposed value-added, innovative solutions including partnership opportunities with energy utilities;

j) Cost to the Region of Durham (form of pricing has yet to be determined).

In regards to the procurement of anaerobic digestion technologies, criteria appropriate for a Request for Proposals would depend on the form of contract as well as the type of technology, and generally would include (but not be limited to):

a) The capability of the respondent team, for all roles identified in the form of contract (design, build, operate, maintain, finance) including reference projects;

b) Demonstration that the technology is proven for sorting of mixed waste and management of organic streams similar to that proposed by the Region;

c) Demonstration that the technology is capable of effectively managing inorganic residues;

d) The guaranteed biogas generation rate;

e) The proposed facility energy balance (net energy generated);

f) Proposed energy market and approach (upgrading etc.);

g) The design of the residuals management system including dewatering, stabilization (composting) or other processes;

h) Proposed liquid and solid materials generated post AD processing, and the marketing plan proposed for those materials;

i) The proposed facility water balance (net water consumed, wastewater generated);

j) Proposed facility design, in regards to compatibility of the design with the features of the site(s) and the environment surrounding the site as put forward by the Region including (but not limited to):

    a. Traffic flow
    b. Materials receipt and handling
    c. Odour control
    d. Noise control
    e. Stormwater management
    f. Geotechnical conditions
    g. Process water management
    h. Site topography

k) Ability of the technology and facility design to accommodate variability in input material composition and volume;

l) Proposed approach to facility servicing and maintenance, in order to meet operating availability guarantees;

m) Proposed value-added, innovative solutions;

n) Cost to the Region of Durham (form of pricing has yet to be determined).

Additional detail will be provided within the technical report for Task 4.