SOLID WASTE
MANAGEMENT
CONSULTANTS

MEMORANDUM

TO:	Gayle Wilson, Director, Orange County Solid Waste Management Department
FROM:	Steve Simmons, Gershman, Brickner & Bratton, Inc. (GBB)
CC:	Lynn Klappich, Draper Aden Associates (DAA); Harvey Gershman and Ljupka Arsova, GBB
DATE:	March 23, 2016
RE:	Overview of Mixed Waste Processing for Orange County, NC

Introduction

Orange County's Solid Waste Management Department has requested GBB, as a sub-consultant to DAA, to prepare this overview of mixed waste processing opportunities for Orange County, NC. The content of this overview includes:

An overview of the current status of solid waste processing technologies in the U.S;

- Description of the Mechanical Biological Treatment (MBT) plant under construction by a private company, Ensorga, in Martinsburg, West Virginia;
- Listing of potential end users for refuse derived fuel (RDF) in Orange County, NC; and
- A general description of elements of a successful mixed waste processing facility.

This memorandum and a separate PowerPoint presentation summarizing the information in this memorandum comprise GBB's outputs for this assignment.

Overview

As communities across the globe struggle to meet constituent demands for higher municipal solid waste (MSW) recycling and landfill diversion goals, one avenue gaining popularity to meet those demands is mixed waste processing. Mixed waste processing incorporates a suite of unit operation technologies that provides mechanisms for the recovery of recyclable materials that have been misplaced into the disposal stream while producing an alternative fuel for energy recovery. This alternative fuel is commonly referred to as solid recovered fuel or SRF. Recently reported, there were 23 mixed waste processing facilities ("MWPF") located in the U.S. of which approximately 11 are part of RDF energy recovery projects.[1]

Modern MWPF's are far more sophisticated that the RDF facilities of a previous generation. Depending upon the project specific requirements, these modern facilities can include rotating screens, ballistic separators, metal recovery and optical sorters in addition to manual picking and sorting stations. The facilities can be designed to recover multiple product streams including traditional recyclables such as paper, plastics, and metals; wet organics for either anaerobic digestion or composting; and a residual fraction for conversion into an energy products or landfill disposal. MWPF's are frequently employed as a pre-processing step in larger solid waste management complexes incorporating advanced energy conversion technologies such as anaerobic digestion, gasification to electricity, or liquid transportation fuel production. There are a large number of mixed waste processing facilities in California. There, a primary use for the wet organics is use as alternative daily cover at landfills while the residual fraction is landfilled.

Originally developed in Europe, these technologies are now being imported into the United States. American communities can choose to buy individual pieces of processing equipment from manufacturers, or fully integrated waste processing facilities from system integrators. The larger system integrators will provide design, build, own and operate offerings and have the corporate balance sheet strength to support long term service agreements.[2]

As with the adoption of any new technology, mixed waste processing facilities have had mixed commercial results in the North American. A few notable examples are provided in Table 1 and discussed below.

Table 1: North American Mixed Waste Processing

Location	Owner	Start Up Year
Region of York , Ontario, Canada	Dongara	2009
San Antonio, TX	Waste Management, Inc.	2012
Philadelphia, PA	Waste Management, Inc.	2014
Edmonton, Alberta, Canada	City of Edmonton	2015
Montgomery, AL	Infinitus	2015

[1] For a full review of mixed waste processing technologies and their history in the U.S., see: "The Evolution of Mixed Waste Processing Facilities 1970 – Today" for the American Chemistry Council, by GBB, June 2015 (https://plastics.americanchemistry.com/Education-Resources/Publications/The-Evolution-of-Mixed-Waste-Processing-Facilities.pdf).

[2] Some of the technology and developers include: Amut, BHS, CP Mfg., Envision Holdings, Infinitus, Lindner America LLC, Machinex, Mustang Renewable Power Ventures, LLC, RRT, Stadler America, Van Dyk Recycling Solutions, Vecoplan, and others.

The Dongara facility located in Ontario, Canada was designed to process approximately 200,000 tons per year of residential MSW from surrounding communities. The processing system recovered high value materials such as metals and removed undesirable contaminants, glass, PVC plastics, etc.[3] Constructed at a cost of $50 million, the facility was a technical success, but failed commercially as it could not obtain a non-waste designation for its fuel product in Canada. For a while, the company exported its fuel to the United States, but increasing transportation costs made that uneconomic and the facility was closed in 2014[4].

Waste Management, Inc., ("WMI") has developed two SRF production facilities to produce a proprietary product called SpecFUEL™. The commercial success of these facilities is unknown as WMI considers the information to be confidential. The Philadelphia facility was the result of a public procurement conducted by the City of Philadelphia which encouraged the development of a pilot facility.

The Edmonton facility serves as the front end processing step for the Enerkem waste-to-ethanol production facility. The mixed waste processing facility, owned by the City of Edmonton, appears to be working as planned. The waste gasification and methanol production components have been constructed, started up, tested, and produced methanol as planned in 2015. The energy conversion facility is currently shutdown to install the methanol-to-ethanol conversion line which is expect to be completed in 2017[5].

The Infinitus project in Montgomery, Alabama was successfully constructed at a cost of $35 million and placed into commercial operation in 2014. The project economics 3 were based upon a $28 per ton tipping fee coupled with high recycled commodity revenues of which 40-50% were shared with the host community[6]. The collapse in commodity prices has made the project uneconomic and Infinitus shut the facility down in October 2015. As of the date of this memorandum, the City of Montgomery and Infinitus are considering alternatives for this project and contract.

Entsorga MBT Facility

On January 6, 2016, Entsorga West Virginia LLC ("Entsorga"), held a groundbreaking ceremony for a new mechanical biology treatment ("MBT") facility in Martinsburg (Berkeley County), West Virginia. This groundbreaking was the culmination of a six plus year project development effort driven primarily by the project's three private sector participants: Entsorga Italia S.p.A. (technology provider), Apple Valley Waste

[3] Dongara, Manufacturing Process, http://www.dongara.ca/mprocess.html.

[4] The Star, York Region ends contract with company turning garbage into fuel pellets, November 3, 2014, http://www.thestar.com/news/gta/2014/11/03/york_region_ends_contract_with_company_turning_garbage_into_fuel_pellets.html.

[5] Enerkem, Enerkem Alberta Biofuels: a global game-changing facility! http://enerkem.com/facilities/enerkem-alberta-biofuels/.

[6] Recycling Today, Montgomery, Alabama, mixed-waste processing facility announces temporary closure, October 5, 2013, https://www.recyclingtoday.com/article/montgomery-alabama-infinitus-waste-processing-temporary-closure.

(waste supply), and Essroc Cement Company (fuel off-taker). The project participants are all equity members in the special purpose project company formed to own and operate the facility.[7]

The Entsorga facility is permitted to accept up to 500 tons per day, 9,999 tons per month, of incoming MSW[8]. The facility utilizes the MBT process to stabilize the raw waste, to recover high value scrap metal, and to produce a homogenous, high energy value, fuel product solid recovered fuel called SRF. The production process takes about 14 days, explained below, from the receipt of raw MSW to the shipment of finished SRF.

At the facility, route collection vehicles will discharge their waste loads into a pit inside an enclosed waste receiving hall. The hall will be equipped with high speed roll up doors as a part of the facility's overall odor management system. An overhead crane will retrieve waste from the receiving pit and load it onto a conveyor feeding a rotating screen. The rotary screen will divide the waste into two fractions, oversized and undersized. The oversized fraction, consisting mostly of dry paper and plastics will be directed to the SRF production line. The undersized fraction, rich in wet organic material, will be placed into a biological stabilization pit by the overhead crane system. In this stabilization pit, warm air will be forced through waste pile enhancing biological degradation and drying the material. Exhaust air from the stabilization process, and the balance of the plant, will directed to a bio-filter for odor control. After 10 to 14 days, the organics within the waste pile have been stabilized and an overhead crane will remove the dried stabilized waste from the pit and feed it into the SRF production line. Apple Valley already has a materials recovery facility to process clean, source separated recyclables, so no additional recovery of recyclable material, other than metals, is included at the Entsorga facility.

At the SRF production line, shown in the diagram in Figure 1, oversized material from the pre-processing section, and dried stabilized undersized material will be passed under magnets and eddy current devices to recover valuable metals. The balance of the combined streams will be fed to a shredding system for final size reduction. After shredding, the SRF will be held in a storage pit until it is loaded into trucks for transport to the fuel user.

---

[7] Berkeley County Solid Waste Authority, Findings of Fact and Conclusions of Law, January 24, 2013. http://berkeleywv.org/sharedimg/bcswa/13.pdf

[8] Procedural Order, Case No 12-0803-SWF-CN Case No 12-0803-SWF-CN, Public Service Commission of West Virginia, January 15, 2013. http://www.psc.state.wv.us/scripts/orders/ViewDocument.cfm?Case ActivityID=360476&Source=Docket

8

Entsorga sought and received a comfort letter from the Federal EPA stating that based upon the information submitted by Entsorga, the SRF produced by the Berkeley County facility should be considered a non-waste fuel under the EPS's Non-Hazardous Secondary Materials (NHSM) rule[9]

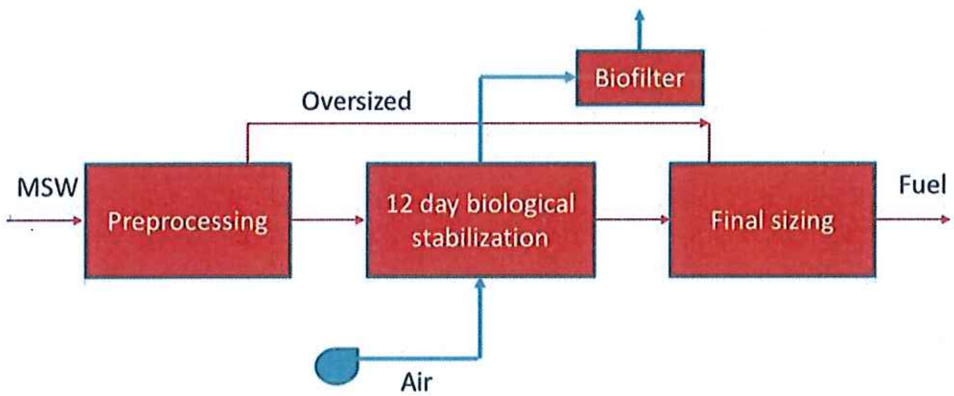

Figure 1: Ensorga Processing Diagram

The Entsorga process is presented as fully automated and controlled by a central computer system housed in a control room. Construction of the facility has been estimated to take about 18 months at a reported cost of $19 million. The facility is to be constructed on a site rented from the Berkeley County Solid Waste Authority. Entsorga proposes to charge a tipping fee of $65 per ton which includes $5.25 per ton for state and local assessments.[10] Active site construction is expected to commence in the spring of 2016 with commercial operations beginning in the summer of 2017.

Apple Valley Waste has committed to provide 54,000 tons of waste per year to the facility

The primary SRF consumer will be Essroc also located in Martinsburg, WV. The Essroc facility is a part of an Italian materials conglomerate, Itlacementi Group. On November 5, 2014, Essroc filed an application to modify its facility Title V air emissions permit to include the combustion of up to 35,581 tons of alternative fuel called "refuse based fuel (RBF)" per year. The application specified that the RBF would be delivered via walking floor trailers and offloaded into one of two alternative fuel hoppers. Fugitive dust at the offload hoppers would be controlled by baghouses. Screw conveyors would reclaim the RBF from the receiving hoppers and feed it into a pneumatic fuel feeding system, where it would be blown into the cement kiln. The exhaust from the receiving hopper baghouses would be directed to the cement kiln's

---

[9] US EPA letter to Entsorga WV LLC dated December 9, 2013. https://yosemite.epa.gov/osw/rcra.nsf/0c994248c239947e85256d090071175f/E676980825D88D5385257C71005B2C64/$file/14838.pdf

[10] Procedural Order, Case No 12-0803-SWF-CN Case No 12-0803-SWF-CN, Public Service Commission of West Virginia, January 15, 2013. http://www.psc.state.wv.us/scripts/orders/ViewDocument.cfm?CaseActivityID=360476&Source=Docket

clinker cooler and eventually exhausted out through the cement kiln's emission control system. No new emissions point source would be required. A permit modification was granted by the WV DEP Air Quality Division on March 27, 2015. In November of 2015, an Administrative Update was filed with the WV DEP seeking to increase the amount of RBF allowed to 67,593 tons per year. At the time of this memorandum, the increase request is still under review.

Orange County, NC Fuel Consumers

The potential fuel customers for an Orange County MBT facility would be coal or biomass fueled power plants and district energy facilities. Cement kilns could be another consumer but there are no such facilities within 50 miles of Orange County.

Using databases generated by the U.S. Energy Information Administration[11] and the North Carolina Department of Environmental Quality[12], the potential off-take customers within approximately 50 miles to Orange County were identified. There are three power production facilities in the area and zero cement kilns, as shown in Table 2. The three plants process coal, tire derived fuel, and biomass to generate power as electricity and/or steam.

Table 2 - Potential RDF Off-take Customers

Name	Operator	Fuel	Tons Per Year Fuel	Product
Mayo	Duke Energy Progress - (NC)	Coal	3,592,716	Power
Capital Power USA NC Roxboro	CPI USA NC Roxboro LLC	Coal/Tire/Wood	670,670	Power
Roxboro	Duke Energy Progress - (NC)	Coal	5,306,503	Power
University of NC Chapel Hill Cogen Facility	University of North Carolina	Coal	87,437	Power, Steam, Chilled Water

The location of these facilities relative to Orange County is provided in Figure 2.

Duke Energy is the local investor owned electrical utility ("IOU"). As a fully regulated state, IOU's have a fiduciary responsibility, as overseen by the state Public Service Commission (PSC), to seek the lowest possible fuel cost for its rate payers. Any capital investment required to burn SRF would likely require PSC approval which could be time intensive and costly. Given the size of the plants, even modest equipment modifications could be costly

[11] Monthly Generation and Fuel Consumption Time Series File, 2014 Final Release, U.S. Department of Energy, The Energy Information Administration (EIA).

[12] Permitted Facilities, North Carolina Division of Air Quality, March 2016.

Capital Power is a North American wholesale power generator headquartered in Edmonton, Alberta Canada. The Roxboro facility was built in 1987 and has a capacity of 48 Megawatts. It consists of 3 stoker grate fired boilers which are equipped with fabric filter baghouses for particulate control. This equipment configuration could be amenable to firing SRF with minimal equipment upgrades.

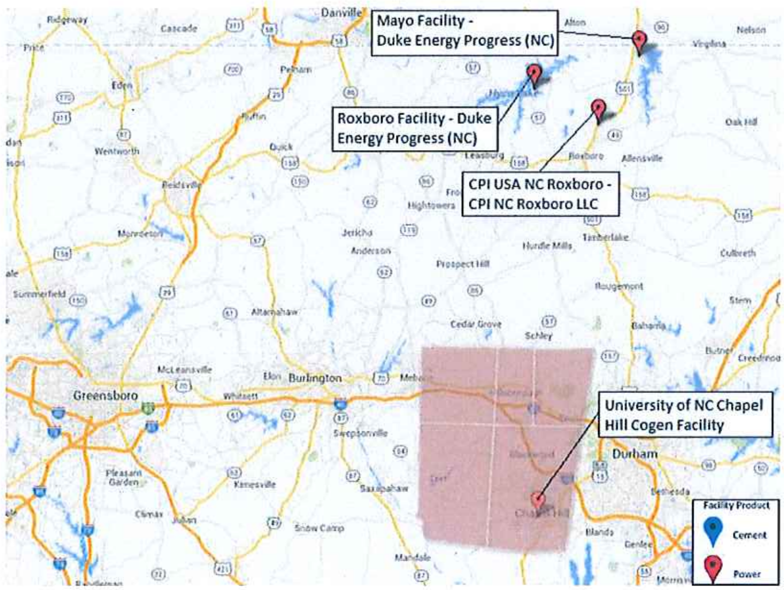

Figure 2: Facility Locations

The University of North Carolina operates a district energy system which provides electricity, steam and chilled water for its campus in Chapel Hill, NC. The district energy steam plant, shown in Figure 3, includes two coal-fired, circulating fluid bed boilers which can produce 500,000 lbs. per hour of steam each and 28 megawatts of electricity. The each boiler is equipped with a fabric filter for particulate control.[13] This equipment configuration could be amenable to co-firing SRF. An overhead view of the facility appears to indicate that all fuel deliveries made to the facility are via railcar, something that would need to be confirmed and accommodated.

In UNC's 2009 Climate Action Plan, UNC indicated an interest to utilize landfill gas from the County's closed landfill and testing of dried wood pellets and ~~terrified word~~ torrified wood as supplemental fuels for its coal-fired cogen boilers. If their interest in biomass fuel could be re-directed to a biogenic SRF instead, the fuel requirement of the cogen boilers appear large enough to absorb much more than the quantities of SRG that could be produced from the MSW and C&D materials generated in the County.

[13] University of North Carolina Energy Services Department, Cogeneration Facility. http://www.districtenergy.org/assets/pdfs/CHP_Case_Studies/UNCChapelHill.pdf

Figure 3: UNC District Energy Plant

Elements for a Successful MBT Project

Business Issues

A key step in developing a successful project is to lay a foundation of basic building blocks which provides the business case. Table 3 below provides a summary of building blocks and issues for a MWPF in Orange County.

Table 3: Project Building Blocks

Project Building Blocks	Considerations for Orange County
Regulatory Impetus and Incentives	A MWPF project would significantly increase diversion of recyclables and other MSW from landfill. Creates opportunity for production and utilization of renewable fuels.
Limited or High Disposal Costs	Orange County has access to reasonably priced out of county landfill disposal resources. It is GBB's opinion that it may be difficult to match those service charges. The question becomes: Will Orange County, incorporated jurisdictions, and businesses, be willing to pay a premium for moving to a 'greener' solution and can take the region closer to a zero waste to landfill waste management system?
Waste Supply	Orange County generates approximately 76,000 tons per year of MSW and C&D waste now; of which only about 12,000 tons, mostly C&D waste, are managed through the County's C&D Landfill. Will the generators of almost 74,000 tons be willing to contractual commit their waste volume to the project?
Markets	The key market to develop is that for the SRF. Markets first! From the review GBB has done, it would appear that the University of North Carolina's District Energy facility would be a prime candidate to consider.

12

	However, its potential supplemental fuel demand appears significantly greater than what could be sources from indigenous Orange County waste.
Site with Good Logistics That Can Be Permitted	The location of the MWPF does not have to be contiguous or on the site of the SRF user. It can be remote and the SRF shipped to the user in transfer trailers and unloaded within a totally enclosed receiving building.
Landfill for Residues	Arrangements would have to be made for this as Orange County does not have its own landfill resources. Significant shipments to out of county landfills will increase project economics negatively.
Contractor with Resources and Proven Technology	One would have to be procured through a competitive process; there are many that would be interested for a project that has addressed and pre-developed many of these building blocks.
Capital	This would become available with a financeable project and contractor with resources. Either public ownership or providing for tax-exempt private financing will improve project economics.
Ability to Pay Service Fees	This is a very important requirement as the certainty to pay by responsible parties with resources, e.g. local governments, will be important for project financeability and lower interest rates on debt, thereby improving project economics. If significant waste supply and payments are at risk, project financing will be more difficult and be a detriment to project economics.
Financing	Having a credit worthy contractor with proven technology as well as waste suppliers under contract and users for the SRF will be important to support a project financing. If these factors are not in place, project financing with public ownership and debt or significant equity would need to be considered to support a more risky and resulting more expensive project.
Compatibility with a High Level of Recycling	Orange County and the incorporated cities within it have admirable recycling already in place, including developing new channels for organics diversion and utilization. If a MWPF project were to be implemented, it will need to be kept in mind as abandoning current programs is probably not going to be considered.
Political Will	Is there a political elected official and/or body that will step forward to support the project?

Facility Design Considerations

After a decision to develop a project has been made, having a comprehensive material composition study on all types of material that will be processed is important to understand what can be recovered, and what equipment would be necessary to achieve this recovery. In addition, the study should also have evaluated the material to ascertain how it would behave in a processing facility, as a simple composition does not always tell the whole story. Once the material is known, estimates on the material flow within the processing system can be made to predict what materials could be recovered for recycling, what materials would end up as fuel, and what materials may be residue or other products.

In general, the more materials targeted for recovery, the more equipment and personnel needed. Metals, both ferrous and non-ferrous are straightforward to recover from the MSW stream and are almost universally included in MWP systems. Plastic bottles of #1 PET and #2 HDPE are also relatively easy to recover, either by optical units or manually, and have a good resale value. Other recyclable plastics and fibers such as clam shells, film bags, cardboard, newspaper, and office paper have also been recovered at certain facilities. However, the equipment and effort to recover these items is greater than with metals and bottles, and the percentage of recovery can be much less, especially if robust source separation/recycling is already in place in the County and its incorporated jurisdictions. For instance, upwards of 90% of the total metals and bottles in the waste stream can be recovered in modern MWPF with proper magnets and optical units. However, fiber recovery is generally between 50% and 70% of the total fiber in the stream, and can be less depending on a number of factors.

The final development of the goals of the facility would be to establish what will be done with the rest of the material outputs and what the systems throughput will be. This will also dictate the equipment needed for processing and clean-up of the other streams. For instance, for the SRF/RDF produced, is there a size requirement and does PVC need to be removed to keep the chlorine content low? For the fines and organics fraction, is composting or Anaerobic Digestion an option or would this also be used as a fuel? And finally, how much incoming material will be processed? Most facilities will rate the equipment system in tons per hour (PTH) which will ultimately dictate how many tons can be processed in a year. For example, a 50 TPH system running five days a week with two shifts (14 hours of runtime per day) can process approximately 182,000 tons per year (TPY). Sizing the system appropriately for the potential future incoming material is important, but so is sizing for efficiency. Too large a system is not cost effective to operate. Below, in Figure 4 and Figure 5, are layouts for two different MSW processing systems with different goals and levels of automation to illustrate the potential range (and complexity) of these systems.

14

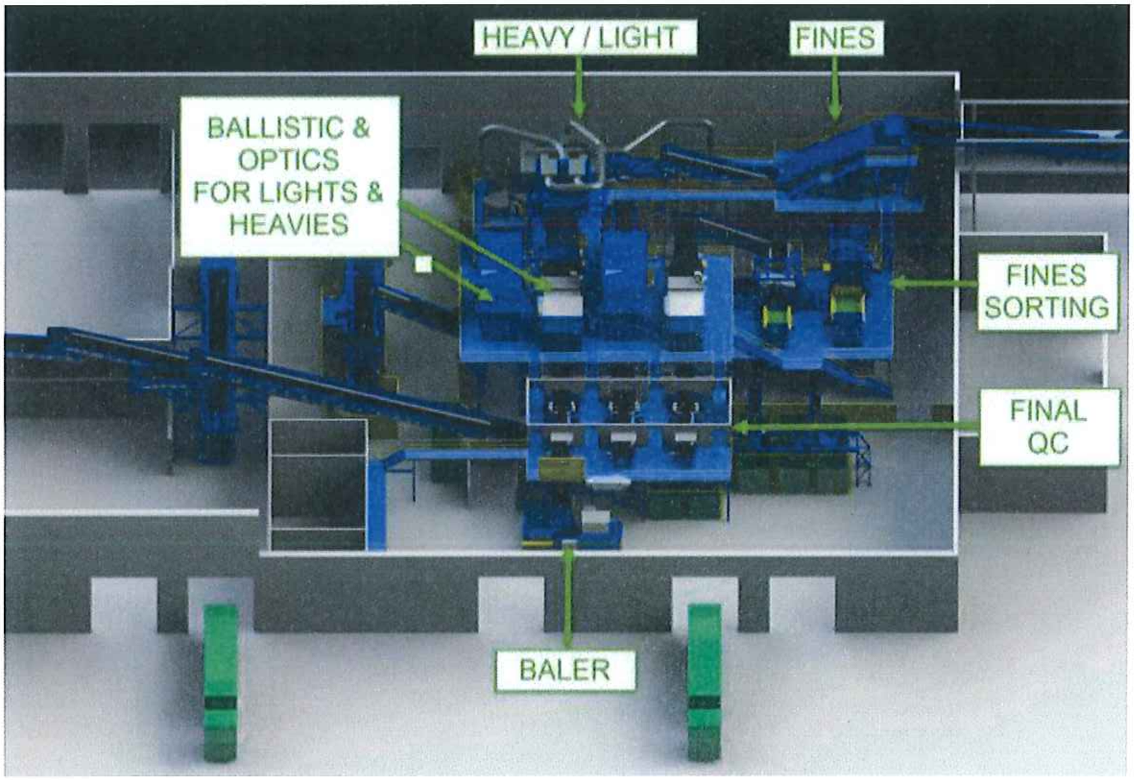

Figure 4: 30 TPH System to produce RDF and recover certain recyclables from MSW (Source: Machinex)

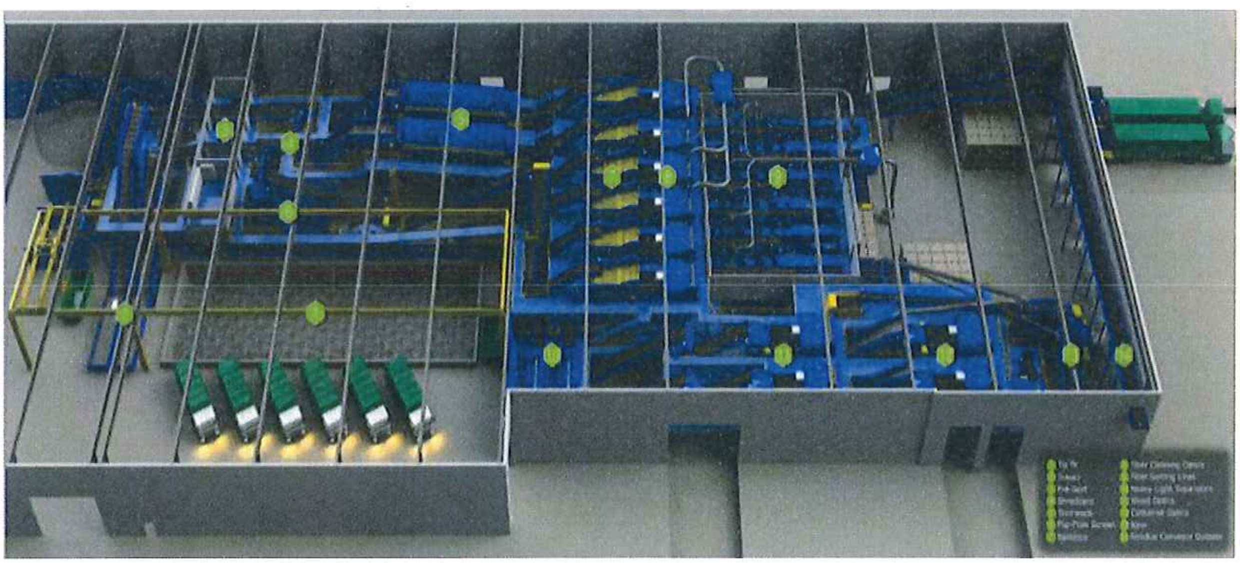

Figure 5: Facility to recover recyclables from a "one-bin" concept as well as produce an RDF fuel (Source: Machinex)