Review of Opportunities for Zero Waste to Landfills for Industries

Prepared for:

Kent County, MI
Department of Public Works

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1.0 Executive Summary

Gershman, Brickner & Bratton, Inc. (GBB) has been engaged by the Department of Public Works for Kent County, Michigan to review opportunities for Zero Waste to Landfill (ZWL) initiatives at commercial manufacturers throughout the Western Michigan region. Our team has partnered with the Sustainable Research Group (SRG) of Grand Rapids, Michigan to complete this review.

Together, the multiple waste streams produced by members of the Zero Waste to Landfill Users Group, have been examined and the corresponding methods and technology employed to divert that refuse from landfilling. The study involved empirical research on waste production, collection and disposal (from public and private sources), in-depth interviews with executives and engineers responsible for overall facilities management (including waste reduction and control) and on-site inspections and tours of manufacturing facilities (around Kent County).

This review was conducted during the months of June, July and August of 2015. Formal interviews and/or site visits took place at the following office furniture manufacturers; Haworth Inc., Trendway Corporation, Herman Miller Inc., in addition to, Grand Rapids Label Company, Heat Transfer Technology, Inc. and Padnos, Inc.. Additional information was gathered through public sources, during phone interviews and submission of proprietary Waste Generation and Management Information Forms to GBB and SRG.

Although each of the companies GBB researched and interviewed for this study had their own individual take on waste collection and diversion, it was clear that everyone shared a similar commitment to making Western Michigan a sustainable and responsible place to do business. They were equally concerned with the sustainability of their product, the economics of their business model, the welfare of their employees and the long-term health of the environment.

Each of the furniture manufacturers from the ZWL Users Group GBB visited has implemented rigorous and repeatable processes for recycling and reusing materials to reduce waste in their commercial production. They also face similar issues surrounding tough to recycle elements of their industrial process (e.g., powdercoat paint, used sanding belts and scrap wood permeated with resins and glue). A fundamental goal of the feasibility study will be to formulate and coordinate ideas to handle these difficult to recycle items, and avoid sending them to landfills.

The furniture manufacturers also share a similar quantity and content of their waste products. Several companies are individually producing thirty (30) tons per day of waste wood material, six (6) days per week. When you aggregate the total from other furniture manufacturers, this amounts to over 1,000 tons per day, or 6,000 tons per week of waste. It is this concentration of high output and homogeneous waste material on a daily basis within a limited geographic region that gives rise to potential sustainable solutions for Kent County. GBB will explore three of those options in Section 6.2 – ZWL Project Concepts, below.

When considering these concepts, GBB examined the availability and profitability of the technology for each waste stream. It is imperative that these projects have a long-term life cycle, a credible and expandable operating capacity and a reasonable rate of return to promote individual, corporate and institutional investment. Additionally, the report considers whether the projects should be spearheaded by the public sector or private industry alone; or if they can be more effectively developed and operated jointly through a public-private partnership, and presents the business case for each.

At the end of the day, customers around the world are now demanding transparency regarding sustainable business practices; and Western Michigan manufacturers feel the pressure to show their commitment to ZWL. One way for companies to handle their excess waste was to send tough to recycle material to the Waste to Energy Facility (WtE Facility) at 950 Market Avenue in Grand Rapids, rather than the landfill. However, this was not considered as an effective method of achieving ZWL. Kent County's WtE Facility has now reached its operating capacity in its current two-line configuration. Accordingly, a central goal of the study is to help DPW determine the necessity and economy of operating a third line at the WtE Facility in Grand Rapids, Michigan.

When this ZWL Project Review was initiated by the Kent County DPW, the basic perception was that a fundamental choice would have to be made between the construction and operation of a third line at the Kent County WtE facility versus the independent solutions of gasification and on-site MDF to energy in the West Michigan region. At the completion of our analysis, it appears these solid waste solutions for Kent County would not necessarily be mutually exclusive. In other words, our three project concepts defined above should not be seen as a "This or That" decision between competing solid waste solutions; they can legitimately be viewed as a series of "This and That" opportunities for Kent County, Michigan.

The next logical step in this analytical process and industry evaluation would be to select which of the ZWL Project Concepts (identified in Section 6.2, above) has a real potential for success in Kent County and Western Michigan; and then conduct a formal feasibility study to create a comprehensive business plan that supports those initiatives – politically, financially, and technically. Thank you again for the opportunity to participate in this important process. We look forward to hearing your thoughts and comments on this review of project concepts for ZWL and the industries in the Kent County region.

2.0 Introduction

2.1 Purpose

In 2015, Kent County's (County) Department of Public Works (DPW), retained Gershman, Brickner & Bratton, Inc. (GBB) to help the County identify opportunities for the County DPW to work with local industry, particularly manufacturers, to increase the availability of zero waste to landfill disposal and processing options in the region. GBB efforts include understanding waste being generated by these companies and to evaluate disposal and processing possibilities through the County's existing infrastructure. This report presents various technology options to the County and discusses the possibility of utilizing new or additional technology to manage materials from industry.

2.2 Scope

Nationwide, major brands and manufacturers are gaining interest in certification as ZWL businesses, due to pressure from distributors and retail customers, shareholder interest, or as a key piece of a company's sustainability plans. Nestlé recently announced that in the U.S., all of its manufacturing facilities are landfill-free. This transition away from landfilling included WtE, composting, recycling, and modifications to supply and assembly systems. Local companies, like Steelcase, Haworth, Trendway, and Herman Miller have already moved in this direction by bringing waste for secure destruction at the Kent County WtE facility, building their own internal conversion facility, or shipping prepared fuel to Genesee facility.

Several local industry associations have expressed interest in being able to become certified as ZWL and want to consider available approaches and technologies for this and understand the cost implications as well. The County has space at the WtE facility to add a third line or to utilize an alternative WtE technology, and the County wants to be responsive to the needs its local and regional industries and consider the efficacy of expanding its waste-to-energy or adding conversion technology infrastructure. There also is a company in the region that has gasification technology that the industries are interested to consider.

The scope of this evaluation includes:

- Assistance in establishing communications with these industries that have desire to become ZWL certified;
- Determination of how much feedstock is available for processing or conversion; and
- Evaluation of available approaches and technologies for use with available feedstock types and quantities.

2.3 Methodology

The methodology GBB has applied for this review is comprised of the following elements:

- Collection of data about the regional manufacturing marketplace and review of same;

- Engagement of Sustainable Research Group, to connect the County DPW with its industry members;
- Conducting meetings with four manufacturer stakeholders to hear their opinions/perceptions/ideas regarding a County DPW partnership, waste to energy technology, and the need for zero waste to landfill processing and disposal options;
- Undertaking independent research for development of waste projections, technology benchmarks, ideas and strategies;
- Development of three project concepts for review by the County DPW and stakeholders;
- Analysis of information gathered; and
- Preparation of this report.

This work was conducted over a two-month period.

2.3.1 Engagement of Sustainable Research Group

Sustainable Research Group (SRG) is facilitating a user group program through the Michigan Manufacturers Technology Council, West (a US Department of Commerce/National Institute of Standards and Technology[1]) program. The Zero Waste to Landfill (ZWL) User Group is working with Western Michigan industry to evaluate ZWL options in the region. The User Group is a membership initiative composed of many of Western Michigan's leading manufacturers that have corporate initiatives seeking to divert as much waste material as possible from landfill disposal. GBB is working to support the County's outreach to these groups, and their member companies as potential ZWL customers.

GBB held meetings with SRG and ZWL User Group members, and set up facilitated meetings. During these meetings, GBB reviewed potential ZWL customers':

- Current waste management practices: materials generated, frequency and patterns of generation, current contractors and management strategies used, costs, and disposal and processing locations.
- Desire to go to ZWL, and what has already been done to achieve this goal.
- Openness to using WtE (at the existing facility or with a new technology in the space set aside for a third line) to achieve ZWL.
- Interest in using recycled products/recovered materials streams/steam generated by WtE in their manufacturing process, if applicable.

GBB and SRG are to work with the County to advance discussions with other companies that are interested to contract with the County for disposal or processing, and to ensure that the County's facilities can provide ZWL certification for these customers. SRG are to work with targeted regional businesses to help generate interest in the project, create introductions and to help schedule timely meetings with the GBB team. To support the efforts of the project five members of the ZWL User Group have partnered with the Kent County on the project.

[1] http://www.nist.gov/mep/about/index.cfm

Table 1 - Zero Waste to Landfill Participating Companies

Company	Location	Industry
1. Grand Rapids Label Company	Grand Rapids, MI	Printing
2. Haworth Corporation	Holland, MI	Office Furniture
3. Herman Miller, Inc.	Zeeland, MI	Office Furniture
4. Landscape Forms, Inc.	Kalamazoo, MI	Outdoor Furniture
5. Trendway Corporation	Holland, MI	Office Furniture

3.0 Background

3.1 Waste to Energy in the Region

The County's WtE Facility, operated by Covanta Energy (Covanta), began commercial operation in January 1990. The facility, shown in Figure 1, located at 950 Market Avenue SW in Grand Rapids, is designed to process 625 tons per day of MSW, generating up to 18 megawatts of electricity and up to 116,000 pounds of steam per hour for export. Under Covanta's operating contract, the company is responsible for maintaining the WtE facility. Waste is delivered to the facility from the City of Grand Rapids and five surrounding cities of East Grand Rapids, Grandville, Kentwood, Walker, and Wyoming, as well as some waste haulers and commercial customers from the County.

This facility provides some capacity for secure destruction services and offers local industry an opportunity to be Zero Waste to Landfill (ZWL). Although some businesses utilize these services, the WtE facility's limited capacity and the high heating value of discards from manufacturing, especially wood and plastic composites prevent the County from increasing the supply that can be combusted for energy recovery and directed away from landfilling.

Figure 1
Waste to Energy Facility

The facility has two 312.5-ton per day waterwall furnaces with Martin® reverse-reciprocating grates, ash handling system, computerized combustion controls, semi-dry flue gas scrubbers injecting lime, carbon injection for control of mercury emissions, a SNCR system for control of nitrogen oxides, bag houses for control of heavy metals and particulates, continuous emissions monitoring (CEM) and ferrous recovery systems. The WtE Facility operates under one of the toughest environmental permits in the State. In

addition, an independent lab conducts separate stack emission tests every year in accordance with State standards with State Inspectors present. The ash produced at the plant is nonhazardous and represents a 90 percent reduction of the space in a landfill of regular waste would require. MSW coming to the WtE Facility is screened by County employees before being placed in the waste storage pit. The Facility also has the ability to remove oversized or non-processable waste from the waste storage pit without running it through the combustion units. The facility and site were designed to add a third line if expansion were to become necessary. Table 2 shows 2014 throughput statistics for the Facility.

Table 2 - WtE Facility 2014 Performance

2014 Tons Processed	2014 Tons per Day Averaged Processed	Capacity Tons Per Day
247,406	678	625

The WtE Facility's Average Tons per Day Processed is higher than its Capacity because approximately 50 tons of waste per day is received at the facility but not combusted. Instead, this waste is transferred to the South Kent Landfill.

The County's responsibilities for management of the facility include:

- Oversight of Covanta operations;
- Operation of the facility scalehouse;
- Management of the tip floor at the facility, including loading bulky and high BTU materials into open top transfer trailer;
- Operation of compactor and waste transfer functions at the facility; and,
- Waste transfer from the Facility to the County's South Kent Landfill.

The County has an agreement with Covanta for the operation and maintenance of the facility, and a Power Purchase Agreement (PPA) with Consumers Energy, for the sale of energy produced by the facility. The agreement with Covanta, originally titled "the Construction and Service Agreement was entered into between the County and Covanta, formally known as Ogden Martin System of Kent, Inc., was signed in 1987, was recently amended 2008, and is now entitled the "AMENDED AND RESTATED SERVICE AGREEMENT between THE COUNTY OF KENT, MICHIGAN AND COVANTA KENT, INC. The original agreement covered the design, construction, acceptance and post acceptance operation of the facility, and the Amended and Restated agreement signed in 2008 will end on February 1, 2023.

The PPA with Consumer Energy for the purchase of power was signed in 1986 and ends 32 years after the facility commercial operation date, in 2023. The payments to the County are comprised of four primary components and one adjustment for administrative costs. As a result, the average price for power sold from the facility is approximately $0.087 per kWh. This is a very high revenue for WtE power as compared to many facilities across the U.S.

There is one other major biomass and waste material-to-energy boiler near the region. Consumers Energy operates the Genesee Power Station in Flint, Michigan, 122 miles from the Kent County WtE facility, shown in Figure 2. The facility is a biomass power station, and primarily accepts wood wastes as feedstock. Small amounts of tire-derived fuel are also accepted. Commercial customers, including

several manufacturers with whom GBB met during June 2015, often haul waste materials to be utilized as a fuel. Genesee Power Station produces up to 38 MW of renewable energy. The facility displaces 100,000 tons of coal and 1.13 acres of landfill space each year.

Figure 2
Genesee Power Station

Accepted materials at the Power Station include:

- Pallet, plywood, laminated wood, and other clean wood waste debris.
- Overseas heat treated pallets, containers, boxes and or other engineered / manufactured wood materials containing glues and resins.
- Metal fasteners, screws or nails less than 5/8" in diameter used in the construction of wood pallets, containers or boxes.
- Gaylord boxes
- Wood Chips & lumber cut-offs
- Branches, brush, logs & stumps

The State Department of Environmental Quality also approved the power station to use animal bedding in addition to scrap wood for up to 30 percent of its fuel, after test burns found only minuscule amounts of nitrogen oxide and carbon monoxide from the new fuel mix.

In 2012, Consumers Energy announced plans to build a major new natural gas power plant in Thetford Township, Genesee County, which is about 20 miles northeast of Flint, with an estimated project investment of $750 Million. The site already is home to nine smaller **natural gas fired combustion turbine units.** Construction was planned to begin in 2015, but the project was then put on hold. During the meetings with manufacturers it was noted that the Genesee Power Station taking wood waste from industries may close in the next ten years, and that manufacturers will need to find an alternative end-of-life facility for their wood waste. Though Consumers Energy's intentions and plan for closure have not been formally announced, the company's plans to grow its natural gas capacity in other parts of the state and throughout its service area (in part to replace coal capacity that is coming off line) lend context to the expectation of closure.

3.2 Commercial and Industrial Waste Generator Needs

Nationwide, major brands and manufacturers are gaining interest in certification as ZWL businesses, due to pressure from distributors and retail customers, shareholder interest, or as a key piece of a company's sustainability plans. This transition away from landfilling may include technologies such as WtE, composting, recycling, and modifications to supply and assembly systems. Local companies, like Trendway, Haworth, Landscape Forms, and Herman Miller have set ZWL goals and are already moving in this direction by establishing internal goals and have made great strides toward achieving ZWL.

More companies in the region are realizing that setting a goal to achieve zero landfill disposal can be a powerful tool to energize their larger sustainability initiatives. What they have found is that setting such a seemingly unachievable goal empowers staff to find cost savings, potential new revenue streams and it serves to reinforce their existing lean manufacturing philosophy. In many cases these initiatives have come to be known as Zero Waste to Landfill programs (ZWL).

The U.S. Zero Waste Business Council defines zero waste as: "Zero Waste is a goal that is ethical, economical, efficient and visionary, to guide people in changing their lifestyles and practices to emulate sustainable natural cycles, where all discarded materials are designed to become resources for others to use. Zero Waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health."[2]

In the beginning of the ZWL movement zero waste was loosely defined as achieving 90 percent or better diversion from landfill disposal. Recently many companies claiming ZWL are reporting 100 percent diversion; however these claims typically do not include waste generated outside their facility such as the resulting ash when sending waste to a waste-to-energy or renewable energy facility.

Today, leading companies and several independent third party validation schemes do include these outside issues in their definition of ZWL. Companies that accept the ZWL challenge are committing to look at all forms of waste generated or caused to be generated throughout the life cycle of their operations and many now require between 98 and 100 percent absolute landfill diversion to receive a ZWL designation. ZWL is a growing concern among the commercial/industrial sectors in Western Michigan. Table 3 lists ZWL certification programs available to manufacturers.

Table 3 - Zero Waste to Landfill Certification Programs

Organization	Name of Program	Definition of Zero Waste	Certificate/Verification Period
Green Circle Certified	Waste Diversion from Landfill	98%	Annually
Intertek	ZWL Certification	99%	3 years with annual review
NSF International	NSF Guideline 445	99%	5 years with annual reviews
UL Environment	UL 2799	100%	On-going, with annual reviews

[2] Zero Waste Business Council http://uszwbc.org/about-uszwbc/uszwbc-guiding-principles

Table 4 shows facilities available in the West Michigan region for processing and disposal of waste materials.

Table 4 - Regional Processing and Disposal Facilities

Company	Type	Location	Website
Autumn Hills Recycling & Disposal Facility	Municipal Landfill/Compost/Gas	Zeeland	https://www.facebook.com/pages/Autumn-Hills-Landfill/145662415464923
Bata Plastics	Recycling Broker/Processor	Grand Rapids	www.bataplastics.com
Benton Metal Recycling	Non-Ferris Recycling	Benton Harbor	www.bentonmetalrecycling.com
Central Sanitary Landfill	Municipal Landfill	Pierson	https://www.facebook.com/pages/Autumn-Hills-Landfill/145662415464923
Chef	Commercial Single Stream Recycling & MRF	Holland	www.chefcontainer.com
CLM pallet recycling Inc.	Wood Pallets	Grand Rapids	www.clmpallet.com/bluewood.html
County of Muskegon Landfill		Ravenna	www.co.muskegon.mi.us/solidwaste
Forest Lawn Landfill	Kalamazoo County	Three Oaks	www.republicservices.com
Franklin Metal Trading Corporation	Metal Recycling	Grand Rapids	www.franklinmetaltrading.com
Fiber By-Products Corp	Pallet, Wood & Sawdust Recycling	White Pigeon	www.fiberby-products.com
Fremont Metal & Paper Recycling	Metal & Paper	Fremont	www.fremontmetalandpaper.com
Fryman's Recycling	Plastic Recycling	Benton Harbor	www.frymansrecycling.com
Grand Rapids Iron & Metal Co.	Metal, Plastic and Paper Recycling	Wyoming	www.grimrecycle.com
Harbor Foam Inc	Plastics, Metal	Grandville	www.harborfoam.com
Kamps Pallets, Inc.	Wood recycling	Grand Rapids	http://www.kampsinc.com/
KLW Recycling	Paper & Plastics	Holland	www.klwrecycling.com
Michigan Recycling Industries LLC	Plastics, Glass, Metals	Holland	www.mirecycling.com
Ottawa County Farms Landfill	MSW	Coopersville	www.republicservices.com
Padnos	Metal, Plastics, Paper	Holland	www.padnos.com
South Kent Landfill	MSW, ASF, Recyclables, Tires, Appliances	Byron Center	www.accesskent.com/Departments/DPW/south_kent.htm
West Side Iron & Metal Co	Metal	Holland	www.westsideironandmetal.com

4.0 Site Visits and Meetings

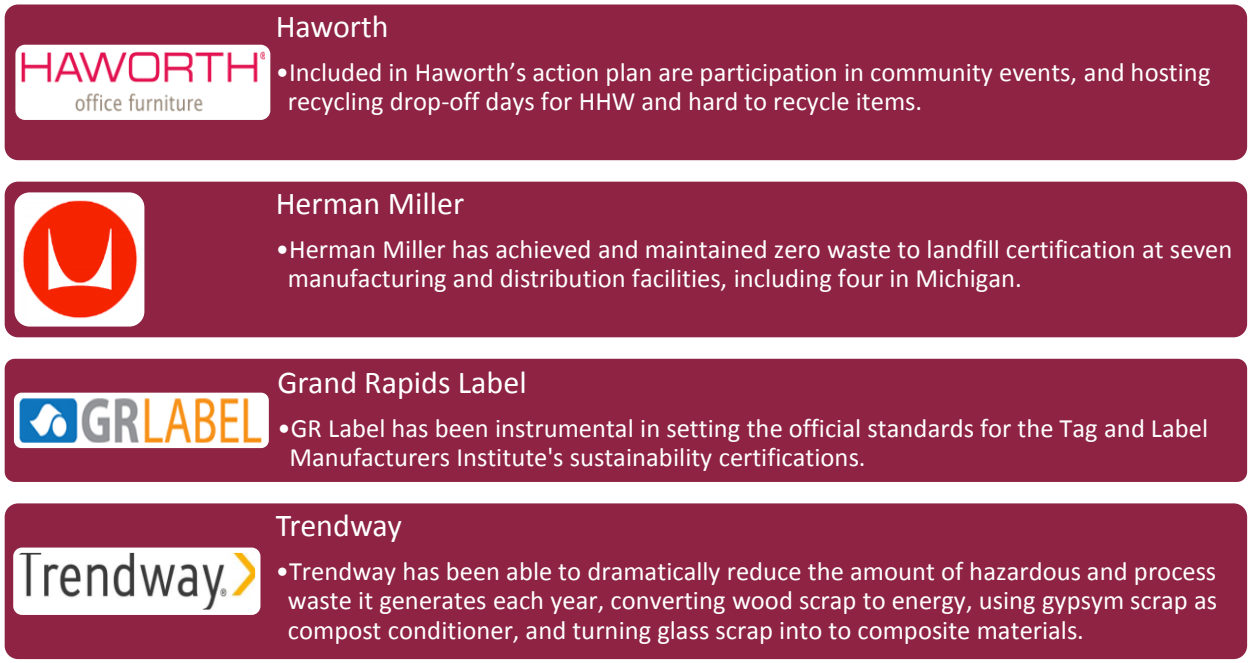
4.1 Background Research and Preparation for Meetings with Regional ZWL Partners

Grand Rapids has long been a manufacturing center for the office furniture, automobile and aviation industries. It is still home to five of the world's leading office furniture manufacturing companies. The economic engine, and corresponding municipal waste, of West Michigan goes well beyond the nickname of Furniture City. A comprehensive look at the top 100 employers (shown in Attachment A) indicates a robust economy, diverse academic, commercial and industrial base, and high potential for participation in an organized and publicized ZWL program.

Prior to meeting with industry members in Kent County, GBB gathered data on manufacturers' current waste management practices and goals. This information includes: Company mission and Intention regarding sustainability and waste, solid waste to landfill (in tons), technology use in sustainability/waste, financial commitment to sustainability/waste, locations and personnel participating in waste reduction and diversion efforts, and certifications achieved through key zero waste and sustainability metrics. GBB tracked this information from the past, the present, and plans and outlook for the future in Attachment B.

Many of the companies reviewed prior to the meetings had stated sustainability goals that included waste reduction, increasing recycling and reuse for manufacturing scrap and packaging materials, composting any non-hazardous organic waste, and finding improvements in wood finishing, powder coating, or other manufacturing processes to improve the recyclability of materials. Figure 3 highlights the activities of several participating manufacturers.

Figure 3
Company Steps toward ZWL



In addition to specific company information, GBB reviewed research and reports on commercial waste generation in West Michigan. The West Michigan Sustainable Business Forum and the Michigan Manufacturing Technology Center – West (MMTC-West) have supported business ZWL efforts and have developed programs to help manufacturers manage their wastes.

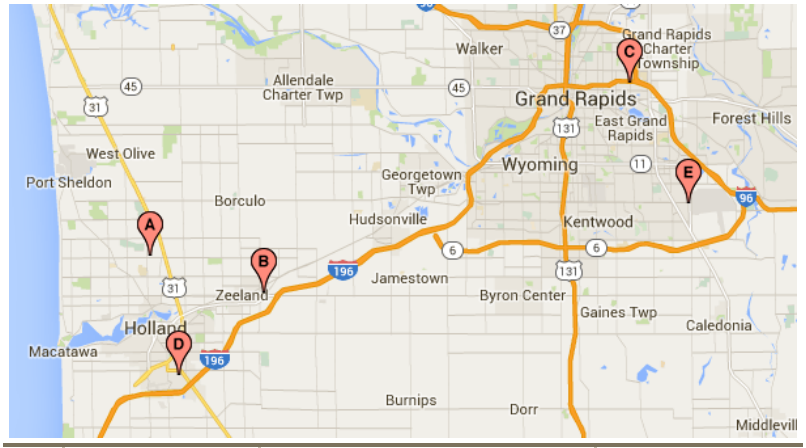
In 2013, MMTC-West developed a new "Zero Waste to Landfill" User Group to assist regional manufacturers in finding ways to divert landfill waste with a goal of achieving zero waste going to a landfill. The group consisted of 10 West Michigan companies representing a variety of industries (ADAC Automotive, Crystal Flash Energy, DeWys Manufacturing, Grand Rapids Label Company, Haworth, Herman Miller, Landscape forms, Light Corporation, Trendway Corporation, and Western Michigan University). These groups have worked to repurpose materials that were previously disposed, modify manufacturing and packaging practices to reduce waste, and find facilities to process recyclable materials.

4.2 Meetings with Regional ZWL Partners and Site Visits

Our team was able to meet with executives and engineers from four of those companies during our comprehensive site visit to Western Michigan. In addition, GBB scheduled interviews with executives from the leading recycling operator in the region, Padnos, as well as the emerging gasification technology company in Kent County, Heat Transfer International (in Section 4.3). Figure 4 shows the locations of sites visited during these meetings.

The following represents a summary of those visits and the information that was gleaned from public sources, private interviews and on-site tours and inspections of their production facilities. Each of the companies and individuals GBB interviewed demonstrated a disciplined and rigorous commitment to Zero Waste to Landfill in general, and a deep sense of personal and corporate responsibility to their products, the environment and long-term sustainability in West Michigan.

Figure 4
Map of Sites Visited and Manufacturing Facilities in Region



	Name	Address	City
A	Trendway	13467 Quincy St	Holland
B	Herman Miller	855 E Main Ave	Zeeland
C	GR Label	2351 Oak Industrial Dr. NE	Grand Rapids
D	Haworth	1 Haworth Center	Holland
E	HTI	4720 44th Street SE	Kentwood

4.2.1 Herman Miller

Herman Miller is a 100-year-old-plus furniture company that places great importance on design, sustainability and the environment, community service, and the overall health and well-being of its customers and employees. Based in Zeeland, Michigan, their furniture designs are some of the most respected and popular pieces throughout the world. Herman Miller became a public company in 1970 and trades on the NASDAQ Global Select Market under the symbol MLHR. Their net sales in fiscal year 2013 were $1.8 billion.

GBB interviewed and toured the main production facility with Tom Egeler, Senior Safety and Sustainability Specialist at the Global Headquarters of Herman Miller. Following that initial visit, GBB interviewed and toured the on-site waste-to-energy facility with Jerry Akers, Senior Energy Manager in the Engineering Department. As with all our manufacturing site visits, the purpose was to understand the company's commitment to ZWL, the actions taken to achieve that status, the changes (aka growth) in waste production, the challenges faced by tough to recycle materials and the willingness to work with other companies and the County to create solutions.

Herman Miller has manufacturing and distribution facilities around the globe, with major brand production in Western Michigan. Here is a current list of production facilities (and subsidiaries):

- Zeeland, MI
- Holland, MI
- Spring Lake, MI
- Atlanta, GA (Geiger)
- Hildebran, NC (Geiger)
- Sheboygan, WI (Nemschoff)
- United Kingdom
- Ningbo, China
- Dong-guan, China (POSH)

Seven of the Herman Miller production facilities have achieved – and continue to maintain – ZWL status: GreenHouse, the Design Yard, Marigold Lodge and Midwest Distribution Center in Holland, MI; Hickory in Spring Lake, MI; Geiger International in Atlanta, GA; Geiger Seating in Hildebrand, NC; and Ningbo, China. There is also a goal for 100% of products to be BIFMA[3] Level 3 Certified by 2023. At the end of fiscal year 2014, over 64% of their furniture product lines were Level Certified, with more than 35% being Level 3 Certified. The goal for fiscal 2023 is for 100% of products at Herman Miller to be BIFMA Level 3 Certified.

[3] BIFMA is a multi-attribute, sustainability standard and third-party certification program for the furniture industry. In order to achieve a Level Certification, a manufacturer must contract with an authorized, independent, third-party certification body. That certification body then uses the ANSI/BIFMA e3 Furniture Sustainability Standard to conduct the audit function, measure all required information, verify compliance and certify the specific product with the level conformance mark. Products can be awarded a Level 1, Level 2, or Level 3 conformance mark based on the combined score achieved in their sustainability evaluation. These three thresholds are comparable to the Silver, Gold, and Platinum rankings within the LEED rating systems.

The company has created a 10-year sustainability strategy called Earthright. Earthright began in 2013 and has three guiding principles: positively transparent, living things, and greener together. According to the CEO, Brian Walker, "We renewed our commitment to environmental advocacy by focusing our goals in a program called Earthright, which will extend our environmental work to the entire Herman Miller community."

Prior to Earthright, the sustainability program for Herman Miller was called "20/20." Its basic goal was to divert all solid waste from landfills by 2020. This was a lofty goal, considering that only 20 years ago, the company sent just over 13,000 tons of solid waste to landfills in their fiscal year ending 1994.

Within fifteen years, the company had reduced the total amount of solid waste going to landfills by almost 90% to just under 1,500 tons in fiscal year ending 2009. According to public records, Table 5 shows the progression / reduction of solid waste to landfill for the past 8 years at Herman Miller:

Table 5 - Herman Miller Solid Waste to Landfill

Year	Tons
FY 2009	466
FY 2010	1,064
FY 2011	1,328
FY 2012	445
FY 2013	442
FY 2014	305

The reduction goal for Fiscal Year 201 is to send 292 tons of solid waste to landfill.

After tracking the first year's (2014) results for total waste against the 10-year Earthright target, there was a cumulative reduction of 137 tons from fiscal 2013. Of this total reduction, 120 tons of landfill waste was reduced by recycling powder paint as well as composting at Nemschoff.

As an integral component to Earthright, the company reported in 2013 that they had asked a sampling of core suppliers to commit to a long-term date to get to a zero footprint along with Herman Miller. They must track and show an ongoing reduction in their air emissions, landfill, process water use, energy, and hazardous waste. Currently, 76% of suppliers are engaged. The goal is to get 100% of Herman Miller suppliers to be part of the 10-year Earthright commitment.

As with all office furniture manufacturers, one of the biggest problems they face in ZWL is the waste generated from powder coat paint. Herman Miller works with VanderWall Bros. Concrete Products of Spring Lake to develop a process for mixing scrap powder paint waste with concrete used as counterweights inside some furniture products and in building blocks. This technique allows the company to recycle and reuse some of the powder coat back into the production line.

The transfer efficiency of powder coat paint is anywhere from 50% (low) to 70% (highest). Herman Miller claims a transfer rate of 60 to 70%. Even with that high production standard, there is a minimum 30% of powder coat waste to dispose, which can easily exceed One Million pounds (or 500 tons) per

year. All waste powder coat is mixed together, and turns grey in color. Unfortunately, there is no active market for waste grey powder coat paint for industrial re-use.

In 2012, the company had a technical breakthrough related to reusing waste powder coat from the painting of their metal parts for filing and storage products. Using a new technique, they were able to reuse 65% of the powder coat overspray to paint the interiors of filing drawers.

The major component of waste for office furniture manufacturers is wood. Currently, Herman Miller and other manufacturers send the bulk of their wood waste to the Genesee Power Station in Flint, Michigan. However, there is a concern among the ZWL Users Group that the sharp drop in energy prices could eventually force Genesee to close down its operations. That would leave the manufacturers with a limited choice of current options to avoid landfilling their waste.

Three of those options are examined in detail in Section 6.2 – ZWL Project Options, below.

One innovative way Herman Miller is solving their waste problem is by converting their MDF (Medium Density Fibreboard) into energy at their on-site production facility in Zeeland, MI. They built an $11 Million waste-to-energy Heating & Cooling plant that saves Herman Miller approximately $1 Million per year in fuel and landfill fees. When the WtE plant is operating, it provides approximately 10 percent (10%) of the complex's heating and cooling requirements.

Herman Miller has taken other innovative steps to manage its waste. In its Zeeland, MI plant, they reduced Styrofoam packaging by 70%; and it replaced the 800,000 Styrofoam cups used annually by its employees with 5,000 reusable ceramic mugs. It also sells its scrap fabric rather than burning it or landfilling. At every turn, the company pursues sustainability and participation amongst its employees, suppliers and customers. The founders of Herman Miller believed in Green Manufacturing. Earthright looks at the entire life-cycle of their furniture products (from supply to manufacturing to use and after use) to eliminate harmful content in their product line.

The executives at Herman Miller would embrace any solid waste solution or creative program that would help their community, their region and the environment. They have also offered to make additional engineers and executives available for this study, if requested.

Figure 5
Herman Miller Site Visit Photographs

4.2.2 Haworth

Haworth is another amazing story of originality and perseverance in the Western Michigan furniture business. In 1948, Gerrard Wendell (G.W.) Haworth borrowed $10,000 of his parents' life savings to expand a woodworking operation in his family's garage. Six years later, in 1954, Haworth wins a bid to build an innovative office partition system designed for the United Auto Workers headquarters in Detroit. Over the next 20 years, the company expanded its partition line into pre-wired and modular office spaces and grew revenue by 400 %. At present, Haworth operates in 126 Countries, has 650 dealers and 6,000 employees (which are known as members).

Through all this time of growth and expansion, Haworth has remained a privately held company with a clear commitment to sustainability for its products, its employees and the environment. By the end of 2014, Haworth had global sales over $ 1 Billion for its office furniture business.

Haworth's commitment to sustainability is seen in their Value Stream Approach to business and operations. For years, the economy promoted a linear value stream that focused on products and services with short life spans. At Haworth, their goal is to alter and improve this paradigm into a circular value stream that includes products and services that are part of a sustainable economy.

Shifting to this holistic approach required sustainable products and sourcing, the sharing of knowledge and services, continuous support and engagement of the community, and the accountability of their global operations. Figure 6 shows a graphic view of their value stream approach.

Figure 6
Haworth Value Stream Approach

GBB interviewed and visited the main facility in Holland, Michigan with Bill Gurn, Manager of Facilities and Operations for Haworth. Bill has worked at Haworth for 35 years, and he been a driving force for waste reduction and sustainability inside the company and around the Western Michigan region, he also serves as the Chair of the Board of Directors of the Michigan Recycling Coalition an organization that promotes commercial and residential recycling in the State. Bill has instituted innovative recycling campaigns and procedures at Haworth; and he has served as Chairman of the Michigan Recycling Coalition for the past 10 years.

Haworth has been landfill free since 2009 in the U.S., and throughout the world since 2012. The goal is to make all of the waste "disappear" within the cost frame of landfill tipping fees (which are currently $35 per ton in Western Michigan) plus pull fees. Currently, 99% of their furniture waste goes to reuse or recycle, and only 1% goes to the WtE Facility in Kent County.

Haworth has a broad range of recycling options for its operations and its members, including powder coat paint, wood waste, computers and electronic components, paper, fabric, plastic, aluminum, steel,

corrugated cardboard, light bulbs, glass, skids, batteries, and other by-product materials of manufacturing and office operations. Even large bulky items like appliances are accepted at Haworth. Virtually everything is accepted from members except refrigerators. If items used by members cannot be recycled at Haworth, they are simply asked to take them home.

In the Haworth Sustainability Report from 2014, they proudly declare "One of our most tangible goals in the past 10 years was to achieve Zero Waste to Landfill (ZWTL) status globally." This program has four defined sustainability objectives centered on the furniture production process:

- People: Conducting business with communities in mind
- Product: Driving more sustainable material and design choices
- Accountability: Taking responsibility for waste, energy, and water use
- Knowledge: Partnering with suppliers and clients to drive sustainable changes

Currently, headquarters at Haworth is driving for the preservation of Zero Waste to Landfill status by using data from regular waste-to-energy audits to help identify potential areas where improvements are needed.

Immediately after achieving Zero Waste to Landfill status at Haworth, the second stage of their zero waste initiative began. Waste-to-energy reduction goals were created and global teams are working to increase recycling rates, eliminate unnecessary materials, and source more recyclable resources. Since 2010, U.S. plants have reduced waste-to-energy quantities by nearly 40 percent.

Haworth generates about 30 tons per day of wood waste, or 180 tons per week based on a 6-day production cycle. They also produce 1 Million pounds (or 500 Tons) per year in Powder Coat.

They currently have their wood chipped by an outside source and send the material to Genesee Power Station in Flint, Michigan. They would prefer not to have to grind their wood in advance; and they believe cogeneration and waste to energy plants are too expensive. That said, Haworth would consider any reasonable solution short of landfilling. Recently, they warehoused refuse production material for two years at their plant to avoid sending their waste over to the landfill.

At Haworth, member education is a vital aspect of sustaining ZWTL status. Team leaders ensure all members understand the benefits of ZWTL through training courses, information videos, and factory tours. The team performs regular audits to gauge waste-to-energy reduction.

Haworth conducts community-wide recycling events to collect less-often recycled materials such as appliances, electronic components and computers; and pays to have them recycled. Haworth Packaging Reduction Initiatives focus on minimizing the total packing materials used while still protecting the product. All Haworth packaging materials are designed to be recycled. Wherever possible, Haworth uses returnable packaging in manufacturing. Customers are offered options such as bulk pack, and in some cases, blanket wrap which can significantly reduce customer-site installation waste.

Haworth is a partner in the Michigan Business Pollution Prevention program. Haworth is also a charter member of EPA Waste Wise solid waste minimization program and has won a number of Waste Wise

awards including the sustained achievement award in 2004. They recently located a new recycling source (while working with the Zero Waste to Landfill User Group) for powder coat waste – which helped them achieve a zero waste to landfill designation for their West Michigan locations. Smaller companies with powder coat waste – that would not otherwise have enough volume to interest a recycling company – are now able to aggregate their waste at Haworth and take advantage of larger volume recycling when recycling markets have the capacity. As a result, Haworth was able to lower its overhead expenses and reduce the cost of disposal for smaller companies.

All facilities owned and operated by Haworth continue to be Zero Waste to Landfill and ISO 14001 certified. Throughout 2014, all global Haworth manufacturing facilities, including sales subsidiaries in the UK and Spain, renewed ISO 14001 certifications. Manufacturing facilities also renewed OHSAS 18001 certifications (occupational health & safety management systems).

At the end of the day, Haworth and its executive leadership have proven to be disciplined and generous supporters of sustainable production practices and Zero Waste to Landfill initiatives. They have indicated a commitment to work with other companies and the County to create long-term waste solutions for the benefit of their company, their community and the environment.

4.2.3 Trendway

Trendway Corporation has been building and shipping contemporary design furniture from the same location in Holland, Michigan since 1968. They have a very modern facility that occupies 500,000 square feet of production floor and office space. Trendway is committed to operating its business in a socially, legally, ethically and environmentally responsible manner. They also hold their suppliers to the same high production standard.

Trendway has been committed to increasing environmental sustainability for over 30 years. In 1991, they were recognized for their environmental stewardship as Michigan Environmental Small Business of the year. In their Sustainability Report, Trendway declares: "We're committed as a company and as team members to continuously improving every aspect of our organization, with sustainability front and center.

GBB visited the facility and interviewed with Tom Geyer, CIH, Environmental and Sustainability Manager at Trendway. Tom joined the company in May of 2011. Prior to his role at Trendway, Tom was responsible for Environmental Health and Safety at American Seating in Grand Rapids. Tom earned a Bachelor’s Degree in Chemistry and Environmental Health at Oakland University, and a Master’s Degree in Occupational Health and Industrial Hygiene at Wayne State University.

Trendway's *Less is More* program, reduces waste with a selection of high-yield furniture options that reduce resource consumption without sacrificing function or aesthetics. In 2013, Trendway met their goal of zero waste to landfill. They went from 328 tons to ZWL in only two years, after collaborating with Holland-based Chef Container LLC. Trendway reduced another 4,500 tons of recyclable waste a year with this partnership and cut disposal expenses in half with its ZWL program. Chef Container was invited to present to the Zero Waste to Landfill User Group based on the successful partnership.

Trendway has a unique waste stream that comes from urethane foam used to create their popular line of office furniture known as Feek – which is sold primarily to customers with lounge area venues and/or alternative seating needs. Feek uses a three step coating process, which creates a fully bonded, tough top-coat on the foam. This makes the scrap foam very difficult to separate and recycle.

Trendway also powder coat paints the majority of its metal furniture and components. While they are able to recycle lighter colored waste powder, they have the same problem as other furniture manufacturers to get rid of the darker color waste powder. They currently have quite a backlog of forty-gallon paper barrels of waste powder coat in storage.

The plant produces 150 Tons per Year of waste Gypsum Board and dust from office furniture and architectural wall production. Gypsum waste is taken to Westshore Recycling, where it is ground and used in Compost and soil conditioning.

Approximately 1850 Tons per year of Wood Scrap, excess materials and Food Wastes, currently go to the Genesee County Waste to Energy Incinerator. Trendway does not have the same aversion to WtE that was voiced by the larger furniture manufactures in the region. They are open to new, cost effective, ideas for better recycling or repurposing these materials. But for now “burn to energy is better than landfilling”.

Trendway is committed to promoting sustainable work environments and business practices of BIFMA (Business and Institutional Furniture Manufacturers Association International) into their production. The Design for Environment review is a mandated for every product introduction process. Each product in development is evaluated for material chemistry, ease of disassembly, recycled/renewable content, recyclability, water management and energy efficiency.

Trendway's manufacturing takes place at their single production facility in Holland, Michigan; and they are active members of the following environmental groups and national organizations:

- US Green Building Council
- American Society of Interior Designers (ASID)
- Business/Institutional Furniture Manufacturers Association
- West Michigan Sustainable Business Forum
- Scientific Certification Systems (SCS)
- NSF International

Trendway partners with The CarbonNeutral™ Company to reduce their carbon footprint by subsidizing the development of new green energy and carbon sequestration projects. Their sustainability efforts follow the ANSI/BIFMA level e3 Sustainability Certification Program. These efforts are rigorously reviewed and supported by the full Executive Committee at Trendway. Their products are BIFMA Level 1 Certified and ANSI/BIFMA Certified SCS Indoor Advantage Gold. In 2013, Trendway earned the maximum two points under ANSI/BIFMA Level e3 Certification Program for achieving total solid waste diversion from landfill.

The engineers and executives at Trendway would be very willing to work with other companies and the County to develop sustainable waste solutions that would help their community, their region and the environment. Trendway has products manufactured from recycled materials throughout their facilities, including the waste and recyclables sorting station shown in Figure 7.

Figure 7
Trendway Recycling Station

4.2.4 Grand Rapids Label Company (GR Label)

Since 1884, the GR Label Company has produced everything from books of Scottish poetry and Pennsylvania Railroad schedules to posters promoting Harry Houdini. The Michigan company has remained family owned for over 125 years, and is now run by the fourth generation of descendant of the founders Seymour & Muir. The rich history of GR Label literally tracks the progress of our nation. They print labels of any type, for any application or container, and they hold nearly 20 patents for commercial printing.

GR Label is known for customized, cost-effective solutions and systems, tailored to exacting requirements of customers across all industries. Whether printing, converting, testing, conducting R&D for special adhesives, or engineering and building custom machinery, they accomplish it all in-house to ensure consistent, superior quality. They are also committed to sustainability.

"Protecting our environment is an integral part of our company and culture at Grand Rapids Label. We were instrumental in setting the official standards for TLMI's[4] Label Initiative for the Environment (L.I.F.E.), and we were the first company to meet these standards and receive L.I.F.E. certification. Embracing a structured, company-wide program enables us to effectively promote the continual improvement of environmental standards."

[4] Tag & Label Manufacturers Institute

GBB interviewed and toured the plant with John Crosby, Vice President for Sales and Marketing, and one of the owners of GR Label. Mr. Crosby's journey to waste stream analysis and reduction began after his daughter was a summer intern at GR Label, where she catalogued all of the waste streams. In addition, a team of Calvin College students, doing research on their senior thesis, contacted various recyclers to collect waste from their facilities.

As a result of this youthful initiative, the company made a cultural change with respect to waste. They examine everything that comes in and goes out of their production line and plant facility. Approximately 20% of their product produces waste in the silicon backing and label boundaries. This amounts to 400 tons of waste that leaves the plant on an annual basis. At present, 50% is recycled product. From a corporate perspective, John believes they will get to 70% landfill diversion rate overall.

This knowledge of their waste stream has enabled them to reduce costs as well as landfill use. Originally, they were paying $100 per ton for pick up and disposal of solid waste to the landfill. Now, they are paying a total of $65 per ton for the same service with an alternate waste hauler.

GR Label has identified potential new outlets for many of its specialty label papers and films that would allow them to significantly reduce the amount of waste sent to disposal, generate new revenue from the sale of the waste and invest in upgrading their recycling equipment. Currently, much of their paper and silicone products are shipped to outsourced facilities where they can be reused and recycled into "B" grade products.

It is important to recognize the significance of the waste stream and recycling initiatives at GR Label. While they are much smaller – and produce far less commercial waste – than an international office furniture conglomerate, the numbers add up quickly within their industry.

For example, GR Label produces 120 tons per year of waste from pressure sensitive film, which is a peel off backing for their customer labels. Moreover, there are 20 other printing and label companies in the West Michigan region using similar products and creating the same amount of waste film. The math for this category works out to a meaningful amount of waste, or 2,400 tons per year.

When considering the list of 100 top employers in the Western Michigan region, it is easy to imagine a significant source of waste that can be coordinated and used for common solutions.

According to their environmental policy "Grand Rapids Label Company is committed to provide safe, competitive products and services, while striving for the continuous improvement of the global environment, to the health of our employees and to the communities in which we operate by complying with all relevant environmental systems, legislation, regulations, and any other requirements." Grand Rapids Label is currently certified to ISO 14001 an international standard for environmental management systems.

It is clear GR Label and its executives would cooperate with other companies and the County to support any solutions to solve the waste problems faced by their company, the community and the environment.

Figure 8
GR Label Site Visit Photographs

4.2.5 Padnos

PADNOS Scrap Management (PADNOS) manages scrap for industrial and commercial accounts in Michigan and throughout the United States. PADNOS builds relationships with scrap providers and consumers, logistics providers, and scrap dealers across the United States, providing turnkey scrap management services, and seeking to find the best, most efficient way of recycling scrap. PADNOS is headquartered in Holland, MI and operates out of 21 different locations. Founded in 1905, it is now a fourth generation family owned organization recycling metals, paper, plastic and electronics. In 2014 PADNOS expanded its plastics recycling portfolio with the manufacturing and marketing of compounded and resin regrind products for molders.

As a major dismantler and processor of automobiles, Padnos' three auto-processing shredders produce significant quantities of auto shredder residue (ASR). Approximately 80,000 tons per year of this material is effectively utilized by area landfills as alternative daily cover (ADC). After removal of metals and some organics, ASR is known to have a significant fuel value. After some additional processing to optimize fuel value, ASR has been reported to have a heating value of approximately 13,240 Btu per pound[5]; this value is higher than that of most coal types. Therefore, there is potential to consider ASR as a fuel source in the event its use for ADC is not needed as less and less unprocessed and putrescible materials require landfill disposal. Padnos expressed interest in further discussions around possible

[5] Source: US EPA; http://www.epa.gov/oswer/docs/iwg/auto_shredder_residue.pdf.

partnerships in a resource recovery / environmental industrial park complex to receive and convert materials for reuse, recycling, and re-manufacturing.

4.3 Heat Transfer International Technology Site Visit

Located in the Grand Rapids region, Heat Transfer International (HTI) has developed a gasification technology that several of the manufacturing industries have expressed interest in, and desire to understand whether there is potential to apply HTI's technology to help them achieve ZWL. As part of GBB's work, GBB was required to learn about HTI and its technology, meet with their management and if possible visit their pilot and/or commercial operations located in the Grand Rapids region. In addition, the project concepts GBB develops should consider the application of the HTI technology.

4.3.1 HTI Background

HTI's home office is based in Kentwood, MI. In the Kentwood facility, HTI has a fuels laboratory, engineering design and development center, a pilot scale Biomass Development Center and an advanced manufacturing rapid prototyping center. Its heavy metal manufacturing is done at the Morbark Manufacturing's facility in Winn, MI.[6] Morbark is one of HTI's owners. HTI offers both a waste-to-energy gasification process and a high temperature ceramic heat exchanger technology. The technology was acquired in 2006 when HTI purchased the Patents of Bob Graham and the intellectual property of Presque Isle Engineering and C & H Combustion. The technology can be incorporated into gasification processes and air turbine power generation for medium sized biomass energy systems. In additions to the purchase patents, HTI's technology has received multiple United States and foreign patents.

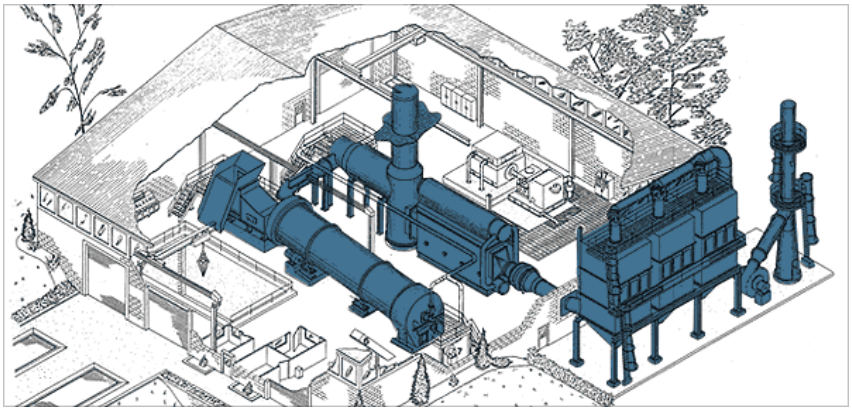
4.3.2 HTI Technology – Fixed Bed and Rotating Kiln Starved Air Gasifier

HTI states that their technology has been demonstrated in a variety of industrial applications since the 1970's, and is designed to process medical waste, animal wastes, hazardous solids, Army munitions, PCB's and coal tailing waste. The waste is metered into via air locked rams and fed upwards into the gasifier, to forms a fuel pile. A controlled percentage of stoichiometric air is injected throughout the pile. The air injection arrangement keeps the pile temperature below the sublimation, vaporizing or melting temperatures of the noncombustible solids and, at the same time, vaporizes the volatiles using the energy from partial combustion of the wastes. The syngas generated is collected above the pile and induced into the oxidizer. In testing, the emissions leaving the stack at the facility have been below the most stringent code levels.

[6] Morbark, Inc., based in Winn, Michigan, builds equipment that creates opportunities for customers serving the forestry, recycling, sawmill, biomass, landscaping/irrigation, rental and tree care markets. Morbark has 500 employees and has a 1.1-million-square-foot manufacturing complex in Winn. The company offers worldwide sales, support and service through an independent, authorized dealer network. (Source: http://www.morbark.com/about-us/who-we-are/.)

Figure 9 shows a cutaway of an HTI facility with its equipment train in place along with a cross section of an equipment train showing a combination biomass gasifier with electric power generation.

Figure 9
HTI Technology



For Large industrial and utility scale applications, HTI has developed a Starved Air Rotary Gasifier based on industry proven cement kiln technology, which allows for increased control gasification variables. HTI's starved air rotary gasifier accepts a wide variety of biomass fuels and waste products, to generate syngas that can then be used to power air turbines coupled to electric generators, steam boiler, hot air furnaces, hot air dryers and absorption cooling machinery. HTI's starved air rotary gasifiers are designed to operate continuously with a variety of mixed biomasses, as rotary gasifiers are more tolerant of fuel sizing issues and high moisture content fuels than other gasifier configurations. Utility scale systems can be achieved with multiple Rotary Gasifier Modules operating in parallel.

HTI's patent-pending oxidizer takes the syngas from the rotary gasifier and induces high temperature air through a series of tuyeres that control the rate of combustion and the temperature profile to ensure complete combustion of the carbon monoxide and hydrocarbons without forming nitrogen oxides. Most biomass fuels are high in bound nitrogen. HTI states that its test facilities have shown that the high nitrogen fuels can be processed successfully and that the percentage of nitrogen oxides emitted kept well below code levels.

4.3.3 Commercial Facility for Turkey Waste to Combined Heat and Power

HTI was awarded a contract to design, manufacture and install a turkey litter-to-power gasification system at Sietsema Farms Feeds operation in Howard City, Michigan to convert 70,000 pounds of turkey litter per day into the electricity and steam energy needed to operate the feed mill, providing Sietsema with reliable power and long term predictable and stable energy costs. HTI design and testing facility is designated and awarded as a Michigan Ren Zone tax credit area. Sietsema Farms' responsibility is to collect and deliver the manure (litter) from approximately 1.1 million turkeys to the HTI gasification plant, where the waste is converted into heat and electric power. Sietsema Farms uses most of the power and heat for its operations, and sells the excess power to the grid. The amount of electric power to be generated by the turkey waste is approximately the amount that would be used by 500 homes. The amount of heat generated is roughly equivalent to the power output, which is set at 500KW. The system is comprised of HTI's gasification and heat exchange systems coupled with a Dresser Rand extraction turbine. Since the ash generated, approximately 10 percent by weight of the input, contains significant concentrations of phosphorous and potassium, the ash is recovered and used in fertilizer trial production runs.

The commissioning ceremony took place on October 23, 2009 when HTI and The Right Place Inc. of Grand Rapids partnered with Sietsema to open the facility. The operation is housed on a 40-acre site at 19117 Lake Montcalm Road next to the Sietsema grain elevator just south of Howard City. Figure 10 shows the extraction turbine equipment for the combined heat and power production from the system.

Figure 10
Extraction turbine installed at the Sietsema Gasification Facility

4.3.4 Comments about HTI and its Technology

Since its founding in 2006, HTI has made great strides to advance the technology it has acquired and developed into working pilot and one commercial facility. HTI's focus has been to be a technology engineering organization, manufacturer (through its relationship with Morbark), and supplier of the equipment train necessary for converting various waste and biomass feedstocks into usable energy products, primarily heat and power, as has been done in the Sietsema commercial facility location. HTI does offer ownership and operations services currently.

The technology requires adaptation for application with the many different kinds of feedstocks that exist. The main technology offering, the starved-air gasifier, is a concept that has been manufactured and proven by others, but HTI's rotary design offers benefits for waste feedstocks. The combination of it with other unit operations and process steps involving other proven elements should provide confidence that there will be success in using the HTI technology.

However, with little track record and only one commercial operation for several years now, there are risks associated with using the HTI technology for other commercial scale facilities. It will be important for HTI to develop partnership and contract performance guarantee arrangements in order to be able to offer its technology to parties interested in applying the HTI technology to their waste streams. Depending on the feedstock, pre-processing may be required. As of now, HTI does not have experience with pre-processing feedstock, though Morbark has experience providing equipment for processing construction waste, agricultural products, pallets, forest waste, and some MSW. Additionally, having an engineering-procurement-construction wrap around contracting partner with financial resources to provide pre-processing engineering support, back the start-up and longer-term operations performance would help HTI achieve market entry more quickly. HTI reported that its largest module size is designed to process approximately 30 tons per hour. So, for a 24 hour per day operation, this equates to 720 tons per day of capacity. HTI reports that is currently developing $300 million USD in utility scale projects in Italy and the Caribbean and the status of those developments will need to be revisited if a technology is being selected by the County or other regional generators in the future.

5.0 Waste Supply Estimate

GBB collected data on commercial waste generation data from the interviews and meetings in Task 2 and through publicly available reports developed in the region that quantify commercial and industrial wastes, as well as materials diverted for commercial recycling. Where available, GBB located relevant material composition data. As the manufacturing facilities in this region produce materials that can be difficult to recycle and have high heating values, this is relevant to determining what type of capacity is needed to handle this waste. Once the waste and recyclables streams are better understood, the potential for the direction of additional waste and recyclables to the County's facilities can be evaluated.

5.1 Data Sources

Following the meetings in Kent County in June and July 2015, all companies were presented with a survey form that requested data on their waste generation and management practices, including:

- What types of waste materials are generated
- How much waste material is generated
- Who hauls and processes waste materials
- How much is spent each month on waste hauling/processing/disposal services
- What percentage of material is reused/recycled/disposed/converted to energy

These survey responses show a total of approximately 6,000 tons per month of waste and 920 tons per month of recycling, tallied in Table 6.

Table 6 - Disposal and Recycling Documented by Survey

Facility	Tons per Month
Disposal	***672.65***
Coopersville (Ottawa County Farms Landfill)	409.70
WWTP-Landfill	224.45
Other	38.50
Waste to Energy	***5,299.60***
WTE-Grand Rapids	183.00
WTE-Genesee	5,116.60
Recycling	***917.62***
Block Mfg.	42.00
Organicycle	11.75
Padnos	497.00
Yes	356.87
Compost	10.00

The responses to this survey were aggregated and direct references to any company name, location, or product were removed, to preserve the confidentiality of the respondents. This data is shown in Table 7.

There is a significant amount of waste still going to landfill disposal in the region. Over 400 tons per month are reported as going to Republic's Ottawa County Farms landfill. Some of this material was noted as being high in woody wastes, paper, auto shredder fluff, and other high-energy content materials, that could be used in a waste to energy facility. Table 6 and Table 7 do not include the 6,000 tons per month of ASF that PADNOS produces, which is a high-heating value waste stream that could be sourced for its energy content.

The costs of recycling and disposal were also documented by some respondents to this survey. The lowest cost for disposal documented is $65.15 for MSW, and the highest cost for disposal documented is $175.97 for manufacturing liquid waste. The lowest cost for recycling was $(97.09) in revenue from the sale of recyclables, and the highest was $285.00 for secure destruction and recycling services. There appears to be opportunity in the region for reduction in the cost of recycling through use of the County WtE Facility or through provision of recycling technical assistance to support ZWL programs that have the potential to reduce costs.

Some waste materials from industry are being re-used in other manufacturing processes. Powdercoat wastes, which are composed of polymers, metal oxides, and other filler compounds are used as an additive to cast concrete products by a local manufacturer. Organicycle, the composting service provider to the City of Grand Rapids, also has some industry customers in the region.

However, as discussed earlier in this Report, several companies are individually producing thirty (30) tons per day of waste wood material, six (6) days per week. For all furniture manufacturers, the aggregate waste stream has been estimated at over 1,000 tons per day, or 6,000 tons per week of waste. Many of these large manufacturers divert their woody waste to the Genesee biomass boiler, and/or did not elect to participate in this survey.

Table 7 shows the designation of materials to "Disposal" and "Recycling" as reported. Some manufacturers consider the County's WTE Facility in Grand Rapids to qualify as disposal, while others use the Genesee Facility and document this as recycling.

Table 7 - Industry Waste Survey Responses

Industry	NAICS	Material Generated	Tons/Month Waste	Tons/Month Recycle	Disposal	Recycling	Vendor	Total Est. Monthly Cost	Total Cost per Ton Waste	Total Cost per Ton Recycle	Notes
Health Care	62110	MSW	130		WtE-GR		Republic	$ 10,000.00	$ 76.92		
	62110	Mixed		65		Yes	Rapid Green Group	$ 17,500.00		$ 269.23	
	62110	Organics		6		Compost	Arrow	$ 400.00		$ 66.67	
Health Care	62110	MSW	43		WtE-GR		Republic	$ 3,000.00	$ 69.77		
	62110	Mixed		20		Yes	Rapid Green Group	$ 5,700.00		$ 285.00	
	62110	Organics		4		Compost	Arrow	$ 400.00		$ 100.00	
Office Furniture	337211	Composite Wood	2700			WtE-Genesee	Genesee County	$ -	$ -		
	337211	Powder Coat		30		Yes	NA	$ -	$ -		
Office Furniture	337211	Composite Wood		525		WtE-Genesee	NA	$ -	$ -		
	337211	Powder Coat		42		Block Mfg	NA	$ -	$ -		
Pharmaceutical	325412	MSW	270.15		Coopersville		DeYoung	$ 17,600.00	$ 65.15		
	325412	Finished/liquids	224.45		WWTP/landfill		K&D	$ 39,497.00	$ 175.97		Includes containers
	325412	Mixed		241.87		Yes	Various	$ (23,482.00)		$ (97.09)	Recycling revenue returned to generator
Office Furniture	337211	MSW	48.8		Coopersville		Republic	$ -	$ -		Contains a lot of wood waste
	337211	MSW	38.5					$ -	$ -		
	337211	Organics	0	11.75		Organicycle	Spurt Industries	$ -	$ -		
	337211	Wood	1891.6			WtE-Genesee		$ -	$ -		
	337211	Mixed		497		Padnos		$ -	$ -		90% steel
Printing Industry	323111	MSW	10		WtE-GR		Republic	$ 601.00	$ 60.10		
	323111	Paper	10			Coopersville	Republic	$ 600.00	$ -	$ 60.00	
Office Furniture	337211	Coal Ash	80.75		Coopersville		Cordes	$ -	$ -		Closing soon

5.2 Commercial Waste Supply Estimate Model

In the model, U.S. census business data was used to develop estimates of the number of employees working in businesses under each NAIC classification. This was cross-referenced with average waste generation estimates per employee per NAIC code (developed by the California Integrated Waste Management Board) to generate an estimate of waste generation per-industry sector per-year in Kent County. This data accounts for not only manufacturing waste, but also waste generated /by other types of commercial establishments throughout the County.

Table 8 - Waste Supply Estimate

SIC Code Business Category	Total Waste Tons/ Employee/ Year	Establishments in Kent County	Paid Employees in Kent County	Total Waste Tons/Year
Agriculture, forestry, fishing and hunting	0.55	14	175	100
Mining, quarrying, and oil and gas extraction	1.80	11	80	150
Utilities	0.30	13	750	230
Construction	3.00	1,195	11,137	33,420
Manufacturing	1.26	1,080	59,290	74,800
Wholesale trade	0.90	1,191	28,038	25,240
Retail trade	2.02	2,140	32,477	65,500
Transportation and warehousing	1.40	391	10,752	15,060
Information	0.30	261	5,447	1,640
Finance and insurance	0.30	1,135	13,223	3,970
Real estate and rental and leasing	0.30	591	3,389	1,020
Professional, scientific, and technical services	1.20	1,665	13,273	15,930
Management of companies and enterprises	1.20	158	10,905	13,090
Administrative and support and waste management and remediation services	0.90	907	28,866	25,980
Educational services	0.80	219	14,726	11,790
Health care and social assistance	1.50	1,562	46,128	69,200
Arts, entertainment, and recreation	1.10	217	4,080	4,490
Accommodation and food services	2.10	1,199	26,207	55,040
Other services (except public administration)	0.90	1,648	14,611	13,150
Industries not classified	0.40	18	10	10
Total for all sectors		**15,615**	**323,594**	**429,720**

429,720 tons per year is 1,377 tons per day, on a 6 day-per-week basis. Although not all of this material is suitable for a project where manufacturing waste is to be processed, much of this material is recyclable, and could be diverted from landfill as a result of increased recycling outreach and education to businesses. This estimate also includes food and other organic wastes, which signals that Organicycle or other organics processing in the County could expand if these materials could be separately collected.

6.0 Technologies and Project Concepts

6.1 Technologies for ZWL

Aside from recycling innovations that improve the separation accuracy and processing efficiency of recyclable materials at MRFs, and technological improvements to packaging design and manufacturing for recyclability, there are many waste conversion technologies for managing what is left over after recycling activities occur. The County WtE and HTI have two such technologies, but there are others for managing mixed waste, biomass, plastics, and hazardous materials.

Conversion technologies are typically grouped into thermal technologies (that use heat to break down bonds within waste materials, further generating heat and gaseous byproducts) and biological technologies (that use enzyme and biological activity convert portions of waste materials into gases). The most common thermal technologies include mass burn, refuse-derived-fuel combustion, gasification, and pyrolysis. Table 9 shows major differences between these technologies.

Table 9 - Waste to Energy Technologies

Mass Burn
•The most common type of thermal conversion facility in the United States and Europe •Single combustion chamber with excess air •Temperature range of 1560-2,000°F (850-1,090°C) •Ash remains as a residual
Pyrolysis
•Thermal decomposition of the volatile components of an organic substance •Temperature range of 400-1,400°F (200-760°C) •Absence of air or oxygen •Forms syngas and/or liquids •A mixture of un-reacted carbon char and ash remains as a residual
Gasification
•Thermal decomposition of the volatile components of both organics and non-organics •Temperature range of 900-3,000°F (480-1,650°C) •Very little air or oxygen •Ash remains as a residual
Anaerobic Digestion
•Biological degradation of organic material in absence of oxygen •Products include: •Biogas fuel for electricity and/or heat production; can be conditioned to pipeline quality •Digestate for soil amendment, animal bedding, or rolled into a composting process

The County WtE Facility is a mass burn facility, combusting un-processed wastes to generate steam that drives turbines. When waste is first processed to create a more uniform stream, or to remove recyclable materials, it becomes a refuse-derived fuel (RDF) that can be combusted in the same way. The Genesee Power Station biomass boiler operates in a similar manner as technology that converts RDF. Gasification and Pyrolysis differ from mass burn waste to energy in that they operate at lower temperature ranges and air flows, i.e. with very little air present (in Gasification) and no air present (in Pyrolysis). These technologies often require a more homogenous waste stream, and are most effectively applied to specific feedstocks. Pyrolysis is often used for the conversion of plastics to fuels or chemicals, while gasification is often used for the conversion of biomass and wood wastes to energy or gaseous fuels.

ACS, Inc., Consutech Systems LLC, International Environmental Technologies (IET), International Waste Industries, Pennram, and Waste to Energy Canada, Inc. (WTEC) are companies that provide existing small scale waste to energy technologies: either by incineration or gasification/oxidation. These small-scale plants are able to reduce waste volume by over 90% and are typically sized to process 50 to 200 tons of waste per day.

- Pennram's solid waste incinerators, which have capacities ranging from 25 kg/hr to 2,500 kg/hr, cost $50,000-$1,300,000 for systems without air pollution control (APC) systems, and begin at $250,000 for APC systems. Pennram is able to produce steam or electrical power.
- IET's waste gasification/thermal oxidation process transforms waste into energy through a two-stage process. The primary stage promotes the conversion of solids into gas, and the secondary stage allows for the complete gas combustion. The hot air that results from the secondary stage produces steam, and in turn, electrical power. A typical 100 ton per day IET system is able to generate 3 MW of electrical power; 5 MW generation is possible with the additions of high BTU waste.
- WTEC's continuous Batch Oxidation technology is able to provide local or regional energy production through their 20-360 metric ton per day systems.

The most common biological technologies include anaerobic digestion and fermentation used in the production of liquid fuels. While only organic materials can be processed through biological methods, they can accept both source-separated organics, and organics processed out of mixed waste streams. These technologies are highly sensitive to chemical process agents that may be used in manufacturing.

6.2 ZWL Project Concepts

GBB has developed three (3) project concepts for advancing the concept of ZWL for industries in and around Kent County. Presented for each concept is an overview describing it, the sources and types of waste supply, processing and conversion technology that could be used in the concept, site location requirements, thumbnail economics, contractual relationships, and financing approach. Evaluated technologies can use mixed MSW, recyclables, compostable materials and specialty industrial waste generated in the County as feedstock. To develop the three project concepts described below, the following technologies were evaluated: mass burn waste to energy (at a third-line addition to the

existing facility), RDF production, gasification, pyrolysis, anaerobic digestion, composting, and other technologies for processing and disposal, as desired by the County.

6.2.1 On-site MDF to Energy

In this concept, a manufacturing location that has very significant quantities of manufacturing by-products that have significant heat value, e.g. Medium-density fiberboard (MDF) or other wood, plastic or paper products, can source separate these materials and dedicate for an on-site processing/energy recovery system that is integrated into the manufacturing locations heating and cooling on-site production assets. This approach is currently in place at the Herman Miller [location] manufacturing complex, where it provides approximately 10 percent of the complex's heating and cooling requirements.

The design and delivery of an on-site MDF to Energy system would be relatively simple for most of the furniture manufacturers in the West Michigan, Region. They each have ample supply of Refuse Derived Fuel (RDF) on hand as well as the land and physical space required to develop and construct such a system.

The only impediment to building these on site energy facilities is the current price of electricity does not support the necessary commercial Return on Investment Capital to justify the expense of these systems. When Herman Miller designed and approved their WtE system, their anticipated cost of energy from the utility company was $0.22 per kilowatt. That figure would have resulted in a handsome ROI as well as the necessary Internal Rate of Return (IRR) for such a facility. Unfortunately, the bottom dropped out of the energy market, and the true cost of electricity has been under $0.10 per kilowatt – or less than half of the anticipated cost - for several years. Although these systems can last for 30 or more years, most investors judge the efficacy of an alternative energy investment based on the previous 5 years actual costs basis with a reasonable increase based on Consumer Price Index or another recognized financial standard. The net result of this financial analysis is that folks are sitting on the sidelines until energy prices recover. Based on the recent discoveries of natural gas thought out the Northeast corridor, those prices are likely to remain low, or become softer, over the next ten years.

ACS, Inc., Consutech Systems LLC, Eco Waste Solutions, Inc., International Environmental Technologies (IET), International Waste Industries, Pennram, and Waste to Energy Canada, Inc. (WTEC) are companies that provide existing small scale waste-to-energy (WTE) technologies: either by incineration or gasification/oxidation. These small scale plants are able to reduce waste volume by over 90% and are usually sized to process 100 tons of waste per day, depending on the company.

- Pennram's solid waste incinerators, which have capacities ranging from 25 kg/hr to 2,500 kg/hr, cost $50,000-$1,300,000 for systems without air pollution control (APC) systems, and $250,000 and up for APC systems. Pennram is also able to produce steam, but the electrical power output is dependent on the customer. Therefore, their systems are individually designed and priced.
- Eco Waste Solutions, Inc.'s system allows for installations of any size to process waste to recover heat.

- IET's waste gasification/thermal oxidation process transforms waste into energy through a two-stage process. The primary stage promotes the conversion of solids into gas, and the secondary stage allows for the complete gas combustion. The hot air that results from the secondary stage produces steam. In turn, the steam is routed through a steam turbine to produce electrical power. A typical 100 ton per day system is able to generate 3 MW of electrical power; however, 5 MW generation is possible with the additions of high BTU waste.
- WTEC's continuous Batch Oxidation technology is able to provide local or regional energy production through their 20-360 metric tons per day system. The 5%, or less, non-toxic ash that is produced can be sold or used as an aggregate. Gas is also burned in an enclosed system, which allows for less greenhouse gas emission than landfilling.

6.2.2 Gasification for Industries at South Kent Landfill Environmental Industrial Park

Because of the concentration of manufacturing industries, ranging from large to small, there are significant flows of manufacturing by-products. These industries are doing an admirable job in reducing/reusing/recycling these materials. Additionally, some are able to make arrangements for by-products with energy content that are not recyclable and have them utilized as a fuel. The Genesee Power Plant in Flint is the primary receiver of these materials, while the County's WtE Facility gets some as well. However, there is limited capacity between these two solid fuel users for the by-products with fuel value from manufacturers in the region. Additionally, there is concern with the long-term sustainability of the Genesee Power Station as a purchaser of these materials from the industries in the Kent County region, and at least two major furniture manufacturers supply MDF/wood fuel to this facility currently. One other benefit from is the significant reduction of greenhouse gases manufacturers could realize if they could reduce 200 miles in round-trip travel for disposal.

As a result, there is a need for sustainable fuel use in the region for what does not go to the above two locations and perhaps for what currently goes to the Genesee Power Station. Because the manufacturing by-products are more homogeneous than MSW, gasification technologies can be considered. Mentioned earlier is the gasification technology being developed and offered by HTI and it certainly can be considered for this discussion. There are other gasification technology providers as well as developers that are interested in new gasification technology offerings. A status report on MSW conversion technologies that has been shared during the GBB team's meetings with some of the manufacturers is presented in Attachment C.

Setting aside whose technology would be used, the concept here is to consider the development of new gasification infrastructure specifically that would use the non-reusable, non-recyclable MDF/wood/paper manufacturing by-products processed into a blended fuel. Additional fuel feedstocks might also be TDF, ASR currently being used as ADC at the non-County landfills, and even an engineered fuel produced from processing MSW. The capacity of this infrastructure may need to be able to receive and convert from 500 to 1,500 tons per day having a fuel value in excess of 10,000 BTU per lb. to even as high as 14,000 BTU per lb. The primary output of the gasification technology would be a low quality producer type gas having a heat value of 300-400 BTU per cubic foot. This gas could be used for a range

of things, such as combusted for heat generation and recovery for HVAC or power, feedstock into converting to chemicals/fuels (methanol, ethanol, bio-diesel or jet fuel).

A site would be needed for this facility. This is where the County could provide a location, such as in the new acreage being acquired adjacent to the South Kent Landfill. Assuming the land area is significant, e.g. approaching or greater than 100 acres, the development of the area into a resource recovery or environmental industrial park could also be considered. Additional background on resource recovery and environmental industrial parks are provided in Attachment D. It would be very exciting for helping achieve the sustainability goals and zero waste to landfill motivations of industry to create the impetus for such a development in the Kent County region that ends up both helping assure ZWL for the industries and develops markets for recyclable materials and manufacturing of products with those recyclable materials in them.

While the design and development of this regional scale facility would be much harder and more complex that the on-site solution, in 6.2.1, above, it is more likely to pass the financial test for potential investors. In other words, there may be difficulty securing the land and the environmental permits for gasification; but the combination of business and industrial interests in the project could provide the necessary ROI and IRR to promote the investment. This "strength in numbers" approach needs to be evaluated and approved for investment. The only real issue (or obstacle) would be the total cost of the technology itself.

Gasification units are very capital intensive and they can be cost prohibitive based on current tip fees in West Michigan. One solution may be to engage a newer technology company – such as HTI – without many installations in the commercial marketplace. They may be willing to invest their technology in order to establish credibility in the US Market. This would require an independent Engineering, Procurement and Construction (EPC) wrap to convince any equity investor or commercial banker to fund the project.

This means the technology company would ultimately need to be open to an independent analysis and evaluation of their proprietary process. This type of internal investigation and technology validation can often raise conflicts over confidentiality issues. The alternative would be to select a more reliable technology company that could stand on its own laurels (and installations) in the marketplace; but the cost of those technologies tend to be very expensive. In either case, this project concept deserves more consideration and evaluation.

To assist in the evaluation and exploration of this Project Concept, the County will need to put a team together to advance the Environmental Industrial Park. Several regional business groups and independent organizations could make a significant contribution to the discussion, evaluation, planning and progress of the Environmental Park Initiative. Here are three organizations that would be terrific planning partners:

- Design West Michigan: www.designwestmichigan.com
- West Michigan Sustainable Business Forum: www.wmsbf.com
- Michigan Energy Innovation Business Council: www.mieibc.org

6.2.3 Third Line at County WtE

Under separate work for the County, GBB has identified potential opportunities for the County to consider regarding enhancing the WtE Facility's revenues and expanding the facility. The opportunities fall under two primary categories: expanding the facility, and utilizing the Facility's steam generation and export capabilities, originally designed to provide steam to the County's former district energy steam loop in downtown Grand Rapids, to produce steam for sale to current, or new, local industries.

The design and construction of the original facility included the provisions for the waste tip floor, waste pit and facility footprint to add a third 312 TPD line in the future. This third line, assuming the same design as the current two lines, would provide additional processing capacity for 100,000 tons of waste annually, adjusted for outages. Table 10 provides an estimate of the potential gross energy revenues if the third line were installed.

Table 10 - Third Line Potential Gross Revenues

	Third Line Electrical Revenue Est.				
Energy Component	kwh Produced	$ kWh[1]	Gross Revenue	Tons Processed	$ Per Ton Processed
Energy (on Peak)	25,615,000	$ 0.0429	$ 1,098,884	100,000	$ 10.99
Energy (Off Peak)	29,478,000	$ 0.0336	$ 990,461	100,000	$ 9.90
Capacity (on Peak)	25,615,000	$ 0.0534	$ 1,367,841	100,000	$ 13.68
Capacity (off Peak)	29,478,000	$ 0.0454	$ 1,338,301	100,000	$ 13.38
		Total	$ 4,795,487	100,000	$ 47.95

	Third Line Electrical Steam Est.					
Energy Component	K/lbs. Steam Produced	Est. Annual k/lbs.	Rate per k/lbs.	Est. Gross Rev.	Tons Processed	$ Per Ton Processed
Estimated Capacity	55,000	433,620,000	$ 7.0	$ 3,035,340,000	100,000	$ 30,353

Note: Gross Revenue figures are mutually exclusive

The industry currently estimates a new facility with similar technology would cost somewhere between $225,000 and $250,000 per daily installed ton to engineer, permit and construct a facility today. In keeping with these estimates, a similarly sized third line of 312 TPD[7] may cost somewhere between $70,000,000 and $78,000,000 ($2015). However, since the original facility contemplated the addition of the third line in its original design, it is estimated the County's cost to construct the third line would be on the lower end of the aforementioned scale, so if GBB were to use a cost of $235,000 per daily installed ton, the third line would cost approximately $73,300,000 today. Annual debt service for this capital over a 20-year term would be approximately $5.4 million per year (assuming a four percent interest rate). Assuming another 100,000 tons per year were processed, the additional debt service would be approximately $52.70 per ton.

[7] Covanta has indicated to the County that a third line as large as 500 TPD with 13 MW electricity production may be possible.

Table 11 provides an estimate of the tip fee requirement assuming that there is no revenue sharing for the power sales for the third line.

Table 11 - Estimated Tipping Fee

Description	Estimated fee	Comments
Power Sales	$47.95	
Debt Service	$52.70; 4 %, 20 years	$42.00 per ton; 4%, 30 years
O&M Fee	$40.00	
Tipping Fee Requirement	$44.75	Assumes no additional power revenue for Covanta

The facility was originally designed to supply steam to the downtown Grand Rapids steam loop when the downtown steam plant and loop were owned and operated by the County. The steam loop is currently owned and operated by Veolia North America. Based on discussions with County DPW staff, Covanta, and Veolia representatives, the line has not been energized since 2008, and is in need of significant repairs before it could be re-energized. Nonetheless, there may be opportunities to consider updating and re-connecting this steam line so that Veolia can add reliability to its steam production and attract new customers. There also may be opportunities to attract new industries requiring 24-7 steam supply to available industrial sites within one to two miles of the facility or the steam line.

Besides considering more MSW for the third line, the County could consider using the third line space for providing dedicated capacity for industries and manufacturers wanting assured utilization of their industrial/manufacturing by-products that are non-recyclable and have fuel value. In considering using the WtE facility third line space, consideration should be given to providing for pre-processing and blending functionality at the site for these feedstocks. Additionally, a different combustion/conversion technology should be considered for the third line space. For example, utilizing a spreader/stoker semi-suspension or fluidized boiler configuration may provide for being able to process more tonnage of the higher BTU value blended fuel that would result from the industrial/manufacturing by-products. With a similar designed mass burn technology, the annual tonnage of this fuel may be limited to the 50,000 ton per year level. Since there is considerably more than the supply potential, technology that can process higher levels would be preferred.

From an operational standpoint, the design and development of a third line would be the easiest solution to implement, since there are currently two similar lines being operated at the WtE facility in Kent County. It may not be so easy to accomplish from a financial perspective or political vantage point. In the event that the plant in Genesee closes, even the most ardent supporter of ZWL may be forced to embrace waste to energy as the best available – and logical – alternative to landfilling commercial and manufacturing waste in the County.

Based on the amount of waste that is being produced on a daily basis at the multiple office furniture manufacturers in West Michigan, the third line could be an excellent alternative. Moreover, some ZWL advocates have recently chosen to warehouse their manufacturing by-products for extended periods of time rather than delivering it to a Waste to Energy facility. These data points suggest strong

consideration of a third line. To validate these issues and assumptions, we would need to conduct a more thorough feasibility study for this particular ZWL Project Concept.

6.3 ZWL Project Concepts Comparison

Comparative analysis of the three project concepts described in the previous section are presented in Table 12 below: the on-site MRF to energy; the gasification project for Industries at S. Kent Landfill Environmental Industrial Park; and, adding a third line at the County WtE project. The concepts were analyzed and compared against the parameters defined by the County, as follows: advantages, disadvantages, PPA barriers, partnership opportunities, processing capacity, cost, economics, risk, type of financing, footprint of the solutions and the location needs, and synergy with other industries.

Table 12 - ZWL Project Concepts Comparison

ZWL Project Concepts Technologies	Advantages	Disadvantages	PPA Barriers	Partnership Opportunities	Processing Capacity (TPD)	Cost	Economics	Risk	Type of Financing	Footprint/ Location	Synergy with Other Industries
On-site MDF to Energy at each industry	- Control own destiny - Individual solution for each company, - Exact size needed, - No waste transportation costs;	- Low energy recovery efficiency and electricity generation; - Facility Debt & all O&M costs - Able to adjust with economic swings (the size that is good now may not be appropriate in future) - Poor economy of scale	- Too small, - Limited amount of electricity generated, - The companies should want to use the energy for their own use	Not applicable or needed with the County	20-300	N/A	Not preferable due to economy of scale	- Low, but operations and economics subject to economic swings; - Vendor contracting and guarantees are critical;	Private-assumed individual industries	- Small footprint; - Located on the manufacturing sites;	N/A; Individual solution
Gasification Project for Industries at South Kent Landfill Environmental Industrial Park	- Central biomass facility, - Higher energy recovery efficiency, - Reduction of the transportation costs, - Shared risk of input; - Potential energy users in the Park - Larger size presents ability to attract more experienced technology vendors;	- The local biomass gasification vendor does not have enough operational records and experience; - Requires additional independent analysis and evaluation studies; - Waste supply contracts may be required	- None from technology standpoint - Local utility issues - State regulatory constraints	- Yes, the project would be a partnership between the County and the industries; - Land use, zoning and/or financing could be County contribution	500-1,500	N/A	More complex and not clear;	Moderate	Private (potential for Industrial Revenue Bonds)	>100 acres	- Yes, this plant will be able to accept waste from multiple and different industries; - Partners during planning period could include: Design West Michigan, West Michigan Sustainable Business Forum, and Michigan Energy Innovation Business Council
Third line at County WtE	- Proven technology; - Already existing and successfully operating plant;	- WTE has not been widely recognized as a recovery option but more as a disposal option; - Some local industries do not recognize it as a recovery option;	- Minimal (current facility has an existing PPA)	- N/A - Industries would have waste supply agreements;	312	$70- 78 Million	Estimated tipping fee $44.5 per ton of waste;	Low	Public (Kent County Refuse Disposal System Refunding Bonds (Limited Tax General Obligation) were issued initially for this plant in 1985)	On the existing location of the WTE plant;	Yes, this expansion of the WTE plant will be able to accept waste from multiple and different industries;

7.0 Conclusions and Recommendations

Throughout this ZWL review, it was clear that all of the stakeholders GBB interviewed in Kent County were fully committed to finding solid waste solutions that will benefit their companies, their community and the environment. The County is pro-active, and could support innovative solutions by potentially offering available property and financing support. The furniture manufacturers are willing to work with their competitors and the County to coordinate their efforts to achieve and sustain ZWL status. Although everyone has adopted their own individual strategies to solving the solid waste issues they are facing, they are willing to come together to find long-term solid waste solutions.

In addition to working independently, many of the firms GBB interviewed are working together in coalitions and industry groups to find solutions to their common waste problems. SRG has aligned several of the top employers and manufacturers in Western Michigan for this express purpose. They currently meet on the second Thursday of every other month to discuss issues and recommend solutions. The Right Place has also agreed to help raise the requisite funds to expand this initial review to include additional corporations in Western Michigan and to develop specific projects and financial pro-formas, and has provided a letter of commitment in Attachment E. This new information can be utilized for project development and timeline analysis by potential investors. See Attachment A for a listing of other major West Michigan Employers.

It is this deep sense of commitment to sustainability and the environment and the spirit of cooperation that exists between the County and its commercial industries that promotes multiple solid waste solutions for Western Michigan. Here is a summary of our conclusions and recommendations for Kent County.

Conclusions:

- There is significant interest for ZWL by those industries that have responded and have significant non-recyclable by-products with high BTU value
- There are many more manufacturers in the region that GBB did not have time to survey; however, using data about them, these industries may have significant tonnages potentially available for a ZWL project
- Non-MSW and high energy content nature of the industrial by-products make it a highly suitable fuel feedstocks for gasification technology that has lower emission volume profiles than the County WtE.
- County's interest in considering a resource recovery/environmental park can provide interesting opportunity to locate a ZWL gasification project as a base tenant.
- The letter of interest from the Right Place shows promise as a channel for the County to develop a partnership for advancing a ZWL project
- There appear to adequate tonnages that could support a combination of on-site WtE, a third line at the County WtE, and a greenfield gasification facility

- There is a significant amount of large sized scrap MDF and other reusable manufacturing scrap generated through manufacturing in the County that can be reused

Recommendations:

- Meet with the Right Place to develop a memorandum of understanding that outlines how ZWL projects can be undertaken working together with the County
- The County should be willing to continue to invest in this concept so long as industries, through the Right Place, step up to participate actively and financially as well
- Establish a County ZWL Development team that includes County Economic Development representation as well as participation of other local industry support groups
- Develop a conceptual site plan for utilizing the South Kent Landfill expansion acreage for a resource recovery/environmental park; long-range landfill utilization and resources need to be addressed as well
- County expand its service offerings to provide recycling technical assistance to commercial waste generators
- Develop a partnership with an industry and design group like Design West to investigate the use of recycled and unused materials from manufacturing into new and innovative product design

When this ZWL Project Review was initiated by the Kent County DPW, the basic perception was that a fundamental choice would have to be made between the construction and operation of a third line at the Kent County WtE facility versus the independent solutions of gasification and on-site MDF to energy in the West Michigan region. At the completion of our analysis, it appears these solid waste solutions for Kent County would not necessarily be mutually exclusive. In other words, our three project concepts defined above should not be seen as a "This or That" decision between competing solid waste solutions; they can legitimately be viewed as a series of "This and That" opportunities for Kent County, Michigan.

The next logical step in this analytical process and industry evaluation would be to select which of the ZWL Project Concepts (identified in Section 6.2, above) has a real potential for success in Kent County and Western Michigan; and then conduct a formal feasibility study to create a comprehensive business plan that supports those initiatives – politically, financially, and technically.

Attachments

Attachment A - Top West Michigan Employers Listing
Attachment B - Company Waste Information
Attachment C - Technology Review of Industry Meetings
Attachment D - Environmental Industrial Park Background
Attachment E - The Right Place Letter of Commitment