Report

Technology Comparative Analysis

Project I.D.: 13R003

Prepared for:

Ramsey/Washington Counties
Resource Recovery Project Board

January 2014

RAMSEY/WASHINGTON COUNTY
RESOURCE RECOVERY PROJECT
RAMSEY AND WASHINGTON COUNTIES, MINNESOTA

Foth

75 YEARS

Eagle Point II • 8550 Hudson Blvd. North, Suite 105
Lake Elmo, MN 55042
(651) 288-8550 • Fax: (651) 288-8551
www.foth.com

January 23, 2014

Zack Hansen
Judy Hunter
Ramsey Washington County Resource Recovery Project
2785 White Bear Ave N
Maplewood, MN 55109

Dear Zack and Judy:

RE: Technology Comparative Analysis

Foth Infrastructure & Environment, LLC (Foth) is pleased to provide this *Technology Comparative Analysis Report*. This report compares the three options analyzed in the *Preliminary Resource Recovery Feasibility Report* to the current RDF System and to landfilling. The five options were compared and rated for the following factors: Technical, Financial, Environmental, Permitting, Siting, Reliability, and Flexibility.

We look forward to presenting the *Technology Comparative Analysis Report* to the Project Board along with the information developed in the *Preliminary Resource Recovery Feasibility Report* addressing any questions or comments you may have, as well as any follow up needs.

Sincerely,

Foth Infrastructure & Environment, LLC

Warren Shuros
Client Director

Curt Hartog, P.E.
Technical Director

Technology Comparative Analysis

Distribution

No. of Copies	Sent To
1	Zack Hansen Joint Staff Committee Ramsey/Washington Counties Resource Recovery Project 2785 White Bear Avenue, Suite 350 Maplewood, MN 55109-1320
1	Judy Hunter Joint Staff Committee Ramsey/Washington Counties Resource Recovery Project 2785 White Bear Avenue, Suite 350 Maplewood, MN 55109-1320

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Executive Summary

The Ramsey/Washington Counties Resource Recovery Project Board (Board) is completing policy evaluations to determine how the Counties may continue waste processing after the current Processing Agreement term with Resource Recovery Technologies, LLC (RRT) expires at the end of 2015. Foth Infrastructure and Environment, LLC (Foth) is assisting with this policy evaluation process and is completing reports concerning the potential options.

Previous reports completed in this policy evaluation process include:

- *Alternative Technologies for Municipal Solid Waste*
- *Preliminary Technical Status of the Newport and Two Xcel Combustion Facilities*
- *Preliminary Resource Recovery Feasibility Report*

The *Alternative Technologies for Municipal Solid Waste* reviewed several potential alternatives at a high level to determine if the Board desired to review each technology at a more in-depth level. The Board chose to review the following technologies:

- Anaerobic Digestion
- Gasification
- Mass Burn
- Mixed Waste Processing
- Plastics to Fuel

The Joint Staff Committee of the Board worked with Foth to frame the additional review of these technologies into a work plan for the *Preliminary Resource Recovery Feasibility Report.* This report provided a preliminary feasibility study for three different technology options including:

- A standalone Mass Burn facility;
- A combination of technologies including the existing Newport refuse derived fuel (RDF) facility with Mixed Waste Processing (MWP) and Gasification added; and
- A combination of MWP, Anaerobic Digestion (AD), and Plastics to Fuel.

It is important to note that the three technology scenarios were selected to provide a range for comparison purposes. This analysis offers a starting place for understanding the technological feasibility for each individual technology and alternatives possible when they are combined. There is some flexibility as the Board continues its evaluation to look at other technology combinations. In other words, the three technologies analyzed are not absolute, but can be modified.

The *Preliminary Resource Recovery Feasibility Report* provided preliminary information on these technologies that was used in this report titled *Technology Comparative Analysis*. The purpose of this report is to compare these alternative technologies with the existing RDF System (Newport Facility and the two Xcel Combustion Facilities) and with a sanitary landfill. Thus, there are five technologies or combinations of technologies compared in this report. These include:

- The Current RDF System
- Newport with MWP and Gasification
- MWP with Anaerobic Digestion
- Mass Burn
- Sanitary Landfill

The structure of this report compares each technology to different factors including:

- Technical
- Financial
- Environmental
- Permitting
- Siting
- Reliability
- Flexibility

A rating for each technology for each comparison factor is provided. The ratings are based on the status of each technology for the various factors. The rating is based on a scale of one to five with five being the most favorable ranking and one being the least favorable ranking on the specific factor being considered. When rating different technologies or combinations of technologies against the various factors, it is common that different factors may not have equal importance to each other for R/W Counties. Therefore, some factors may carry more weight in the overall analysis than others.

In this analysis, the Financial and Environmental factors were weighted to carry more significance and each has three scoring criteria providing a potential total of fifteen points. The Technical factor has two scoring criteria for a potential total of ten points. The remaining criteria – Permitting, Siting, Reliability, and Flexibility each have one scoring criteria for a potential total of five points.

Table ES-1
Ratings Weighting on Technology Factors

Technology Factors	Rating Weighting = Number of Criteria	Maximum Rating
Technical	2 criteria	10
Financial	3 criteria	15
Environmental	3 criteria	15
Permitting	1 criterion	5
Siting	1 criterion	5
Reliability	1 criterion	5
Flexibility	1criterion	5

Technical factors are the technology's capability to handle municipal solid wastes (MSW) and include size, age, functionality, experience, and/or specific features.

Financial factors are related to costs and revenue, and include capital costs, debt service, operating costs, transportation costs, and potential material and energy revenues that all play a role in the estimated tipping fees per ton. The data for the rankings include the capital costs, breakeven costs, and the calculated cost per diverted ton (diverted tons are the tons diverted from a landfill annually).

Environmental factors are the technology's effect on the environment, and include production of renewable energy, potential for emissions (including groundwater, air, greenhouse gases and odors, and landfill space saved (diversion).

Permitting considers all the required permits for the technology and the ease, likelihood and time period to obtain all the required permits for the option. This factor is closely related to the siting factor covered in the next section. Permitting is focused on the technical issues and requirements required in the permitting process.

Siting relates to the ability to identify and permit a technology as a selected site, and also includes community response to the project and the development of potential organized opposition.

Reliability is related to the ability of the technology successfully perform on a daily basis over time. This factor includes considerations such as proven technologies, daily and future capacities, age, and redundancy.

Flexibility is a consideration of how flexible the technology is to successfully managing the variations – both in the continued capacity to handle the changes without significant changes in cost or the ability to modify the technology to manage the change higher on the waste management hierarchy.

Each of the five technologies was rated for each of the factors and individual criteria. A summary of the ratings is provided in the following Compiled Comparison Rating table. Data related to each factor is described in the report; along with explanations of the ratings.

Table ES-2
Compiled Comparison Rating

Technology	Technical	Financial	Environmental	Permitting	Siting	Reliability	Flexibility	Total
Current RDF System	8	8	10	5	5	5	3	**44**
Newport w/ MWP & Gasification	7	13	11	4	3	2	5	**45**
MWP w/ AD	5	7	8	3	3	2	4	**32**
Mass Burn	10	5	10	1	1	5	3	**35**
Sanitary Landfill	10	8	5	1	1	4	2	**31**

Highest technical rating possible= 60; lowest technical rating possible = 12

Two technologies, the “Current RDF System” and “Newport with MWP and Gasification” had similar values and ranked higher than the other three technologies.

- The Current RDF System scored highly for permitting and siting since it is already sited and permitted. It also scored highly on reliability.

- Newport with MWP and Gasification rated higher than the Current RDF System for the financial factor and flexibility. It also rated one point higher than the Current RDF System on the environmental factor and would have been higher if the energy criteria had not been limited to strict classification of “renewable” energy (production of ethanol is obviously an energy product, but does not qualify as a “renewable” energy).

Table ES-3
Comparative Analysis Categories and Scoring

Category	Technology	Technical	Financial	Environmental	Permitting	Siting	Reliability	Flexibility
Definition	The type of technology(-ies) under analysis	Factors related to the technology's ability to handle MSW	Factors related to costs and revenue	Factors related to the effect on the environment associated with the technology	Factors related to obtaining all required permits for the technology option	Factors related to the ability to identify and permit a technology at a selected site	Factors related to the ability of the technology to successfully perform on a daily basis over time	Factors related to the ability of the technology to handle changes in MSW character and quantity without significant change in cost
Factors	Key elements of the category that are considered in comparing technologies, leading to a ranking	Size, age, functionality (ability to handle MSW), experience,	Capital costs, debt service, operating costs, transportation costs, revenues, cost per diverted ton	Landfill diversion; recycling and energy production, air emissions, greenhouse gas emissions, potential odors, effects on groundwater,	Ease, likelihood, and time period to obtain all required permits	Technical feasibility, environmentally acceptable, socially acceptable	Proven technology, daily and future capacity, age, design, redundancy	Adaptability of the technology to changes in MSW volume or character; difficulty in making facility modifications
Scoring	Scale of 5 (highest ranking) to 1 (lowest ranking) Some categories have multiple scores, reflecting their importance relative to other categories.	Possible Range: 10 (high) to 2 (low) Experience with the technology – Score 1-5 Functionality – Score 1-5	Possible Range: 15 (high) to 3 (low) Capital Costs - Score 1-5 Break Even Costs - Score 1-5 Cost per Diverted Ton - Score 1-5	Possible Range: 15 (high) to 3 (low) Diversion - recovery of materials and energy from waste - Score 1-5 Renewable Energy Production - Score 1-5 Emissions of air and water pollutants, odors, greenhouse gases - Score 1-5	Possible Range: 5 (high) to 1 (low) Ease, and likelihood of obtaining permits - Score 1-5	Possible Range: 5 (high) to 1 (low) Feasibility of identifying and securing a suitable site - Score 1-5	Possible Range: 5 (high) to 1 (low) Reliability of the technology, Score 1-5	Possible Range: 5 (high) to 1 (low) Flexibility to handle changes over time, Score 1-5

List of Abbreviations, Acronyms, and Symbols

Foth	Foth Infrastructure & Environment, LLC
Board	Ramsey/Washington Counties Resource Recovery Project Board
RRT	Resource Recovery Technologies, LLC
MWP	Mixed Waste Processing
AD	Anaerobic Digestion
RDF	Refuse Derived Fuel
TPY	Tons Per Year
Xcel	Xcel Energy, Inc.
HERC	Hennepin (County) Energy Recovery Center
LFG	Landfill Gas
EPA	Environmental Protection Agency
VOC	Volatile organic compounds
THC	Tetrahydrocannabinol
CO	Carbon Monoxide
NO_x	Nitrogen Oxide
$PM_{2.5}$	Particle Matter, 2.5 micrometers
PM_{10}	Particle Matter, 10 micrometers
U.S.	United States

1 Introduction

The Ramsey/Washington Counties Resource Recovery Project Board (Board) is completing policy evaluations to determine how the Counties may continue waste processing after the current Processing Agreement term with Resource Recovery Technologies, LLC (RRT) expires at the end of 2015. Foth Infrastructure and Environment, LLC (Foth) is assisting with this policy evaluation process and is completing reports concerning the potential options.

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The Lead Staff of the Board worked with Foth to frame the additional review of these technologies into a work plan for the *Preliminary Resource Recovery Feasibility Report.* This report provided a preliminary feasibility study for three different technology options including:

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This *Preliminary Resource Recovery Feasibility R*eport provided preliminary information on these technologies that was used in this report titled *Technology Comparative Analysis.* The purpose of this report is to compare these alternative technologies with the existing RDF System (Newport Facility and the two Xcel Combustion Facilities) and with a sanitary landfill. Thus, there are five technologies or combinations of technologies compared. These include:

- The Current RDF System
- Newport with MWP and Gasification
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- Mass Burn
- Sanitary Landfill

The structure of this report compares each technology to different factors including:

- Technical
- Financial
- Environmental
- Permitting
- Siting
- Reliability
- Flexibility

Technical is first factor covered for each. A description of each technology is included in the technical section. The description does not change when considering each successive factor and therefore, the description of each is not repeated for the following factors. Observations and pertinent data related to each factor for each technology are provided.

It is important to note that the three technology scenarios were selected to provide a range for comparison purposes. This analysis offers a starting place for understanding the technological feasibility for each individual technology and alternatives possible when they are combined. There is some flexibility as the Project continues its evaluation to look at other technology combinations. In other words, the three technologies analyzed are not absolute, but can be modified.

A rating for each technology for each comparison factor is provided. The ratings are based on the status of each technology for the various factors. The rating is based on a scale of one to five with five being the most favorable and a rating of one being the least favorable. When rating different technologies or combinations of technologies against the various factors, it is common that different factors may not have equal importance to each other for R/W Counties. Therefore, some factors may carry more weight in the overall analysis than others.

In this analysis, the Financial and Environmental factors were believed by R/W Counties to carry more significance and each have three scoring criteria providing a potential total of fifteen points. The Technical factor has two scoring criteria for a potential total of ten points. The remaining criteria – Permitting, Siting, Reliability, and Flexibility each have one scoring criteria for a potential total of five points. It is noted that Permitting and Siting are closely related, almost variations of the same factor.

Table 1-1
Ratings Weighting on Technology Factors

Technology Factors	Rating Weighting = Number of Criteria	Maximum Rating
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Environmental	3 criteria	15
Permitting	1 criterion	5
Siting	1 criterion	5
Reliability	1 criterion	5
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Technical factors are the technology's capability to handle municipal solid wastes (MSW) and include size, age, functionality, experience, and/or specific features.

Financial factors are related to costs and revenue, and include capital costs, debt service, operating costs, transportation costs, and potential material and energy revenues that all play a role in the estimated tipping fees per ton. The data for the rankings include the capital costs, breakeven costs, and the calculated cost per diverted ton (diverted tons are the tons diverted from a landfill annually).

Environmental factors are the technology's effect on the environment, and include production of renewable energy, potential for emissions (including to groundwater, the , air, including greenhouse gases and odors, and landfill space saved (diversion).

Permitting considers all the required permits for the technology and the ease, likelihood and time period to obtain all the required permits for the option. This factor is closely related to the siting factor covered in the next section. Permitting is focused on the technical issues and requirements required in the permitting process.

Siting relates to the ability to identify and permit a technology as a selected site, and also includes community response to the project and the development of potential organized opposition.

Reliability is related to the ability of the technology successfully perform on a daily basis over time. This factor includes considerations such as proven technologies, daily and future capacities, age, and redundancy.

Flexibility is a consideration of how flexible the technology is to successfully managing the variations – both in the continued capacity to handle the changes without significant changes in cost or the ability to modify the technology to manage the change higher on the waste management hierarchy.

2 Technical

Technical characteristics or factors are related to the technology's capability to handle municipal solid wastes (MSW) and may relate to size, age, functionality, experience, and/or specific features.

2.1 Current RDF System

2.1.1 Description

The current refuse-derived fuel (RDF) system includes the Resource Recovery Facility in Newport and the two Xcel Combustion Facilities located in Red Wing and Mankato. The Newport Facility has been processing MSW since 1987, recovering metals and producing RDF which is trucked to the two Combustion Facilities. The Newport Facility is permitted to process up to 500,000 tons per year (TPY) of MSW and has routinely processed approximately 400,000 TPY recovering over 325,000 TPY of RDF and another 12,000 plus TPY of metals.

The two Combustion Facilities can burn up to 200,000 TPY of RDF and have routinely each handled approximately 180,000 TPY.

The current RDF System is relatively "large scale" and can handle the current, entire MSW stream generated in the two counties. It is a proven technology capable of handling a wide range of MSW. Producing RDF is an equipment intensive process requiring the use of shredders, screens, conveyors, separators, air classifiers, etc. The maintenance requirements are extensive to assure continued operation.

2.1.2 Observations and Pertinent Data

The facilities have proven their capability to consistently handle the MSW generated in the two counties. Even so, the age of the facilities presents some concerns. The two Combustion Facilities were originally constructed in 1947/1948 and the Newport Facility was constructed in 1986/1987. The technology for producing RDF has been modified and customized since construction of the Newport Facility; particularly the size reduction equipment has changed from the hammer mills used at Newport to shear shredders which have lower capital and operating costs.

The labor force operating both the Newport Facility and the Combustion Facilities is very experienced with proven technical expertise to operate and maintain complex equipment. The facilities require an extensive amount of on-going maintenance which has been well provided by the experienced staff.

There is no actual use of the RDF at the Newport Facility. The RDF has to be trucked to the Combustion Facilities in Red Wing (40 miles one way) and Mankato (90 miles one way). The Combustion Facilities are not owned by RRT, but are owned and operated by Xcel Energy under contract to RRT to use the RDF. Xcel has indicated that the Combustion Facilities could continue operating up to 2027 assuming an extended contract and continued maintenance and replacements.

2.2 Newport with MWP and Gasification

2.2.1 Description

This option builds off the existing Newport Facility by adding a mixed waste processing (MWP) component and a gasification facility to use the RDF to produce ethanol (rather than trucking the RDF to the two Xcel Combustion Facilities).

Mixed waste processing is used to process MSW and recover recyclable materials such as paper, metals, and plastics. The option included in the Feasibility Study targeted only a portion of the total MSW from the Counties, focusing on the commercial waste stream anticipated to contain a higher percentage of recyclable materials and not the residential waste stream.

The residues from the MWP line along with the MSW not sent through the MWP line will be processed in the existing RDF system. The RDF will need to meet the specifications of the gasification technology (e.g., moisture content < 20%). The gasification system will receive the RDF and process it to produce fuels or chemicals.

2.2.2 Observations and Pertinent Data

Mixed waste processing is an emerging technology. The resulting recovered materials may be contaminated with some moisture from the MSW or have some other contaminants reducing their market value.

Gasification of RDF is also an emerging technology. There are a limited number of vendors capable of taking on such a project. Ineos Bio has an operating gasification plant in Florida currently converting yard wastes into ethanol and planning to operate on RDF in 2014. Enerkem has their Edmonton plant expected to start commercial operation in 2014 that converts RDF to methanol.

The gasification process is essentially a refinery and requires a larger footprint than available at the Newport Facility. The gasification processing facility will need to be developed at a different location. For this analysis, Foth assumed the gasification facility will be within 20 miles of the Newport Facility.

2.3 MWP with Anaerobic Digestion

2.3.1 Description

This option was included as a new, "standalone" facility in the Feasibility Study. It included a MWP system separating recyclable materials such as paper, metals, recyclable plastics, potentially non-recyclable plastics, and organics. The recyclable materials will be baled and prepared for materials markets. The non-recyclable plastics could be processed by a plastics to oil facility when this technology becomes commercially proven and available. The organics will be processed by an anaerobic digestion facility to produce a fuel (methane) with the digestate composted into a soil conditioner.

2.3.2 Observations and Pertinent Data

There is limited experience with using each of these technologies to process MSW. Anaerobic Digestion (AD) is well established handling other organics such as agricultural wastes and sewage sludge. However, AD has limited vendors currently developing projects in the United States (U.S.) for MSW. AD can only handle the organic fraction of MSW, and because of that, this option will have the highest percentage of residues and non-recoverable materials of the options included in this comparison. There are seasonal fluctuations in the amount of organics that need to be addressed as well as potential issues associated with the climate in Minnesota (winter temperatures). Particular attention for odor control from the anaerobic process will be required. Also, the handling of the digestate adds to the site size and material handling requirements.

Mixed waste processing is an emerging technology. The resulting recovered materials may be contaminated with some moisture from the MSW or have some other contaminants reducing their market value, compared to recyclables that are source-separated.

Plastics to oil (polymers to fuel from some system vendors) is also an emerging technology. A commercial scale plant in the Twin Cities Metro area recently closed due to problems marketing the oil produced. There are other vendors joining the market and growing interest. The technology for a continuous flow process is being developed which will improve potential throughput. The size of the facility projected to reach financial feasibility has increased from approximately 30 tpd to 60 tpd. Aggregating 60 tpd of mixed plastic is a large amount of plastics that may require a larger source than the two Counties. Marketing the oil produced has been problematic in some instances as the relative amount of oil produced from plastic is very minor compared to the amount of oil processed at a refinery.

2.4 Mass Burn

2.4.1 Description

This option was included as a new, “stand alone” facility in the Feasibility Study. It was assumed to be a 1,000 TPD capacity. There was no facility location planned though it would need to be located at a new site. This mass burn facility would be similar in size and operation to the Hennepin Energy Recovery Center (HERC) facility owned by Hennepin County. The mass burn facility is relatively “large scale” and can handle the current, entire MSW stream generated in the two counties. It is a proven technology capable of handling a wide range of MSW.

2.4.2 Observations and Pertinent Data

Mass burn facilities are capable of handling a wide range of MSW. It is a proven technology and the most common alternative disposal technology besides landfills (there are 6 operating facilities in Minnesota). Although there is a lot of equipment required for material handling, combustion, energy recovery, ash handling and air emissions control, it is a relatively simple process and technology. There are multiple vendors and suppliers available for construction and operation of a mass burn facility.

2.5 Landfill

2.5.1 Description

This option considers a landfill being developed to dispose of 400,000 tpy over a life of twenty (20) years. MSW is trucked to the landfill and is unloaded at a location called the "working face." The MSW is compacted to maximize the amount of MSW that can fit in a cubic yard of the airspace. There is no recovery of materials in the process. Landfills are required to have liners and leachate collection systems to minimize environmental impacts.

At the end of the daily operation, the MSW is required to be covered to control access, litter, and vectors. As a landfill cell is filled, it is covered with soil, a new lined cell is constructed adjoining the previous cell. When the next cell is full, there may be additional MSW placed on previous cell to increase the height of the cell. As cells are completed, they must be covered with a final cover to control infiltration of precipitation. Landfill gas (LFG) collection systems are installed to collect and destroy the LFG. The LFG can be combusted to recover the energy, most commonly converted to electricity using engine/generator sets.

2.5.2 Observations and Pertinent Data

Many improvements have been made in sanitary landfill design, construction, operation, and environmental monitoring since the early sanitary landfills constructed without liners. Sanitary landfill standards include liner systems to control leachate from contaminating ground water. Groundwater monitoring wells are installed with the groundwater tested regularly for potential contaminants. LFG gas must be controlled with gas collection systems and may be combusted for electricity generation.

There are significant environmental monitoring requirements for groundwater and air emissions. There are locational standards that prohibit landfills in some environmentally sensitive locations such as karst geology.

Sanitary landfills are considered as a proven technology for disposing of MSW. They are the most common technology used and are relatively simple compared to the alternative technologies in this analysis.

2.6 Comparative Rating on Technical Factors

As a preliminary means of ranking the five technologies, this analysis uses a simple system of rating each on a one (1) to five (5) scale, with five being the most favorable ranking and one being the least favorable ranking on the specific factor being considered. In some instances, the technologies may be roughly equal and therefore receive the same ranking.

The Technical factors consider functionality which includes the ability to handle MSW and relates to size, age, and experience. The ratings for the five technologies are shown in Table 2-1.

Table 2-1
Technical Comparison Rating

Technology	Experience	Functionality	Total
Current RDF System	5	3	8
Newport with MWP and Gasification	3	4	7
MWP with Anaerobic Digestion	3	2	5
Mass Burn	5	5	10
Sanitary Landfill	5	5	10

Highest technical rating possible = 10; lowest technical rating possible = 2

The Current RDF System is certainly a proven technology with an experienced labor force. The system has consistently functioned for over 25 years. The experience rating is a five. The Functionality rating is lowered due to the age of the facilities, processing technology that has been improved in new facilities, hauling distances to the combustion plants, and limited markets for RDF (Xcel is the only market outlet). The Functionality rating is a three for a total of eight.

The Newport with MWP and Gasification has some experienced components but the gasification technology has minimal experience operating on a commercial scale. The Experience rating is a three. For Functionality, this option builds off the proven technology at Newport by adding technologies to increase the recovery of recyclables as well as the gasification technology emerging with significant potential to produce higher quality energy outputs with associated higher revenue potential. The Functionality rating is a four for a total of seven.

MWP with Anaerobic Digestion has limited experience operating at a commercial scale. There are proven operations however and the technologies are not overly complicated. The Experience rating is three. For Functionality, this option is limited in its ability to handle the entire waste stream and could better be combined with another technology such as RDF, gasification or mass burn. The Functionality of the standalone option is a two for a total of five.

Mass Burn and Sanitary Landfills can handle the entire waste stream, are very proven, and each have an Experience and Functionality ratings of five.

3 Financial

Financial related factors include capital costs, debt service, operating costs, transportation costs, and potential material and energy revenues that all play a role in the estimated tipping fees per ton. The data for the rankings include the capital costs, breakeven costs, and the calculated cost per diverted ton (diverted tons are the tons diverted from a landfill annually).

3.1 Current RDF System

3.1.1 Observations and Pertinent Data

The current tipping fee for MSW delivered to the Newport Facility is $84 per ton. This does not include any debt amortization as the debt has been amortized. Haulers are contracted to pay this fee to RRT. The Counties provide a $28 per ton rebate to haulers for MSW delivered to the Newport Facility from the Counties which results in a net cost to the haulers in 2013 of $56 per ton.

The operating costs include significant budgets for maintenance due to all the moving equipment processing the MSW which is an abrasive and difficult material to handle. The tipping fee is also affected by the cost to transport the RDF to the Combustion Facilities rather than use the RDF on-site (estimated at approximately $4 million per year). There is also a cost to burn the RDF charged by Xcel as their burn fee (estimated at approximately $5 million per year).

The Counties current contract with RRT allows the Counties to consider purchasing the Newport Facility. An arbitration process was undertaken to determine the potential purchase price. The arbitration process resulted in a potential purchase price of $26.4 million.

Using the latest full year's data in 2012, the total MSW received at the Newport Facility was 378,055 tons. At a 2012 tipping fee of $86 per ton, this is a total cost of $32,512,730. There was a total of 32,095 tons of residues sent to landfills (12,036 tons of process residue, 16,008 tons of bulky waste residue, and 4,051 tons of ferrous fluff returned). In addition, burning the RDF leaves approximately 90,000 tons of ash. Subtracting the tons of residues landfilled of 32,095 plus the 90,000 tons of ash from the total tons delivered of 378,055 provides the total tons diverted from landfills of 255,960. Dividing the tons diverted (255,960) into the total annual cost of $32,512,730 yields a net cost per diverted ton of $127 per ton.

3.2 Newport with MWP and Gasification

3.2.1 Observations and Pertinent Data

The capital cost for the Newport, MWP, and gasification system additions to the existing Newport Facility were estimated to range from $170M to $251.4M. This option eliminates the cost of transporting RDF to the Xcel Combustion Facilities and the Xcel burn fees and incentives.

It should be noted that the revenue potential from the gasification technology is significantly higher than from combustion for electricity generation. According to information provided at the Renewable Energy from Waste Conference in West Palm Beach in November, 2013, the average revenue per ton of MSW is only $30 per ton for generating electricity but could range from $100 to $150 per ton for fuel produced from the gasification process.[1] For this analysis, it was assumed one (1) dry ton of RDF yields 90 to 100 gallons of ethanol. Current wholesale prices for ethanol and potential tax credits were estimated to range from $2.10 to $2.25/gallon.

The estimated cost per ton ranged from $(20) to $50 for an average of $15 per ton.

Using an estimated 400,000 TPY and the average cost per ton of $15 provides an estimated total annual cost of $6M. Using an estimated recovery of 307,800 tons yields a net cost per diverted ton of $20 per ton (landfill diversion tonnage is covered in Section 4.2.1.1 of this report).

3.3 MWP with Anaerobic Digestion

3.3.1 Observations and Pertinent Data

The estimated capital cost for this option ranged from $50 million to $60 million. The capital cost is lower than mass burn and Newport with MWP and Gasification.

The estimated cost per ton ranged from $64 to $84 for an average of $74 per ton. The fuel (methane) recovered from AD would compete with cost of natural gas. Pricing for natural gas has gone down due to current discoveries of additional natural gas resources. Electricity pricing was assumed at 4 to 6 cents per kWh. This option has the highest tonnage of remaining MSW that must be landfilled and therefore has the highest residue disposal cost.

Using an estimated 400,000 TPY and the average cost per ton of $74 provides an estimated total annual cost of $29.6M. Using an estimated recovery of 127,020 tons yields a net cost per diverted ton of $233 per ton (landfill diversion tonnage is covered in Section 4.3.1.1 of this report).

3.4 Mass Burn

3.4.1 Observations and Pertinent Data

The estimated capital cost for this option ranged from $350 million to $400 million. This is the highest capital cost of the options evaluated.

The estimated cost per ton ranged from a low of approximately $70 per ton to a high of $100 per ton for an average of $85 per ton.

Using an estimated 400,000 TPY and the average cost per ton of $85 provides an estimated total annual cost of $34,000,000. Of the 400,000 tons, there were 21,200 tons of bulky wastes landfilled with 378,800 tons combusted resulting in approximately 90,000 tons of ash. Using an estimated recovery of 288,800 tons yields a net cost per diverted ton of $118 per ton.

[1] Harvey Gershman, Update on Renewable Energy from Waste Technologies, November 18, 2103

3.5 Landfill

3.5.1 Observations and Pertinent Data

The capital cost for a landfill handling 400,000 TPY will range from approximately $25 million to $30 million in 2013$ to cover the cost of the initial infrastructure, each landfill cell as it is constructed over time, and each successive final capping and closure event. Cells are constructed as they are needed and the entire landfill is not constructed all at once. Obviously the closure costs also do not occur until parts of the landfill have reached final elevations. To handle the 400,000 TPY for 20 years will require 8 to 12 million plus cubic yards of airspace. With an estimated $30 million total capital cost handling 8 million tons of MSW, this equates to under $4 per ton of MSW for the associated capital costs.

The estimated cost per ton may be variable depending on location, the amount of state and local taxes or host fees, whether a transfer station and long haul are required, and competition. Foth is aware of large landfills contracting for MSW at prices under $20 per ton. In the Twin Cities market area, the state and local taxes approach $20 per ton. Due to the prohibition of landfilling unprocessed waste in the Twin Cities metropolitan area and only for purposes of providing a preliminary cost analysis per ton, Foth assumed the 400,000 TPY of MSW would be transferred to an out-of-state landfill at a 2013$ net, all-in price of $45 to $50 per ton.

Using an estimated 400,000 TPY and the average cost of $47.50 per ton provides an estimated total annual cost of $19,000,000. As there are no tons diverted, there is no cost per diverted ton to be calculated.

The estimated capital cost ranged from $30 million to $35 million including the sanitary landfill and a transfer station to handle the 400,000 TPY

3.6 Comparative Rating on Financial Factors

The Financial factor considers capital costs, debt service, operating costs, transportation costs and potential material and energy revenues. The Financial factor criteria include a rating for Capital Cost, Breakeven Cost, and Cost per Diverted Ton. Table 3-1 provides a summary of the key cost considerations for the rating criteria.

Table 3-1
Financial Factor Summary

Technology	Capital	Breakeven	Diversion
Current RDF System	$0 to $26.4M	$84	$127
Newport with MWP and Gasification	$170M to $251.4M	$15	$20
MWP with Anaerobic Digestion	$50M to $60M	$74	$233
Mass Burn	$350M to $400M	$85	$118
Sanitary Landfill	$30 to $35M	$47.50	NA

The ratings for the five technologies are shown in Table 3-2.

Table 3-2
Financial Comparison Rating

Technology	Capital	Breakeven	Diversion	Total
Current RDF System	5	1	2	8
Newport with MWP and Gasification	3	5	5	13
MWP with Anaerobic Digestion	4	2	1	7
Mass Burn	1	1	3	5
Sanitary Landfill	4	4	NA	8

Highest technical rating possible = 15; lowest technical rating possible = 3

The Current RDF system has the lowest Capital cost and has a five rating followed closely by Sanitary Landfill with a four rating. MWP with AD has the next best Capital Cost and rates a four. Newport with MWP and Gasification rates three with Mass Burn rated at one.

Newport with MWP Gasification has the best breakeven cost estimate and rates five. Sanitary Landfill rates a four, MWP with AD rates a two, and the Current RDF systems and Mass Burn each rate a one.

For Cost per Diverted Ton, Newport with MWP and Gasification has the best estimated cost, well below the others and rates a five. The Current RDF system and Mass Burn have costs in the low hundreds and rate a two and a three respectively. The MWP with AD suffers from the low diversion percentage and rates a one. Sanitary Landfill, without any diverted tons is not applicable, which results in a zero value for the criterion.

4 Environmental

Potential environmental factors include production of renewable energy, potential for groundwater contamination, greenhouse gas generation, potential for odors, and landfill space saved (diversion).

4.1 Current RDF System

4.1.1 Observations and Pertinent Data

4.1.1.1 Landfill Diversion

Standardizing the current RDF system to the 400,000 TPY used for the other technologies, meeting average material recovery amounts, and assuring meeting the RDF production needs of Xcel results in the following tonnages shown in Table 4-1 for each category of output from the Newport Facility:

Table 4-1
Landfill Diversion from Current RDF System

Material	Percentage	Tonnage
RDF	83.7%	334,800
Bulky Waste Residue	9.3%	37,200
Metals	3.0%	12,000
Process Residue	4.0%	16,000
Total	**100.0%**	**400,000**

The estimated diversion percentage for the current RDF system is 86.7% rounded to 87%. There is ash that is landfilled after combustion at the Xcel combustion plants. By weight, the ash from the Red Wing Combustion Plant is 27% but by volume, approximately only 13%. Using the 27% ash multiplied times 334,800 tons combusted produces approximately 90,000 tons of ash. Total tons diverted from a landfill calculated to 256,800 tons.

4.1.1.2 Renewable Energy Production

Minnesota has a renewable portfolio standard that includes MSW; along with solar thermal electric, photovoltaic, landfill gas, wind, biomass, hydroelectric, hydrogen, co-firing, and anaerobic digestion.[2] Xcel Energy has a specific standard for eligible renewable electricity of 31.5% of total retail electricity sales in Minnesota by 2020. Of the 31.5% standard, wind must be 24%, 2.5% solar, and 5% generated from other technologies. The next milestone for Xcel is in 2016 when the 25% renewable requirements will be enforced. Currently, Excel has an 18% renewable requirement. Other public utilities also have renewable requirements that include 17% by 2016 and 21.5% by 2020. For non-public utilities, renewable requirements include 17% by 2016, 20% by 2020, and 25% by 2025.

[2] See Minnesota Statute §216B.1691

Xcel includes the Combustion Plants in their renewable power generation portfolio. The Combustion Plants are rated at 24 megawatts (MW) of Renewable electricity.

4.1.1.3 Greenhouse Gas

EPA's WARM model was used to estimate greenhouse gas (GHG) emissions associated with combusting the current RDF and managing the bulky waste, process residue, and metals recovered from the existing waste stream. Results are provided in Carbon Dioxide equivalents (CO_{2e}). The inputs for the WARM model require tonnages to be separated by waste type and management method. From the EPA's WARM Documentation Report:

> *"Extracting, harvesting, processing, transporting and disposing of these materials result in greenhouse gas (GHG) emissions, in part due to the large amounts of energy required for these life-cycle stages. The U.S. Environmental Protection Agency's (EPA) Waste Reduction Model (WARM)is a tool designed to help managers and policy-makers understand and compare the life-cycle GHG and energy implications of materials management options (recycling, source reduction, landfilling, combustion with energy recovery, and composting) for materials commonly found in the waste stream. By comparing a baseline scenario (e.g., landfilling) to an alternate scenario (e.g., recycling), WARM can assess the energy and GHG implications that would occur throughout the material life cycle.*
>
> *WARM compares the emissions and offsets resulting from a material in a baseline and an alternative management pathway in order to provide decision-makers with comparative emission results.*

The baseline used for this analysis is the landfill option. The four (4) other Alternative Technology methods are compared to landfilling all 400,000 tpy.

For the current RDF system, the various material categories were divided into four waste streams: bulky waste (landfilled), process residue (landfilled), metal (recycled), and RDF (combusted). The tonnage for each of these waste streams aligns with the total tonnages provided in Table 4-1 for the current RDF system. In total, for the current system, the following was modeled:

- Recycle - 12,000 tons per year (metals)
- Landfill - 53,200 tons per year (bulky waste and process residue)
- Combust - 334,800 tons per year (RDF)
- Total - 400,000 tons per year

WARM is able to account for additional GHGs generated from the transportation of material to various management facilities. The default distance of 20 miles was assumed for hauling material to the landfill and also to the recycling facility since the exact location of these facilities is not known. A distance of 62 miles was assumed for hauling the RDF to the combustion

facilities. This distance represents the weighted average of the distances from Newport to Xcel's facilities located in Mankato and Red Wing.
Based on these assumptions, the GHG emissions generated from combusting the RDF, landfilling the bulky waste and process residue, and recycling the metals is (84,305) $MTCO_{2e}$. This negative number indicates a GHG savings. GHG benefits for this scenario are associated with being able to recycle some materials and the energy off-sets for using RDF instead of fossil fuels.

4.1.1.4 Groundwater Contamination

The potential for any groundwater contamination from the current RDF system is relatively low as approximately 87% of the MSW is recovered for recycling or as a fuel for combustion for electricity (approximately 90,000 tons of ash from RDF combustion reduces the diversion percentage to 64.2%).

The potential for groundwater contamination would only be from the residues landfilled – the process residue and bulky wastes from RDF processing and the ash from the combustion facilities. It is appropriate to assume that a landfill used for all the technologies covered in this report is properly designed and operated, meeting all environmental regulatory requirements. Thus, risk of groundwater contamination from any of these technologies will be minimized. Any potential risk would be over a long term period and the relative quantities and types of wastes landfilled may be used for comparison of the risk of groundwater contamination over the long term.

4.1.1.5 Potential for Odors

MSW is delivered to the receiving area and piled along primarily the south wall of the existing Newport Facility. Some odors escape from the receiving area and can be noticed in the neighborhood. There are no appreciable odors generated from processing of the MSW into RDF.

4.2 Newport with MWP and Gasification

4.2.1 Observations and Pertinent Data

4.2.1.1 Landfill Diversion

The waste composition data provided in Section 2 of the Preliminary Resource Recovery Feasibility Report was used to develop estimates of the tons of MSW that would end up in the outputs from this option – gasification, recycling, and landfill. The estimated quantities were developed for use in the EPA WARM model for estimating greenhouse gas (GHG) generation, which develops the data for some of the other environmental factors besides GHG generation. The data for landfill diversion for this option are shown in Table 4-3.

Table 4-3
Landfill Diversion from Newport w/ MWP and Gasification

Output	Percentage	Tonnage
RDF to Gasification	81.2%	324,960
Recyclables Recovered	5.5%	21,840
Landfilled Residues	13.3%	53,200
Total	**100.0%**	**400,000**

The estimated diversion percentage for the Newport with MWP and Gasification is 86.7% rounded to 87%. There is ash that is landfilled after gasification. By weight, the ash was estimated to be up to 15% of the dry tons of RDF or approximately 39,000 tons leaving a total of 307,800 tons diverted and reducing the overall percentage to 77%.

4.2.1.2 Renewable Energy Production

The Newport with MWP and Gasification scenario reduces the renewable energy production based on the existing system. Since gasification is not considered in the renewable energy portfolio, conversion of the RDF to fuel via gasification would eliminate the 24 MW of renewable energy being generated at Red Wing and Wilmarth plants. The Newport with MWP and Gasification option would likely require Xcel to look for other renewable energy projects (like wind or solar) to replace the renewable energy loss by not burning RDF at Wilmarth or Red Wing. However, gasification does produce ethanol which is a fuel blended with gasoline combusted in vehicles to produce energy to propel the vehicle.

4.2.1.3 Greenhouse Gas

The quantity and material composition and category designations used for the WARM model were based on recycling some of the commercial waste stream and converting the remainder to RDF for gasification. However, the management method of the various material categories was altered to align with the goal of this technology. Similar to the current system at Newport, a portion of the delivered materials will make up bulky waste and process residue that will be landfilled.

The total tonnages for these two waste streams are the same as that for the current system (bulky waste – 37,200 tpy, process residue – 16,000 tpy). The commercial wastes with an assumed 200,000 tpy would pass through the MWP technology and an assumed 60% of recyclable materials (paper, plastic, metals, etc.) are recovered for recycling. Similar to the existing system, the remaining material would be processed into RDF for the gasification system.

The various material categories were divided into four waste streams: bulky waste (landfilled), process residue (landfilled), recyclables separated by mixed waste processing (recycled), and RDF for gasification. The tonnages for each are shown in Table 4-3

Gasification of the RDF produces a syngas. The syngas has various components that are either converted to an end product (like ethanol); are captured; or are vented to the atmosphere. Most of the syngas is either converted or captured. However, from a GHG perspective, the WARM model assumes combustion of biomass (such as paper, wood, yard trimmings, etc.) as a biogenic emission of GHG and does not contribute to global warming. Thus, only non-biogenic CO_2 emissions would be considered in a gasification facility along with any N_2O emissions that escape. However, for gasification of RDF to fuels, CO_2 emissions are captured and are a salable by product for the facility. N_2O emissions are not typical in a gasification process. Most nitrogen present in the reaction would be converted to ammonia and stripped from the syngas. For the RDF conversion process, the waste composition was used as a basis for GHG emission potentials and offsets.

In order to quantify the GHG impacts from the production of ethanol from RDF, the GHG emissions were calculated using the Center for Climate and Energy Solutions emissions reduction potentials for ethanol. Life cycle GHG intensity was estimated using the California GREET model. The GREET model estimates GHG emissions from corn ethanol produced in the Midwest at 74.3 grams CO_{2e}/MJ (13.15 lbs CO_{2e}/gallon). Gasoline GHG emissions (with a 10% ethanol blend) are estimated to be 95.9 grams CO_{2e}/MJ (25.43 lbs. CO_{2e}/gallon). At a minimum, GHG reductions, as a result of ethanol production via gasification, would be to offset the 13.15 lbs CO_{2e}/gallon of corn based ethanol. For the project plant capacity of 26,784,000 gallons per year of ethanol produced, the projected GHG savings would be 176,105 tons CO_{2e} per year (159,760 $MTCO_{2e}$)

The WARM model was used to calculate the GHG profile for the tons landfilled and recycled as part of the MWP and RDF process. The warm model estimates the GHG emissions from recycling as (66,832) $MtCo_{2e}$ and from landfilling as 1,900 $MtCo_{2e}$.

When combining the ethanol production GHG offsets, the recycling GHG benefits and the landfill GHG emissions, the GHG emissions for the RDF to gasification with MWP yields a GHG emission of (244,692) $MTCO_{2e}$. A negative number assumes a GHG savings.

For the Newport with MWP and Gasification option, the total tons recycled is estimated to be 21,840 tons, landfill 53,200 tons (mostly inerts) with the remainder being gasified. The remainder of the waste stream is either inerts or biogenic sources that are not converted as GHG emissions.

4.2.1.4 Groundwater Contamination

The potential groundwater contamination risk for this option is considered low when compared to the other options. The residue from the gasification process is char/ash which may result in a relatively lower potential long term risk than the current RDF system that would produce considerably more ash from combustion.

4.2.1.5 Potential for Odors

MSW will continue to be delivered to the receiving area with approximately 200,000 tons processed through the enclosed MWP line and the remainder processed through the existing RDF processing lines. Some odors escape from the receiving area and can be noticed in the neighborhood. There are no appreciable odors generated from processing of the MSW. The odor production potential from the new gasification facility is considered minimal. However, since gasification is an industrial process, there is a potential for odors to occur. However, the gasification facilities will likely be located in an industrial area where odors from the process may not cause public opposition.

4.3 MWP with Anaerobic Digestion

4.3.1 Observations and Pertinent Data

4.3.1.1 Landfill Diversion

The waste composition data provided in Section 1 of the Preliminary Resource Recovery Feasibility Report was used to develop estimates of the tons of MSW that would end up in the outputs for this option – organics to AD, recycling, and landfill. The estimated quantities were developed and used in the EPA WARM model for estimating greenhouse gas (GHG) generation, which develops the data for some of the other environmental factors besides GHG generation. The data for landfill diversion for this option are shown in Table 4-4.

Table 4-4
Landfill Diversion from MWP with Anaerobic Digestion

Output	Percentage	Tonnage
Organics to AD	20.6%	82,320
Recyclables Recovered	11.2%	44,640
Landfilled Residues	68.3%	273,040
Total	**100.0%**	**400,000**

The estimated diversion percentage for the MWP with AD is 31.8% rounded to 32%.

4.3.1.2 Renewable Energy Production

AD is eligible in Minnesota as a renewable energy source much like solar and wind energy. Methane produced through the AD process can either be converted to electricity using conventional engine/generator sets or the methane can be further processed into pipeline quality natural gas. The processed methane can then be injected into a nature gas pipeline or compressed and stored as CNG. Since renewable energy in Minnesota is based on electrical output (e.g. public electric utilities have renewable energy mandates) for renewable energy credits the methane produced from AD would need to be converted to electricity in a standard engine/generator set. Based on the expected methane output, the AD facility is estimated to produce 1.6 to 3.2 MW of electricity. This is much less than the current RDF system that produces 24MW of renewable energy from the Wilmarth and Red Wing combustion facilities.

4.3.1.3 Greenhouse Gas

The material composition and the material category designations used for the WARM model were also the same as that assumed for the current RDF system. However, the management method of the various material categories was altered to align with the goal of this technology. All of the material delivered to Newport would pass through the Mixed Waste Processing (MWP) technology. It was assumed that this technology would capture approximately 60% of recyclable materials (paper, plastic, metals, etc.). A portion of organic material would also be separated using the MWP technology for Anaerobic Digestion. It was assumed that this technology would capture approximately 60% of organic material as well. The remaining material (non-captured recyclables (40%), non-captured organics (40%), and other waste delivered) would be landfilled.

The various material categories were divided into three waste streams for this scenario – AD, recycled, and landfilled.

The GHG emissions generated from anaerobically digesting the organics, recycling the captured material, and landfilling the remaining waste is similar to the other processes using the WARM model. Simulating AD with limited recycling and landfilling yields as estimated GHG emissions of (151,972) $MTCO_{2e}$. Since the WARM model does not account for AD, the tonnage going to AD was assumed to be landfilled with energy recovery. This model provides a conservative estimate of GHG potentials. AD will actually produce more methane than landfilling and produce more energy to offset fossil fuel based energy. Thus, the actual GHG emissions may be better than the projected (151,972) $MTCO_{2e}$.

4.3.1.4 Groundwater Contamination

This option is estimated to have approximately 68% of the MSW landfilled which is the highest percentage landfilled except for the landfill option. This amount landfilled increases the potential long term risk for groundwater contamination relative to options that result in a lower percentage of wastes landfilled.

4.3.1.5 Potential for Odors

In addition to potential odors from the receiving area and MWP system, the organics are managed in an anaerobic digestion process. Anaerobic digestion causes hydrogen sulfide type odors that must be closely controlled and not allowed to escape to the atmosphere. The potential for odors are highest from this technology.

4.4 Mass Burn

4.4.1 Observations and Pertinent Data

4.4.1.1 Landfill Diversion

The waste composition data provided in Section 1 of the Preliminary Resource Recovery Feasibility Report was used to develop estimates of the tons of MSW that would end up in the outputs from this option – MSW to mass burn and bypass to landfill. The estimated quantities were developed as part of the use of the EPA WARM model for estimating greenhouse gas (GHG) generation, which develops the data for some of the other environmental factors besides GHG generation. The data for landfill diversion for this option are shown in Table 4-5 below.

Table 4-5
Landfill Diversion from Mass Burn

Output	Percentage	Tonnage
Total Starting Tons	**100.0%**	**400,000**
MSW to Mass Burn	94.7%	378,800
Landfilled Residues	5.3%	21,200
Ash	22.5%	90,000
Total Diverted	**72.2%**	**288,8000**

The estimated tonnage to mass burn is 94.7%. There is ash that is typically landfilled. For purposes of this analysis, the same quantity of ash from the HERC plant of 90,000 tpy (wet weight) is used. This results in 288,800 total tons diverted which calculates to 72.2%.

4.4.1.2 Renewable Energy Production

Mass burn is eligible in Minnesota under the Renewable Portfolio Standard, much like RDF. (Minnesota Statutes 216B.1691, Subdivision 1). However, a mass burn facility is anticipated to produce more renewable energy than the 24 MW currently produced at the Red Wing and Wilmarth RDF combustion facility. Based on the entire 400,000 tpy going to a mass burn plant, renewable energy production is estimated to be 30 MW. For all the options analyzed, mass burn has the most favorable renewable energy production.

4.4.1.3 Greenhouse Gas

The material composition and the material category designations used for the WARM model were also the same as that assumed for the current RDF system. However, the management method of the various material categories was altered to align with the goal of this technology. Similar to the current system at Newport, a portion of the delivered materials will make up bulky waste that will be landfilled. For this technology, it was assumed approximately 5% (~20,000 tons per year) of delivered materials would be landfilled instead of combusted.

The various material categories were divided into two waste streams for this scenario, combusted and landfilled. No recycling was considered in the analysis.

Based on these assumptions, the GHG emissions generated from combusting the majority of the delivered waste and landfilling the remaining waste is (29,301) $MTCO_{2e.}$ This option performed the worst of the options from a GHG perspective.

4.4.1.4 Groundwater Contamination

There is a need for an ash landfill which could conceivably leak. However, with the landfill liner, the ash solidifying in time and the relative inertness of the ash, the likelihood of groundwater contamination is extremely remote. Therefore, groundwater contamination from the mass burn option is considered favorable in the ranking of alternatives.

4.4.1.5 Potential for Odors

MSW will be delivered to the receiving area with approximately 400,000 tons processed through the two combustion lines. The air for the combustion process is pulled from the receiving area such that there is a negative pressure in the receiving area with no air or odors escaping. There are no odors from the air pollution control equipment. Lack of odors at Target Field in Minneapolis with the HERC Facility located next door provides a good basis for effective odor control at mass burn facilities. Therefore, the potential for odors from a mass burn facility are considered low.

4.5 Landfill

4.5.1 Observations and Pertinent Data

4.5.1.1 Landfill Diversion

By definition of this option, all the MSW is disposed in a sanitary landfill. There is no landfill diversion in this option. Land is converted to disposal space during the operation of the landfill. During post closure, the land is typically open “green” space, but can be used beneficially by a community as a park, nature area or golf course.

A sanitary landfill is the lowest, least preferred of the solid waste management hierarchy. In addition, Minnesota Statutes 473.848 restricts the disposal of unprocessed MSW in the metropolitan area at a sanitary landfill unless there is no available processing capacity. However, this does not apply to landfills located outside of Minnesota. The Counties could legally contract for waste disposal capacity outside of the state.

Landfill siting in Minnesota was modified recently by new rules termed the “FASIT” rules. The rules impacts are further discussed in Section 5.5.1

4.5.1.2 Renewable Energy Production

The landfill option considered would place all 400,000 tpy into a landfill. With waste in a landfill, landfill gas is generated. Typically, larger landfills will collect the landfill gas using collection wells to extract the landfill gas from the waste. The landfill gas (typically 50% methane and 50% CO_2) is then routed to an engine/generator system to convert the landfill gas into electricity. Landfill gas to electricity is considered a renewable energy source in Minnesota.

For the landfill option, the USEPA LandGEM model was used to estimate landfill gas production, the landfill was assumed to accept 400,000 tpy of waste for 20 years. For this option, the landfill was started in 2017 and would be full in 2037. The model outputs indicate within three years there would likely be enough landfill gas to collect and run an engine/generator system to produce electricity. Initially, the system would be small (1.2 – 1.6 MW) but would continue to grow as more landfill gas is produced. Peak landfill gas production would be in 2038 (1 year after closure). In the peak year, estimated landfill gas production would allow for potentially three engine/generator sets that could produce 4 to 5 MW of electricity. From a renewable energy production viewpoint, the landfill does not produce as much renewable energy as the existing RDF combustion facilities.

4.5.1.3 Greenhouse Gas

The material composition and the material category designations used for the WARM model were also the same as that assumed for the current RDF system. However, the management method of the various material categories was altered to align with the goal of this technology. For this scenario, all of the material would be landfilled.

It was assumed that the landfill would have a landfill gas recovery system and that the gas would be recovered for energy. A default distance of 20 miles was assumed for hauling the material to the landfill.

Based on these assumptions, the GHG emissions generated from landfilling all of the waste is (78,640) $MTCO_{2e}$. This negative number indicates a GHG savings. This technology performs slightly better than mass burn.

4.5.1.4 Groundwater Contamination

For the landfill option, the potential for groundwater contamination is highest of all the options. Modern landfills do have plastic liners supplemented with compacted clay to limit the potential for the landfill to "leak." However, containment of wastes and contaminants is not perfect so the potential for a groundwater contamination exists for the landfill option.

4.5.1.5 Potential for Odors

Landfills can experience odor problems depending on the waste received and the effectiveness of the landfill gas collection system. Odors generated from a landfill can be strong, but one typically short in duration. Most landfills control odors by using cover soils and active landfill gas collection systems to capture and destroy the gases generated from waste decomposition. For the landfill option, the greatest potential for odors would be in the first 3-5 years of operation.

During the first 3-5 years, the landfill would not have active LFG collection so odors would be more prevalent and difficult to control.

4.6 Comparative Rating on Environmental Factors

Potential environmental factors include the extent of – diverting wastes from landfills, production of renewable energy, greenhouse gas generation, potential for groundwater contamination, and potential for odors. The Environmental factor criteria include a rating for Diversion of Materials, Energy Production, and Emissions.

The rating for the five technologies is shown in Table 4-6.

Table 4-6
Environmental Comparison Rating

Technology	Diversion	Renewable Energy	Emissions	TOTALS
Current RDF System	3	4	3	10
Newport w/ MWP & Gasification	5	1	5	11
MWP w/ Anaerobic Digestion	2	2	4	8
Mass Burn	4	5	1	10
Sanitary Landfill	NA	3	2	5

Highest technical rating possible = 15; lowest technical rating possible = 3

For diversion, the rating is based on the tons diverted from landfilling. Newport with MWP and gasification received the most favorable rating since this option has the least amount of ash that is landfilled. The other ratings were based on the diversion achieved by the technology. Landfills received an NA rating since no landfill diversion would be achieved for this option.

Renewable energy ratings are based on the amount of renewable energy generated from the option. The most favorable option for renewable energy would be mass burn since it would convert the entire waste stream to energy. This is followed by the current RDF system, landfilling, MWP with AD and, finally, Newport with MWP and gasification as the least favorable option for renewable energy. It is important to note that the gasification process will produce ethanol, a green fuel, but ethanol production is not part of the renewable energy portfolio which is based on electric production, thus gasification renewal received a lower rating. If this technology is selected for further analysis, a broader analysis of energy use and production can be completed.

Emissions rankings are based on GHG emissions from the selected processes with some consideration for potential odors and groundwater contamination. The EPA WARM model was used for each option except for AD and gasification. For AD and gasification, other models were used to provide comparative GHG emissions estimates for ranking purposes. The most favorable process in regards to emissions is Newport with MWP and gasification since it has the GHG reduction from recycling. Additionally, there are GHG reductions for the production of ethanol. Furthermore, the Newport with MWP and gasification process has very low stack or fugitive emissions compared to the other processes. Ranking for the other processes regarding emissions were MWP with AD since most of the emissions are captured and used as fuel. The current RDF system was ranked at a 3 based on the amount of GHG emissions from the current system. Landfills received a ranking of 2 because of active LFG collection and conversion to electricity that offsets fossil fuel electric production. The least favorable system was mass burn due to limited recycling and emissions from a mass burn facility.

Overall, the most favorable environmental system is the Newport with MWP and gasification. This system was rated only slightly above the Current RDF system. Mass burn also ranked just below Newport with MWP and Gasification. From an environmental viewpoint, mass burn and the current RDF system are equal. MWP with AD and Sanitary Landfills are less preferred options. Potential for odors and groundwater contamination also affected ratings for these two options.

5 Permitting

This factor considers all the required permits for the technology and the ease, likelihood and time period to obtain all the required permits for the option. This permitting factor is closely related to the siting factor covered in the next section. Permitting is focused on the technical issues and requirements required in the permitting process. Successful siting requires successful completion of the permitting requirements but also relates to the community response to the project and the development of potential organized opposition.

5.1 Current RDF System

5.1.1 Observations and Pertinent Data

The existing Newport Facility and the two Xcel Combustion Facilities are already permitted. No additional permits are required for continued operation, only the regularly required renewal applications.

5.2 Newport with MWP and Gasification

5.2.1 Observations and Pertinent Data

The RDF processing facility is already permitted. MWP has already been permitted in Minnesota and should not be very difficult, taking at most a year.

The gasification permitting process is unknown and untested in Minnesota. The air emissions levels are very low. The residues are estimated to be 10% to 15%.

The RDF and MWP permits are either already in hand or not expected to be extensive and time consuming. The gasification permitting process is not well defined. The actual emissions are relatively low due to the actual processes where the syngas is captured to produce the fuels. Co-locating the gasification technology at a different solid waste management facility or industrial facility could be advantageous. Gasification facilities in Florida, Mississippi, and Alberta (CA) have been permitted by regulatory agencies, so a similar path to permitting may be anticipated.

5.3 MWP with Anaerobic Digestion

5.3.1 Observations and Pertinent Data

MWP and AD facilities are being successfully permitted in Minnesota, but not yet combined in a single facility. The Hometown Bio-Energy Project was permitted and constructed in Le Sueur, MN and has begun operation. The plant processes corn silage and manure to produce methane that is combusted in engines that generate electricity. The plant is in commissioning and working through a number of issues which could take a few months.

Sanimax is planning an AD facility at their property in South St. Paul and has received at least some of the required permits.

If any of the newly developing AD facilities experience problems with odors, it could affect the permitting process of additional AD facilities in Minnesota.

There are permitted/operating MWP facilities associated with some of the mass burn facilities in Minnesota including the City of Red Wing and Pope-Douglas Counties. There appears to be a proven path for permitting these facilities in Minnesota and combining them should not pose additional technical problems.

5.4 Mass Burn

5.4.1 Observations and Pertinent Data

Olmsted County recently permitted an expansion of their mass burn facility indicating there is some successful experience in Minnesota. Hennepin County has thus far not been successful in expanding their permitted capacity 1,000 TPD to their actual plant capacity of 1,212 TPD, even though the capacity already exists.

The permitting process is fairly well defined, but due to the potentially and likely controversial nature of siting a new mass burn facility, the process could be subject to new steps and requirements. The timeline due to likely opposition could extend from seven (7) to ten (10) years, if successful.

5.5 Landfill

5.5.1 Observations and Pertinent Data

Currently, there are 21 permitted mixed municipal solid waste landfills in Minnesota. In the Metropolitan Area, there are four (4) MSW landfills (Burnsville Sanitary landfill, Elk River Sanitary Landfill, Spruce Ridge Resource Management, and Pine Bed Sanitary Landfill) that are permitted. Landfill permitting can be a complex process that considers the need for a landfill, size, environmental impacts, operations, groundwater, geology, traffic and economics. The last "new" landfill permitted in Minnesota was the St. Louis County Regional Landfill in 1993. Most new landfill capacity is obtained by vertical and/or horizontal expansion of existing permitted landfills.

New rules for siting landfills were developed by the MPCA in response to a legislative directive originally passed in 2008. The directive required updates to rules for disposal of solid waste to include site specific criteria to ban disposal in areas based on the sensitivity to groundwater contamination. These rules came to be known as FASIT rules (**F**inancial **A**ssurance and **SIT**ing). The new rules were approved in 2012 and require new landfills to consider groundwater travel times; monitoring of groundwater and response to a release of groundwater; the lateral distance to areas likely to form karst of 200 feet; and the vertical distance to carbonate bedrock of at least 50 feet. For reference there are areas in Ramsey and Washington County where landfills cannot be located due to karst requirements and the carbonate bedrock requirements.

Financial assurance rules were also modified for MSW landfills initially permitted after January 1, 2011. The rule update includes the use of non-standardized financial assurance mechanisms and an approval process for such mechanisms.

A new landfill to be permitted in Minnesota would require significant public outreach and political involvement in order to be successful. It is anticipated there would be significant public opposition, as well as opposition from existing metro area landfill owners.

5.6 Comparative Rating on Permitting Factors

This factor considers the ease, likelihood and time period to obtain all the required permits for the option. Foth's ranking for the five technologies is shown in Table 5-1.

Table 5-1

Permitting Ease Comparison Rating

Technology	Rating
Current RDF System	5
Newport with MWP and Gasification	4
MWP with Anaerobic Digestion	3
Expanded LF at Existing LF	4
Mass Burn	1
Green Field Sanitary Landfill	1

Highest technical rating possible = 5; lowest technical rating possible = 1

The Current RDF System is already permitted and has a significant advantage over the other options and has a rating of five. The Newport with MWP and Gasification option has some of the facilities permitted, but would need to permit the gasification facility and has a rating of four. Expanding a landfill at an existing site has been done several times in Minnesota to the extent it is a standard process and has a rating of four. The MWP with AD option has been permitted in Minnesota and could be completed for the Board but as a standalone facility, could face some permitting issues and is rated as a three. The Mass Burn and green field Sanitary Landfill options will face very vigorous and lengthy processes, if even successful. These are both rated as a one.

6 Siting

Facility siting and permitting has become the most contentious and difficult part of the solid waste management process. Finding sites that are both technically feasible, environmentally and socially acceptable can be difficult.

Many communities have experienced intense political conflicts centered on uses of technology, acceptable levels of risk, and distribution of decision-making power. Indices ranking the level of support or opposition for potential land uses consistently rank landfills as the most difficult local land uses to site. Other solid waste facilities may be less difficult, but may still generate intense opposition.

This siting factor is closely related to the previous permitting factor in that to be successfully sited; the project must successfully receive all required permits. However, permitting alone is focused on the technical issues and requirements required in the permitting process. Siting relates also to the community response to the project and the development of potential organized opposition.

6.1 Current RDF System

6.1.1 Observations and Pertinent Data

The existing Newport Facility and the two Xcel Combustion Facilities are already in existence and face no new siting processes.

6.2 Enhanced Newport with MWP and Gasification

6.2.1 Observations and Pertinent Data

The existing Newport Facility is already sited. Siting the MWP system should not cause significant impacts at the site, perhaps some new building construction. The existing waste stream delivered would not change, nor much difference in traffic.

The gasification system will not fit on the property as it will require a larger total footprint than acreage available. The gasification system may appear more like a refinery such as Ineos Bios in Vero Beach, FL and Enerkem in Edmonton, Canada.

A gasification facility would fit within a heavy industrial zoned area and may have some application if co-located with another type of waste management or petroleum processing facility. It may potentially not generate as much public concern as other waste management facilities, but could still be associated with incineration.

6.3 MWP with Anaerobic Digestion

6.3.1 Observations and Pertinent Data

Both MWP and AD have been successfully sited and permitted in Minnesota, but not yet in combination. The assumption is that this will be a new, green field facility. As such, it may be subject to opposition groups forming objecting the facility, citing truck traffic, odor potential, and other environmental or aesthetic concerns.

6.4 Mass Burn

6.4.1 Observations and Pertinent Data

Siting has proven to be the most difficult aspect for successfully developing a new mass burn combustion facility. Organized opposition typically forms and becomes effective in delaying permitting processes and/or affecting the outcome of local elections for the host community.

At the Renewable Energy from Waste Conference held in West Palm Beach, FL in November, 2013, Pete Johnson of Dynamis Energy described his company's efforts to site a waste-to-energy facility in Idaho. They were not successful as the opposition group caused enough delays to kill the project. Mr. Johnson noted, "It is difficult to fight emotion and bias with logic and science."

6.5 Landfill

6.5.1 Observations and Pertinent Data

Landfill siting and permitting challenges were discussed in Section 5.5.1. Landfill siting in Ramsey and Washington Counties would have some limitations due to new regulations requiring landfills to be greater than 200 feet from karst features and surface coverage of at least 50 feet above carbonate bed rock. Areas of Washington and Ramsey County would be prohibited from landfill siting.

Landfills are often cited by land use experts as the most difficult facility to site of all potentially locally unacceptable land uses (LULUs). Given the nature of residents and local governments in Ramsey and Washington Counties, local siting approval for a new landfill could be impossible.

6.6 Comparative Rating on Siting Factors

This siting factor is closely related to the previous permitting factor in that to be successfully sited, the project must successfully receive all required permits. However, permitting alone is focused on the technical issues and requirements required in the permitting process. Siting relates also to the community response to the project and the development of potential organized opposition. The rating for the five technologies is shown in Table 6-1.

Table 6-1
Siting Comparison Rating

Technology	Ranking
Current RDF System	5
Newport with MWP and Gasification	3
MWP with Anaerobic Digestion	3
Expanded LF at Existing LF	4
Mass Burn	1
Green Field Sanitary Landfill	1

Highest technical rating possible = 5; lowest technical rating possible = 1

The Current RDF System is already sited and has a significant advantage over the other options and has a five is rating. Expanding a landfill at an existing site has been done several times in Minnesota to the extent it is a standard process and is rated at four. The Newport with MWP and Gasification option has some of the facilities permitted, but would need to permit the gasification facility which could carry some of the same perception issues as incineration even though the technology converting the syngas to transportation fuels is significantly different. This option has a rating of three. The AD option has been permitted in Minnesota and could be completed for the Board and also has a three rating. The Mass Burn and green field Sanitary Landfill options are likely to face organized opposition, will face very lengthy processes, and will require dedicated political leadership. These are both rated as ones.

7 Reliability

Managing MSW is an important responsibility of governments to protect the health, welfare, and safety of the citizens. It is critical that the facilities selected to handle MSW actually work successfully from the collection equipment and operations all the way through any processing facility, and final disposal facility. The entire system must be reliable, able to function successfully on a daily basis.

For this analysis, this factor includes considerations such as:

- Proven technologies;
- Daily and future capacities;
- Age of facilities; and
- Designs that include multiple processing lines.

7.1 Current RDF System

7.1.1 Observations and Pertinent Data

The current RDF System has operated successfully for over 25 years. It is clearly a proven technology and MSW management system. There are two processing lines and two combustion plants to provide redundancy.

The facilities have aged with the RDF processing facility constructed in 1986/87 and the combustion plants built in 1946/47, converted from coal combustion to RDF in the mid-1980s. They have been maintained and continue to operate successfully. Xcel is currently the only customer for the RDF and the future success of the current RDF system is dependent on Xcel's business decisions which are not controlled by the RDF facility owner.

The Foth report *Preliminary Technical Status of the Newport and Two Xcel Combustion Facilities* prepared in October, 2013 indicated that the Newport facility has successfully been maintained on an as needed basis and could continue to successfully operate into the future if the maintenance continues. The report also indicated that Xcel's analysis of the two plants indicated they could continue at least until 2027 with proper maintenance.

7.2 Newport with MWP and Gasification

7.2.1 Observations and Pertinent Data

Mixed waste processing equipment and systems have operated for years. However, the capacities and equipment in the newest facilities is much more sophisticated, requiring larger footprints, more equipment, targeting more materials. These larger MWP systems may be considered an "emerging" technology at this point in time. There will likely be a need for improvements in the designs going forward.

The RDF processing system is already proven.

Gasification of MSW at commercial scale is an "emerging" technology. There are successful pilot facilities and commercial scale plants under construction. The next three to five years could be very informative regarding the reliability of the technology to successfully manage MSW on a daily and future basis. Gasification is not a proven technology, but appears to have a lot of promise at this point in time.

The overall reliability of this Newport with MWP and Gasification system depends on the success of the gasification technology as well as the future market for the products produced. If successful, this technology could be a "game changer" in how MSW is managed in the future.

7.3 MWP with Anaerobic Digestion

7.3.1 Observations and Pertinent Data

This technology can only target recyclable materials and the organic fraction (food waste and non-recyclable paper). Anaerobic digestion has not yet been widely used to manage the organic components of the MSW stream in the U.S. There are many facilities in other countries and several facilities being developed, even in Minnesota. There may be issues going forward with the variability of organics disposed in MSW (seasonal variations in production of vegetation and food products). There may also be issues with the climate and temperature fluctuations in Minnesota.

There may also be technical issues with proper separation of organics from MSW in the MWP systems along with potential contaminants in the solid product produced (compost or fuel).

There is adequate history with AD systems in Europe and Asia to believe that MWP combined with AD will be reliable after any associated material handling, process control, and successful marketing of the outputs. Even so, this limited facility can only successfully manage a portion of the MSW stream leaving a significant amount of the MSW for landfill disposal. This technology could however be combined with other technologies such as RDF or gasification.

7.4 Mass Burn

7.4.1 Observations and Pertinent Data

Mass Burn is a proven technology. Existing plants have operated successfully internationally, in the U.S., and here in Minnesota. The Mass Burn facility owned by Hennepin County – HERC has operated successfully at the same tonnage level considered in the *R/W Resource Recovery Feasibility Report*.

Once permitted, constructed, and successful completion of start-up, a Mass Burn facility will reliably handle the MSW delivered for a minimum of twenty-five (25) years and could be maintained to exceed that time period by many years.

7.5 Landfill

7.5.1 Observations and Pertinent Data

Sanitary landfills are a proven technology. There are many successfully operating disposing of the MSW delivered.

Landfills are limited to the permitted airspace. Once this airspace is filled, the landfill is full. In many instances, landfill owners are able to expand at an existing site, to increase the landfill's life, but there are typically limitations in the total.

For R/W Counties to successfully find landfill airspace under contract for a long term, say twenty-five (25) years, may require going outside the state of Minnesota.

A sanitary landfill option will reliably manage the MSW stream on a daily basis until all airspace capacity is fully utilized which will take many years into the future.

7.6 Comparative Rating on Reliability Factors

It is critical that the facilities selected to handle MSW actually work successfully from processing all the way through to the final disposal facility. The entire system must be reliable, able to function successfully on a daily basis.

For this analysis, this factor includes considerations such as:

- Proven technologies;
- Daily and future capacities;
- Age of facilities; and
- Designs that include multiple processing lines.

The rating for the five technologies is shown in Table 7-1.

Table 7-1
Reliability Comparison Rating

Technology	Ranking
Current RDF System	5
Newport with MWP and Gasification	2
MWP with Anaerobic Digestion	2
Mass Burn	5
Sanitary Landfill	4

Highest technical rating possible = 5; lowest technical rating possible = 1

Mass Burn and the Current RDF System are proven very reliable, functioning on a daily and annual basis to dispose of MSW and are rated five. Sanitary Landfills are equally reliable, but the life is limited to the constructible air space receiving a four rating. The Newport with MWP and Gasification option has some of the same processing system as the Current RDF System, but the gasification technology is not fully proven on a commercial scale at this time. This option received a rating of two. The AD facility does not have the capacity to handle the majority of the MSW and relies on landfills for the rest of the waste stream and received a two rating.

8 Flexibility

The MSW stream will change over time, as new products are produced and enter the MSW stream. New recycling or material recovery processes will become available. Waste stream quantities can change – either increasing or decreasing. This factor is a consideration of how flexible the technology is to successfully managing the variations – both in the continued capacity to handle the changes without significant changes in cost or the ability to modify the technology to manage the change higher on the waste management hierarchy.

8.1 Current RDF System

8.1.1 Observations and Pertinent Data

The Current RDF System has historically handled changes in the MSW stream. For example, the composition of the MSW stream has changed such as an increase in plastics. Deliveries to the facility have fluctuated, but they have successfully processed the waste into the minimum tonnage of RDF required at Xcel. They have equipment to recover ferrous and aluminum metals for recycling. They have expansion capacity for a third line, but there is not enough combustion capacity to warrant the addition. RDF has the flexibility to be used for combustion as currently occurs or could be used in a gasification technology assuming the specifications can be met.

The facility has adapted to changes in composition and quantity over time. There is minimal flexibility to recover types of waste higher on the hierarchy.

8.2 Newport with MWP and Gasification

8.2.1 Observations and Pertinent Data

This option has the same characteristics of the Current RDF System but adds significant potential with the MWP system to recover recyclable materials higher on the hierarchy. In addition, the gasification technology has the potential to recover fuels such as ethanol or chemical products that have a higher economic value than combusting RDF for electricity.

A combination of MWP with RDF production for a gasification system has a lot of flexibility to respond to increased recycling/recovery and changes in the waste stream. This system produces a relatively valuable output relative to the other alternatives and manages the highest percentage of the waste stream with the least amount of residues. The system fits the best with the hierarchy with the recycling capability of MWP.

8.3 MWP with Anaerobic Digestion

8.3.1 Observations and Pertinent Data

This option only handles a portion of the MSW stream including recyclables and the organics. Remaining materials are assumed to be disposed in this R/W Resource Recovery Feasibility report. However, the technologies could ultimately be combined with other waste processing technologies. Overall, if combined with other technologies, MWP and AD may provide additional flexibility.

Some AD vendors have narrow material specifications on the types of organics that can be handled. Flexibility in handling wide ranges of organics and moisture contents may be limited.

A "standalone" MWP and AD facility is limited in the total waste stream handled and would be better combined with other technologies.

8.4 Mass Burn

8.4.1 Observations and Pertinent Data

Mass Burn is very flexible to handle a wide range of wastes as there is a very limited amount of pre-processing required and the vast majority of MSW is combustible. This flexibility and capability to handle a wide range of wastes also creates a concern that there could be a tendency to lose motivation to recover materials higher on the hierarchy and to recover newly recyclable materials in the future. There is also a potential concern that a commitment to meet the capacity of the Mass Burn facility could inhibit recycling. This could be addressed by limiting the capacity of a new Mass Burn facility which may or may not be wise for long term planning.

There has been research showing that communities with Mass Burn facilities (or waste-to-energy in general) have higher recycling rates than communities without waste-to-energy facilities. This may be due to higher prices for waste-to-energy driving more recycling or that communities have implemented a fully integrated solid waste management system as part of their programs. The perception and potential for reduced flexibility is present with Mass Burn.

8.5 Landfill

8.5.1 Observations and Pertinent Data

A Sanitary Landfill is very flexible in the types of MSW that can be handled. There are no or very limited front-end processing requirements. A Sanitary Landfill is a necessary part of any integrated solid waste management system for the residues that can't be recovered. However, if the focus is on the hierarchy and managing an integrated solid waste management system, the sanitary landfill has the poorest fit with recycling and recovering resources from the MSW stream.

While flexible to handle all MSW streams, a Sanitary Landfill does not fit with the focus of minimizing landfill disposal of resources and following the solid waste management hierarchy.

8.6 Comparative Rating on Flexibility Factors

This factor is a consideration of how flexible the technology is to successfully manage variations – both in the continued capacity to handle the changes without significant changes in cost or the ability to modify the technology to manage the change higher on the waste management hierarchy. The rating for the five technologies is shown in Table 8-1.

Table 8-1
Flexibility Comparison Rating

Technology	Rating
Current RDF System	3
Enhanced Newport with MWP and Gasification	5
MWP with Anaerobic Digestion	4
Mass Burn	3
Sanitary Landfill	2

Highest technical rating possible = 5; lowest technical rating possible = 1

The Newport with MWP and Gasification option with the MWP technology and the ability to produce different types of fuels to meet market conditions receives the highest rating of five. The AD option has the MWP technology to adapt to additional recyclables and the whole facility could be adapted in the future to additional processing and received a rating of four. The Current RDF System and Mass Burn can handle wide ranges of wastes, but are limited on increased recycling and received a three rating. Sanitary Landfills can handle the widest range of wastes, but simply have the lowest recovery of resources and were rated at two.

9 Summary

Table 9-1 compiles the ratings for each of the technologies for each of the factors. Overall, the Current RDF System and Newport with MWP and Gasification grouped together higher than the other three technologies. The Current RDF System scored highly for permitting and siting since it is already sited and permitted. It also scored highly on reliability.

Newport with MWP and Gasification rated higher than the Current RDF System for the financial factor and flexibility. It also rated one point higher than the Current RDF System on the environmental factor and would have been higher if the energy criteria had not been limited to strict classification of “renewable” energy (production of ethanol is obviously an energy product, but does not qualify as a “renewable” energy).

It is important to note that the three technology scenarios that are compared to the current RDF system and landfilling were selected to provide a range for comparison purposes. This analysis offers a starting place for understanding the technological feasibility for each individual technology and alternatives possible when they are combined. There is some flexibility as the Board continues its evaluation to look at other technology combinations. In other words, the three technologies analyzed are not absolute, but can be modified.

Table 9-1
Compiled Comparison Rating

Technology	Technical	Financial	Environmental	Permitting	Siting	Reliability	Flexibility	Total
Current RDF System	8	8	10	5	5	5	3	**44**
Newport w/ MWP and Gasification	7	13	11	4	3	2	5	**45**
MWP w/ AD	5	7	8	3	3	2	4	**32**
Mass Burn	10	5	10	1	1	5	3	**35**
Sanitary Landfill	10	8	5	1	1	4	2	**31**

Highest technical rating possible = 60; lowest technical rating possible = 12

Two technologies, the “Current RDF System” and “Newport with MWP and Gasification” had similar values and ranked higher than the other three technologies.

- The Current RDF System scored highly for permitting and siting since it is already sited and permitted. It also scored highly on reliability.
- Newport with MWP and Gasification rated higher than the Current RDF System for the financial factor and flexibility. It also rated one point higher than the Current RDF System on the environmental factor and would have been higher if the energy criteria had not been limited to strict classification of “renewable” energy (production of ethanol is obviously an energy product, but does not qualify as a “renewable” energy).