Executive Summary

Alternative Technologies for Municipal Solid Waste

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Ramsey Washington County
Resource Recovery Project

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

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The Ramsey/Washington County Resource Recovery Project Board (Board) has a service agreement with Resource Recovery Technologies, LLC (RRT) to process solid waste from the two counties at the Newport Resource Recovery Facility (Facility). The Facility began processing solid waste into refuse-derived fuel (RDF) in 1987 under different ownership. The current service agreement extends until the end of 2015. The Solid Waste Master Plans for Ramsey and Washington Counties (R/W Counties) each include a processing policy for solid waste as follows:

> *"Consistent with the State hierarchy, Ramsey and Washington County affirms processing of waste, for the purpose of recovering energy and recyclables and other beneficially useful materials, as the preferred MSW and non-MSW management method over landfilling for waste that is not reduced, reused, or separately recycled or composted. This policy applies both to waste generated throughout the county and specifically to MSW generated by public entities including contracts for organized collection of solid waste. Pursuant to State law, public entities in Ramsey County will assure that MSW that they generate or contract for is processed rather than land disposed."*

As part of the preliminary planning process for waste management options after the end of the current processing agreement, the Board is conducting a number of evaluations of the existing Facility and alternative technologies. This report provides a review of the current status and application of the following technologies to R/W Counties:

- Gasification – A thermal process that converts solid waste to a synthetic gas (syngas), using limited amounts of air or oxygen.
- Pyrolysis – A thermal process that breaks down solid waste without air or oxygen and uses heat to produce syngas.
- Plasma arc – A process that uses very high temperatures (5,000 to 13,000 degrees Fahrenheit) to breakdown waste into elemental byproducts,
- Mass Burn Waste-To-Energy – A process that burns solid waste in a combustion chamber, without presorting of waste components, and recovers heat energy.
- Anaerobic Digestion – A process that decomposes the organic (carbon-based) portion of solid waste in the absence of oxygen, producing syngas or natural gas, and a digestate with a liquid and solid component.
- Mixed Waste Processing – MWP – Also known as "front-end separation," this is a process that removes recyclable materials from mixed solid waste; it can either be stand-alone or be part of a front-end process before another technology.

- Plastic to Fuel – A process that uses heat and distillation to convert various plastics into oil.

Waste Stream Analyis

The type and amount of mixed municipal solid waste available in the future needs to be considered when reviewing applicable technologies. Projecting waste volumes takes into consideration the changes likely to occur in the solid waste system, with increased levels of recycling and separate management of organic waste. Between 2012 and 2037 the amount of MSW that is not reduced, reused, recycled or managed as separate organic waste in the two counties is expected to grow from 391,000 tons, to close to 500,000 tons. The waste composition over that time period is expected to change somewhat, with reduced volumes of recyclable paper, glass, metal and organics. The type and amount of materials that are discarded in the Counties depends heavily on a number of factors, such as changes in population, the economy, consumer habits, and types of business development.

Comparison of Alternatives

Table ES-1 provides a summary of the technologies covered in this report according to basic criteria including:

- Whether the technology is proven in North America
- There is available documented cost data
- The relative ease of permitting
- Development time frame
- Flexibility/Compatibility – now and in the future
- Applicability to R/W Counties waste stream, and
- Viability for further consideration.

Technology Status

- Mass burn, RDF, and MWP are considered proven technologies for handling MSW, having been in commercial operation for many years
- Gasification is moving into commercial operation, with three gasification facilities scheduled to begin commercial operation in the next two years. If successful, this could start to prove the technology as capable of handling MSW on a large scale.
- Plasma arc systems, while used for certain special waste destruction, are still in the development phase in the U.S. for use in processing MSW, usually in the form of RDF. There may be one plant coming on line in the next year.
- Anaerobic digestion is receiving a great deal of interest and plant development activity targeting organic rich waste streams, primarily food wastes.
- Plastics to Fuel is drawing interest and there is a local commercial operating plant.
- Pyrolysis is not proven for MSW and there are no known plants being considered in the U.S.

Table ES-1
Summary Comparison of Alternatives

	Proven Technology for MSW in North America	Documented Cost Database	Ease of Permitting	Plant Development Period	Flexibility & Compatibility	Applicable to R/W MSW	Viability for Further Consideration
Mass Burn	Yes with several existing plants in Minnesota	Yes	Proven to be difficult	5 years+	Can handle all non-recyclable waste but size & economics typically need long term commitment	Yes	Yes
Refuse-Derived Fuel	Yes	Yes	Proven difficult	5 years+	Fits with gasification, plasma, AD, MWP	Yes, current system in place	Yes
Mixed Waste Processing	Yes	Yes	Occurring in Minnesota	1 to 2 years	Fits as front end processing to all	Yes for a Portion	Yes
Gasification	Three plants in development	No	Unknown	5 years+	Fits with RDF, AD, MWP	Maybe RDF from Newport	Maybe, pending new plants
Plastics To Fuel	One plant - maybe	No	Occurring in Minnesota	1 to 2 years	Fits with MWP ahead of all technologies	Yes for a Portion	Yes
Anaerobic Digestion	Yes for organic fraction	Yes for organic fraction	Occurring in Minnesota	1 to 2 years	Fits with gasification, plasma, RDF, MWP	Organic fraction	Yes
Plasma Arc	One plant in development	No	Unknown	5 years+	Possibly fits with RDF, AD, MWP	Maybe RDF from Newport	No
Pyrolysis	No	No	Unknown	5 years+	Unknown	None	No

Documented Cost Database

For the Technology Scan in this report, the only technologies that have reasonably available, actual capital and operating costs are mass burn, RDF, and mixed waste processing. Anaerobic digestion costs are likely close to those documented for other AD processes using organic waste streams, and can be projected. The experience with the other technologies of gasification, pyrolysis and plasma arc is not sufficient to accurately document or even estimate the cost per ton of MSW. Should estimates be needed as this work proceeds, further in-depth analysis could provide some cost estimates.

Ease of Permitting/Public Acceptance

Understanding that any new waste management facility typically faces difficulty with public acceptance, some technologies may be less difficult than others to permit. Minnesota law would require an Environmental Impact Statement (EIS) and a lengthy permitting process for a mass-burn facility, and possibly for other newly-sited technologies. The environmental review and permitting process may take five years or more. Based on historical experience, a new solid waste facility will have great difficulty receiving public acceptance. Any of the technologies are likely to be easier to permit at an existing waste management facility that is currently permitted. Permitting is currently being completed for anaerobic digestion of targeted organics, mixed waste processing facilities, and a plastics to fuel facility in Minnesota. Permitting processes for gasification, pyrolysis, and plasma arc are not yet clearly defined by the MPCA which may cause additional delay.

Development Period

This is an estimate of the time from a decision to pursue the technology until actual commercial operation. The time periods in Table ES-1 are for green fields sites. Siting at an existing solid waste facility typically reduces development time.

Flexibility/Compatibility

Future waste processing systems may be most effective if multiple technologies are used in a "systems" approach. This parameter addresses how the technology could fit in "concert" with a system. Gasification, RDF, AD, mixed waste processing, and plastics to fuel could all fit together in a comprehensive system with each technology focused on managing wastes most compatible with the process. Mass burn has an advantage in its capability to handle all non-recyclable wastes, but there may be some concern regarding the size and long term commitment to a single facility and approach.

Applicability to R/W Counties Waste Stream

Gasification requires the MSW to be pre-processed into an RDF type of material and could be quite applicable to the RDF produced at the Newport Facility. Pyrolysis and plasma arc might also use the RDF, but are an unproven technology and likely cost prohibitive. Mass burn technology could be applied to the entire R/W Counties waste stream currently available for processing. Organics such as food wastes and non-recyclable paper could be processed using anaerobic digestion. Mixed waste processing could potentially be used to handle primarily commercial wastes that still have recoverable materials and high amounts of organics or plastics. The Plastics to Fuel technology could be applied to the non-recyclable plastics.

One potential concept could be to use a combination of technologies such as the "front end processing" of a MWP facility that would sort out recyclables (for typical markets), organics (for anaerobic digestion), plastics (for plastics to fuel), with the remainder of the wastes shredded for either RDF for combustion or eventually for some type of gasification facility. This concept would be a "systems" approach. This would be similar to the City of Edmonton, Canada that has a waste management center to process various wastes using multiple technologies.

Viability for Further Consideration

Pyrolysis and plasma arc are not technically or economically viable to be considered further at this time. Mass burn is a proven, viable, and relatively cost effective technology, but has been demonstrated to be difficult for public acceptance and permitting and therefore could be very difficult to implement. Pending how the new gasification plants perform, the technology could hold promise in the future. The concept of the "systems" approach with mixed waste processing, anaerobic digestion, plastics to fuel, and production of RDF has potential for consideration. RDF combustion is a proven technology at the existing Xcel combustion plants at least until and if the gasification technology develops to technical and economic viability.