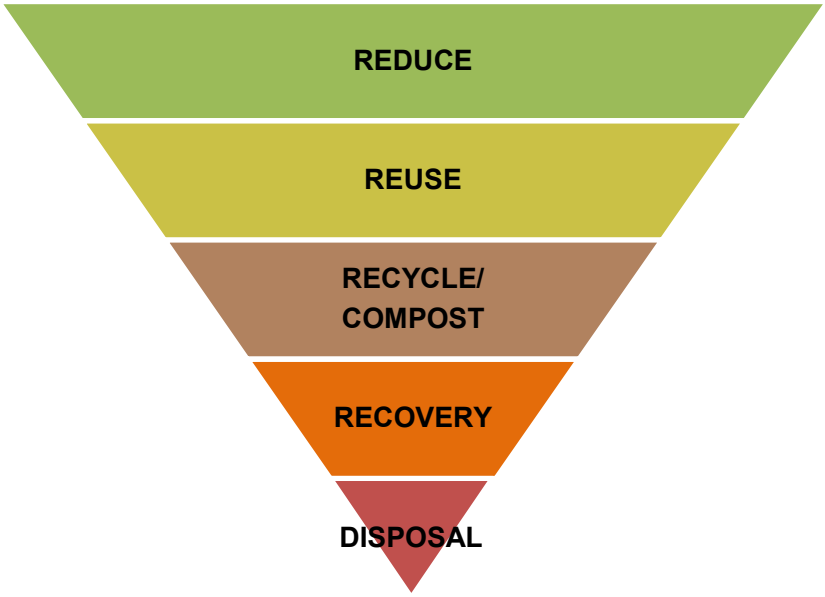
WASTE & RECYCLING SERVICES

Waste-to-Energy Status Update

Introduction

Waste & Recycling Services (WRS) is continually investigating, developing and implementing programs that enable the diversion and processing of materials otherwise destined for landfill to support The City's target of 70 per cent diversion from landfill by 2025. The intent of these programs is to enable the conversion of solid waste materials through reuse, recycling and composting, in alignment with the waste management hierarchy.



Waste-to-energy (WtE) technology is an option for managing the remaining fraction of the waste stream after The City and the private sector undertake all reuse, recycling, and composting activities. Reuse and recycling activities use waste as a resource and return valuable commodities to the marketplace, avoiding the energy consumption and environmental impact of collecting virgin materials from renewable and non-renewable resources.

The strategy developed in 2007 to achieve the 80/20 target envisioned that WtE would be needed for The City to achieve the 80 percent waste diversion target (UCS2015-0835). This technology would extend landfill life and recover latent energy in waste materials in the form of heat, electricity or industrial fuels that would be lost if waste materials were buried in landfills.

Finding a suitable location for a WtE facility can be challenging considering stringent permitting requirements and stakeholder opposition to the potential impacts of the operation of a thermal waste treatment facility. Funding such a facility can also be difficult due to high capital costs and ongoing operational costs.

With the recent introduction of diversion policies and programs, the earliest estimated timeframe for the introduction of thermal treatment of waste by The City is in the 2023 to 2026 business cycle.

Waste to Energy Technologies

The four most common WtE technologies considered for the thermal treatment of Municipal Solid Waste (MSW) include conventional combustion (mass burn incineration), gasification, pyrolysis and plasma arc gasification. Anaerobic digestion (AD) is a non-thermal WtE technology that produces a compostable by-product and is becoming more common in North America.

Conventional combustion or mass burn incineration is the most common type of WtE used around the world to produce heat, power, or combined heat and power from MSW. In a direct combustion system, MSW is burned to generate heat, which is then used to boil water in a boiler for heating/cooling applications, process applications, or driving steam turbines to generate electricity. Most recent installations of this type have focused on the generation and sale of electricity.

Gasification and pyrolysis are emerging WtE technologies in which MSW is heated to high temperatures either in a limited-oxygen environment (gasification) or in the absence of oxygen (pyrolysis). Gasification produces heat and combustible gases, while pyrolysis produces bio-oil, gases and heat as its principle products.

Plasma arc gasification is a more technologically complex gasification process and is less proven on a commercial scale. These systems use a plasma arc reactor in an enclosed chamber using plasma torches to heat MSW to 3800^{0}C or higher. These extremely high temperatures convert organic materials into synthetic gas and inorganic materials into an inert, non-hazardous waste material (slag) that can be disposed in landfill.

Anaerobic Digestion is a biochemical process in which microorganisms break down the biodegradable fraction of MSW (food and yard waste and sewage sludge) in the absence of oxygen resulting in the production of methane and carbon dioxide, otherwise known as biogas. The biogas produced during AD can be used directly for heating in combined heat and power gas engines, or it can be upgraded to pipeline-quality gas called biomethane or renewable natural gas. The remaining product of the anaerobic digestion process is a material called digestate that requires further treatment in a composting facility in order to complete the process.

The Current State in Canada

As shown in Table 1, there are currently only four large-scale (>100,000 tonnes annually) thermal treatment facilities operating in Canada. The facilities, located in Quebec City, QC; Burnaby, BC; Brampton, ON and the Regions of Durham/York, ON (Figure 1) all utilize mass burn incineration.

Table 1: Operating and Planned WtE Facilities in Canada

Location	Technology	Year	Capital Investment ($)	Processing Capacity (t)	Expected Annual Net Operating Cost ($)	Status
Quebec City, QC	Mass Burn	1974	21M	300,000	Unknown	Operational
Burnaby, BC	Mass Burn	1988	180M	280,000	17M	Operational
Brampton, ON	Mass Burn	1992	Unknown	182,500	Unknown	Operational
Durham/York	Mass Burn	2015	285M	140,000	5.1M	Operational
Edmonton	Gasification	2016	75M	100,000	9.4M	Commissioning
Ottawa	Plasma gasification	Exp. 2014	200M	110,000	9.1M	Cancelled
Peel Region	Mass Burn	Exp. 2021	500M	300,000	9M	Cancelled
Metro Vancouver, BC	TBD	TBA	480M	400,000	15-20M (w/o elec. $)	Cancelled

Figure 1: Conventional Combustion Facility Covanta, Durham York, ON

Figure 2: Gasification - Enerkem Alberta Biofuels

With limited landfill capacity in Ontario, the Regions of Durham and York commissioned a WtE facility in 2015. This facility is the most recently completed Canadian WtE project. There are several lessons to be learned from the success of this project. The site is situated in Clarington ON, away from the concentrated populations of Durham and York. The permitting and construction process took more than ten years to complete. Durham and York Regions invested considerable time, money and resources to advance the project through technology selection, site selection, environmental assessment and impact studies, public consultation and a competitive procurement process. Despite good planning and a successful procurement process, operational issues have caused unexpected problems. The facility is currently operating at one-third capacity due to a shutdown caused by high levels of dioxins detected in emissions.

The Enerkem facility in Edmonton is using gasification technology to produce methanol from MSW and has further plans to modify the plant to produce ethanol in the future (Figure 2).

Construction of the facility was recently completed, and while Enerkem has successfully produced commercial quantities of methanol, they are still working on small modifications that will allow uninterrupted and continuous operation. Enerkem has suggested that the growing pains of introducing this innovative technology were expected.

Plasco is the best-known example of a plasma gasification company in Canada. Plasco gained approval for and operated a pilot-scale facility in Ottawa, Ontario starting in 2009 (Figure 3).

Figure 3: Plasco pilot-scale facility in Ottawa

In 2010, The City of Ottawa entered into an agreement that would see Ottawa pay $9.1 million annually to Plasco to construct a full-scale facility capable of receiving 300 tonnes of MSW per day. Plasco did not satisfy the terms of the agreement, missed multiple deadlines, and the City of Ottawa eventually terminated the agreement. Plasco filed for creditor protection shortly thereafter.

The Region of Peel and Metro Vancouver have both recently cancelled procurement processes for thermal WtE facilities in their jurisdictions, citing the high costs for construction and high projected operating costs. Both jurisdictions reported investing significant amounts of money prior to cancelling the projects. (Region of Peel - $7 million, Metro Van - $4.5 million).

Summary

At this time, it is estimated that the cost to implement a WtE facility would range between $100-500 million in capital investment and a guaranteed volume of waste would be required. In order to narrow this investment range, identify an appropriate technology and appropriately size a facility, more certainty regarding the characterization of the approximate 30 per cent residual material remaining once all sector diversion programs reach maturity will be required.

In addition, recent experiences in other municipalities suggest the WtE technology is still evolving. The City is in an advantageous position to learn from other municipalities and provide clear cost effective direction with regard to future capital investment.