40

Report: TES-WMS-16-05

Region of Waterloo

Transportation & Environmental Services

Waste Management

To: Chair Tom Galloway and Members of the Planning and Works Committee

Date: June 14, 2016 **File Code:** E20-40

Subject: **Waste Management Master Plan Update – Completion of Thermal Treatment and Energy Recovery for Residual Waste Management Feasibility Study**

Recommendation:

That the Regional Municipality of Waterloo undertake the following actions with respect to the management of residual waste:

a) Take no further action related to pursuing Energy from Waste (EfW) for residual waste management at this time;
b) Direct staff to continue discussions regarding residual waste management and waste diversion programs with the Intermunicipal Working Group (IMWG); and
c) Direct staff to report back to Planning and Works Committee regarding the remaining site life at the Waterloo Landfill and the state of the EfW industry in 3 years.

Summary: Nil

Report:

Background

A new Waste Management Master Plan (WMMP) was completed in 2013 to establish the direction for integrated waste management in the Region considering that the Region's landfill will likely reach capacity in approximately 15 years. The WMMP examined various aspects of waste management including how to manage residual waste (i.e. garbage) once the landfill is full, how to improve diversion rates, how to further reduce environmental impacts, and established strategic directions in the complementary focus areas of Diversion, Residual Waste Management and Planning.

The WMMP included a recommendation in the Residual Waste Management focus area to further investigate thermal technology options. As a first step, a Feasibility Study to examine the various aspects associated with thermal treatment and energy recovery for residual waste management (EfW Feasibility Study) was initiated in 2014 and recently completed.

The WMMP also included a recommendation in the Planning focus area to establish an inter-municipal working group (IMWG) to explore potential partnership opportunities for both diversion and residual waste management. The group was established in 2014 and meetings were held in the Fall of 2014 and 2015. Initial membership includes the Cities of Brantford, Guelph, Hamilton, London, and Toronto, Counties of Brant, Wellington, Norfolk, Oxford and Regions of Peel, Halton and Niagara.

Report TES-WMS-16-05 provides a summary of the findings of the EfW Feasibility Study and discussions held with the IMWG.

EfW Feasibility Study

In accordance with the recommendations of the WMMP to further investigate thermal technology options for the management of residual waste, a study was initiated in 2014 to assess and evaluate the feasibility of implementing a residual waste management system using thermal treatment technology with energy recovery and to examine the question “What does the Region of Waterloo need to have in place to make EfW feasible for our community?”. The Feasibility Study examined the opportunities and barriers associated with implementation of thermal treatment by the Region, including:

- opportunities for collaboration and partnership amongst neighbouring jurisdictions and/or private sector entities,
- synergies with the Biosolids Master Plan,
- factors which are outside of the primary waste management mandate of the Region, including provincial policy direction and changes,
- considerations related to revenue from energy generation,
- required changes to Regional waste management policies, programs and operational practices necessary to allow for the successful implementation of thermal treatment, and
- the relative benefits of utilizing recovered energy for electricity generation and/or district heating.

The study included a comprehensive overview of a variety of aspects necessary to inform decision making, including technical, operational, environmental, risk, policy, and economic issues. A variety of technologies were investigated, together with various potential feedstock scenarios and energy outputs as shown in Table 1.

Table 1. Study Parameters

Feedstock Scenarios	***Technology Scenarios***	***Recovered Energy Scenarios***
Current residential waste stream	Conventional Incineration	Electricity
Addition of Industrial, Commercial and Institutional waste stream	Advanced Thermal Technology (e.g. gasification, plasma gasification, pyrolysis)	Combined Heat and Power
Addition of municipal solid waste stream from a partner		Bio-ethanol
Addition of multi-residential municipal solid waste stream		
Addition of biosolids		

Study Findings

Key findings from the study include the following:

- The capital cost of an EfW facility could range from $300-$600M depending on size of facility and technology selected;
- The net lifecycle cost per tonne of waste processed could range from $75-$200 depending on technology and facility size. Significant economies of scale exist, reducing the net cost per tonne as facility size increases;
- All residual waste disposal options, including landfilling, can result in environmental impacts. EfW specific impacts associated with facility operations and emissions can be mitigated with engineered design;
- Due to the relatively low greenhouse gas (GHG) impact of the Ontario power grid since the closing of coal-fired power plants, the greatest GHG emission savings are realized with conversion to either combined heat and power or bio-ethanol;
- Advanced Thermal Technologies (ATT) for management of municipal solid waste (MSW) are not yet proven commercially;
- ATT have a narrower range of acceptable feedstock quality, therefore it is typically necessary to include some form of pre-treatment, which adds to capital and operating cost of the facility;
- All technologies produce solid residues requiring disposal (i.e landfill), typically ranging from 10-20% of facility input;
- Bioethanol facilities typically produce a liquid waste stream in addition to solid residuals which may require additional treatment;

- Due to their relatively high moisture content, additional pre-treatment (e.g. drying) would likely be necessary to include biosolids as a feedstock for EfW;
- There is very limited global experience with co-incineration of MSW and biosolids.

Study Conclusions

The study conclusions address the requirements that the Region should have in place or should work to optimize if the Region wishes to pursue EfW as a residual waste management strategy in the future. The primary factors highlighted in the study conclusions include:

Food Waste

The residential waste stream currently contains over 50% by weight organic material, primarily in the form of food waste. Organic matter with a high moisture content reduces the calorific value of the waste stream resulting in a feedstock that is not conducive to EfW. Food waste should be diverted to a higher use such as composting or anaerobic digestion.

Flow Control

The Region's waste management mandate under provincial legislation is limited to residential waste, with no control over the management and ultimate destination for waste generated by ICI sources. In the absence of ICI feedstock, future projected residential waste tonnages (i.e. approximately 125,000 tonnes in 2025 and 153,000 tonnes in 2045) are at the low end of economies of scale for conventional incineration. Economy of scale becomes most apparent at facilities sized at 250,000 t/yr and above.

Long Term Feedstock Supply

The lifespan of a thermal treatment facility is typically in the range of 30 years, thus long term contracts with third parties are necessary to guarantee feedstock and continued plant operation. Many jurisdictions in the European Union (e.g. Netherlands, Sweden, Germany) have found themselves in a position where importing waste across national borders has been necessary to sustain operation of EfW facilities in the midst of diversion rates that were not anticipated at the time of construction of the facilities.

Energy Conversion Efficiencies

Recovered energy can be in the form of electricity (or power), heat or biofuels such as bio-ethanol. Recovery of each form of energy has an associated efficiency in terms of the amount of energy that can be captured as an output based on a given input. Because conversion to heat energy is far more efficient than conversion to electricity, and excess heat will always exist when power is generated, the most efficient energy recovery scheme (referred to as combined heat and power or CHP) includes both heat

and power generation. CHP conversion efficiencies can be upwards of 85%. In order to make the best use of CHP, a large heat consumer is needed, such as a single industrial user where heat or steam is required in a process, or a group of users such as an industrial park or district heating network.

Commercial Viability of ATT

Advanced thermal EfW technologies (ATT) such as gasification to produce electricity or biofuel are not yet commercially proven in MSW applications, and have minimal operating experience. A full scale bio-ethanol plant in the City of Edmonton began operation in 2015 using a gasification process developed in Quebec, however details about operating and life cycle costs are not yet available. Several large gasification projects are underway in the United Kingdom and Australia, driven by a favourable fiscal and regulatory regime. Technology advances are also underway to allow for more efficient direct combustion of gas and conversion of gas to liquid fuels. Again, actual details about operating and life cycle costs and the commercial viability of ATT in an MSW application will be forthcoming over the next few years.

State of the Industry and Trends to Watch

In the past decade several Ontario and Canadian jurisdictions have considered EfW as a residual waste management solution. Due to the significant capital investment necessary to construct a plant, risk associated with securing sufficient feedstock, and a rapidly changing technology and policy environment, no Ontario municipalities are actively pursuing EfW at the present time.

Council at the Region of Peel voted in Fall 2015 to halt the implementation of a planned 300,000 t/yr facility when the projected cost approached $600M, and instead focus on an aggressive 75% diversion target. In late 2015, Metro Vancouver also halted implementation of a regionally-sized EfW facility of approximately 500,000 t/yr when cost estimates exceeded $1 billion and a proposed flow control bylaw was blocked from enactment by the Province. Locally, private waste management firms have proposed EfW facilities in Port Hope and Hamilton. Significant public opposition to these facilities has resulted in the initiatives being cancelled. Third parties partnering with the Cities of Ottawa (Plasco) and Sault Ste Marie (Enquest) to pilot gasification EfW processes both went bankrupt before construction on a full scale facility was started.

The Region of Durham’s 140,000 t/yr EfW facility began processing waste in 2015. The facility, which cost in the neighbourhood of $300M to construct, will produce up to 14MW of power, enough for approximately 10,000 homes. The facility required one year longer to construct than originally anticipated, at an extra cost to the Region of approximately $250k. The Durham project required approximately 10 years to conduct impact studies and secure the necessary approvals from the Province.

In jurisdictions, particularly in Europe, where EfW projects have been implemented, project drivers generally fall into three categories. These include:

- geography; high population densities and lack of available land for the large footprints associated with landfilling drive the need for a solution that is not land intensive,
- energy needs; energy dependence, security of supply, and cost to produce or import energy drive the need for domestic production, and
- political and commercial environment; landfill bans and levies drive economics to favour EfW solutions.

Trends to watch locally include demographics and provincial policy. A period of increased uncertainty currently exists regarding composition of the residual waste stream in the Region, in part as a result of coming demographic changes including population growth, shifts in the ratio of single-family to multi-residential housing, and the evolution of waste diversion that will likely result from changes to curbside policy in 2017. All of these factors could dramatically impact the proportions of various materials present in the residential waste stream. Further, provincial legislative changes as a result of the new Waste Free Ontario Act will likely result in changes to the residual waste stream resulting from new diversion programs for specific material types. In addition, the Climate Change Mitigation and Low-Carbon Economy Act will likely impose a GHG emissions cap on EfW facilities, and the resulting impact on life cycle costs is not yet understood. The Province will require a minimum of two years to enact the regulations to operationalize the Acts discussed above. Until such time as regulations are in place, uncertainly remains as to their impact on EfW initiatives.

Provincially, recent information (Ontario Waste Management Association, February 2016) indicates that approximately 120M tonnes of disposal capacity remains in the province, with approximately one third of this being private landfills. At a provincial fill rate of approximately 8M t/yr (exclusive of the 3.5M tonnes that are exported to New York and Michigan annually), this amounts to 15 years of landfill capacity in the province. This is generally consistent with projections for the remaining lifespan of the Waterloo Landfill.

Opportunities

The study findings present several opportunities associated with long term waste management planning in the Region.

Full cost accounting completed as part of the WMMP determined that the Region's cost to dispose of waste at the Waterloo Landfill is approximately $50/t (adjusted to $2015). The comparable annual operating cost for an EfW facility could range from $75-$200. Capital costs associated with construction of an EfW facility could range from $300-$600M. Alternatively, capital costs associated with siting and constructing a new landfill in the Region could range from $200-$250M.

Implementing strategies to increase the amount of waste diverted from the landfill will increase the remaining lifespan of the Waterloo Landfill beyond the approximate 15 years remaining currently, and defer both a significant capital outlay to construct a new residual waste disposal facility and the potential for future increased operating costs associated with EfW. Further, capital costs associated with the ultimate build out of the Waterloo Landfill will also be deferred.

Deferring immediate next steps associated with residual waste management will also allow for policy (e.g Waste Free Ontario and Climate Change Mitigation and Low-Carbon Economy Acts) and technology developments to stabilize. ATT solutions may mature to the point of improved commercial viability and the private sector may have an increasing market presence, providing for disposal options that are not municipally owned assets. Further, over the next several years neighbouring municipalities with active landfills will also begin to approach the time where decision making must commence for their next residual waste management solution.

Finally, whether or not the Region pursues an EfW solution at some point in the future, consideration of a Community Energy Plan, including district heating concepts is a worthwhile initiative. District heating opportunities would maximize the energy recovery and revenue potential for an EfW system. In the absence of an EfW system, community energy planning and district heating would enable efficiencies in the transportation and use of heat for a wide variety of users, and in turn reduce greenhouse gas emissions through an optimized heating distribution network.

Intermunicipal Working Group

The mandate of the IMWG is to maintain open and on-going dialogue amongst neighbouring municipal jurisdictions to explore opportunities for collaboration, including the joint implementation of waste management policies, programs and/or facilities. Initial membership includes the Cities of Brantford, Guelph, Hamilton, London, and Toronto, Counties of Brant, Wellington, Norfolk, Oxford and Regions of Peel, Halton and Niagara.

As part of the Feasibility Study the Region hosted IMWG meetings in October 2014 and November 2015. Waste management representatives discussed common challenges, opportunities, leading/best practices, and the current state of waste management master planning. In general, waste management strategies include maximizing diversion rates, maximizing existing landfill capacity and non-infrastructure based residual waste disposal options (e.g export of waste). None of the participants in the IWWG are actively pursuing EfW initiatives for residual waste management at this time. The next meeting is tentatively scheduled for Fall 2016.

Recommendations:

Based on the review completed as part of the feasibility study and as described in this

report:

Staff are recommending that no immediate action be taken to pursue an Energy From Waste Facility and that staff continue to monitor the state of EFW industry and report back to Council in 3 years.

Waste Management is a rapidly evolving and changing field. It is expected that the next 3-5 years will continue to see changes. Based on the summary from this report and taking into account the remaining landfill capacity at the Waterloo Landfill site, there is no immediate need to plan or construct an EFW and waiting 3 years to make a formal decision is appropriate.

The Region should continue to work with potential partners in an EFW to ensure that appropriate partnerships can be created.

Corporate Strategic Plan:

Implementation of the recommendations of this report support the Corporate Strategic Plan Objectives of the Environment and Sustainable Growth Focus Area, including 3.1 “Increase the Amount of Waste Diverted From the Landfill”.

Financial Implications:

The approved 2016 Waste Management Ten Year Capital Program includes sufficient funding provisions to implement the recommendations identified in this report.

Other Department Consultations/Concurrence:

Nil

Attachments

Nil

Prepared By: Donna Serrati, Manager, Engineering and Programs

Approved By: Thomas Schmidt, Commissioner, Transportation & Environmental Services