Results of the Mixed Waste Processing Study

Study Overview

In 2018, as directed in the Long Term Waste Management Strategy (Strategy), Solid Waste Management Services Division initiated a Mixed Waste Processing with Organics Recovery Study (Study). The Strategy contemplated processing approximately 150,000 tonnes per year of primarily multi-residential garbage to recover 75,000 tonnes of Blue Bin recyclables and Green Bin organics. Initial Study findings were presented to Toronto City Council in 2020 through *IE12.4 Mixed Waste Processing Study Update*. SWMS was subsequently directed to report back to Council in 2023 with a business case, including a triple bottom line analysis and a utility rate impact assessment, on the mixed waste processing of waste with and without thermal processing compared to increased reduction and diversion and traditional landfilling.

In support of the Strategy, Solid Waste Management Services has studied the viability of a mixed waste processing facility to achieve the following outcomes:

- **Preserving landfill space.** While the Study originally proposed mixed waste processing to extend the life of Green Lane Landfill, a facility could not be operational before its estimated closure date. As such, the performance of a mixed waste processing facility is best assessed against the City's future residual disposal needs.

- **Recovering resources.** A mixed waste processing facility investment ought to be assessed against its ability to support the City's desired circular economy outcomes by recovering resources that can be successfully marketed, such as recyclables and organics. The Strategy originally contemplated a material recovery target of 75,000 tonnes per year**.**

- **Increasing the diversion rate.** A mixed waste processing facility investment ought to be assessed against its ability to contribute to the Strategy target of 70 per cent diversion from landfill. The Strategy targeted a seven per cent contribution to the diversion rate from a mixed waste processing facility.

Over the past four years, Solid Waste Management Services has completed several exercises that culminated in a business case assessment for mixed waste processing. These included:

- Waste generation forecasting
- Seasonal waste characterization audits
- Jurisdictional scans of precedent mixed waste processing facilities, including consideration of the role of thermal processing in mixed waste processing
- Case study analysis of mixed waste processing in jurisdictions where both organics are recovered through both source separation programs and mixed waste processing
- Laboratory analysis of various material samples drawn from the City's garbage stream for their suitability as feedstock for anaerobic digestion (organics processing) and against various fuel quality parameters

- Material recovery estimates
- Order-of-magnitude costing
- Utility rate impact assessment

Operating Assumptions Modelled for Business Case Analysis

A set of high-level operating assumptions were made to model a business case for a mixed waste facility. This included determining what garbage stream sources would be targeted. The business case fore the theoretical mixed waste processing facility contemplated:

- Processing curbside and front-end collected garbage from both single family and multi-residence residences;
- Processing throughput of 279,000 tonnes of garbage annually;
- Targeting recovery of acceptable Green Bin Organics and high-value Blue Bin Recycling (polyethylene terephthalate (PET), high density polyethylene (HDPE), and metals (steel and aluminum) that meet market quality parameters; and,
- Commissioning and being operational in 2036, assuming an aggressive planning and construction timeline beginning in 2024.

The analysis aimed to be technology agnostic and included modelling of additional recovery scenarios for comparative purposes. Consideration was given to the impacts of introducing a new facility into the City's broader Integrated Waste Management System, however this analysis was limited by the lack of specific data to form a design basis (including site and technology selection) for the facility.

Key Findings

Solid Waste Management Services has concluded that a strong business case does not currently exist for investment in a mixed waste processing facility. The facility would be unlikely to meet target outcomes of resource recovery and waste diversion, while being less cost-effective than current waste diversion program efforts. The facility is also a high-risk investment, due to the changing regulatory (e.g. Extended Producer Responsibility) and market conditions that could impact facility performance. This analysis suggests that current City initiatives focused on source separation, such as the Green and Blue Bin programs and community-basedprograms, are more effective, in cost and outcome, to achieving waste diversion goals; and, that infrastructure funds are best allocated to higher priority, higher impact projects such as residual disposal planning and the expansion of Green Bin organics processing capacity.

Key findings that support this conclusion are as follows:

- **Composition data:** Findings indicate that there is less divertible material in the garbage stream available for recovery than originally anticipated.

  Based on seasonal waste composition data, approximately 27 per cent of the garbage stream is estimated to consist of acceptable organics; however, only about 11 per cent of the garbage stream consists of food waste. The remaining 16 per cent consists of material such as tissues and towelling that may not contribute

much value in a wet anaerobic digestion process or to biogas generation, as well as items such as diapers that are made with considerable residual waste (i.e., non-organic) material.

Approximately 23 per cent of the garbage stream consists of Blue Bin recyclables; however, only approximately 16 per cent consists of materials that meet commodity market quality parameters for recycling. Additionally, only 3 per cent of the garbage stream consists of high value plastics and metals that meet market quality parameters.

The business case for mixed waste processing contemplated the recovery of organics and high-value recyclables that meet market quality parameters. Based on the composition analysis, only approximately 30 per cent of the garbage stream consists of material contemplated for recovery by mixed waste processing.

- **Resource recovery and waste diversion estimates**: No mixed waste processing facility can achieve a 100 per cent recovery rate, and so various recovery scenarios were modelled to provide an understanding of potential facility performance. Based on the analysis, a mixed waste facility is unlikely to meet the target outcomes for recovery or diversion. The most likely material recovery scenario would divert an estimated 53,000 tonnes per year from an annual facility throughput of 279,000 tonnes per year, contributing 5.3 per cent to the City's overall diversion rate. These estimated performance outcomes fall below the 75,000 tonnes per year target and seven per cent diversion targets set for mixed waste processing in the Long Term Waste Management Strategy.

- **Preserving landfill space:** Based on the analysis, it is likely that most material going through a mixed waste processing facility would still need to be landfilled after processing. In the most likely recovery scenario, the City would still require approximately 226,000 tonnes per year of landfill capacity for the 279,000 tonnes of garbage being processed by the facility. See Figure 1 below.

- **Technology requirements:** The recovery estimates assumed in this analysis have not been tested or proven in technologies currently available on the market. Further analysis and applied research would be required to refine and validate the recovery estimates in a real-world scenario. Uncertainty remains around whether sorting technologies exist that are sensitive enough to detect and separate a relatively small amount of high-value recycling from a large, heterogeneous feedstock. Similarly, there is uncertainty whether existing technologies could recover the organics fraction from garbage and process it to meet the quality parameters for diversion and to produce compost in Ontario.

- **Capital and operating cost estimates:** In 2019, rough order-of-magnitude estimates were generated for the capital and operating costs for a theoretical mixed waste processing facility. After adjusting the capital cost estimate for inflation, Solid Waste Management Services has determined that construction of a facility would be in line with the $310 million identified in the Strategy. Operating costs for a mixed waste processing facility are currently estimated to be $19.5

million annually. These estimates equate to a combined cost of $126/tonne processed.

- **Diversion cost estimates:** By comparing the capital and operating cost estimates against the most likely recovery scenario, Solid Waste Management Services estimates the project would cost $688 per tonne diverted. Potential revenues from recycling and renewable natural gas generation, plus potential landfill cost savings, do not result in cost savings for diversion via mixed waste processing.

- **Utility rate impact:** The capital and operating costs of a mixed waste processing facility are not included in the current Solid Waste Management Services rate structure. Based on an assumed planning and construction timeline that begins in 2024, Solid Waste Management Services estimates that a mixed waste processing facility would result in an average utility rate impact of 6.4% starting in 2036.

- **Operational Recycling Risk Considerations:** Risks associated with recycling recovery through a mixed waste processing facility remain high, particularly given the upcoming transition to an Extended Producer Responsibility (EPR) model for the Blue Bin recycling program. The transition to EPR is expected to impact the recycling market both in demand and nature of materials that qualify for recycling. Additional market impacts from high energy prices and potential economic downturn may also reduce the revenue that could be recovered from recyclables.

- **Operational Green Bin Organics Risk Considerations:** A major source of uncertainty is whether the final output of organics processing will meet the quality required for compost in Ontario. Compared to source separation, there is a higher risk of contamination in the garbage stream from grit, glass, and other materials. Laboratory analysis was conducted on the organics fraction of garbage and found that samples exceeded the Ontario Compost Quality Standard for finished compost both for total foreign matter and plastic content. Laboratory analysis also identified a relatively low methane yield for the organics fraction of garbage when compared to source separate organics analyzed.

- **Risks related to facility performance:** The performance of a mixed waste processing facility is highly dependent on the nature and composition of the garbage entering the facility. Composition analysis has shown considerable variability in Toronto garbage, both on a seasonal basis, and when major events impact consumption behaviours in the economy. This variability will influence the amount of waste processed by the facility along with estimates of how much resources can be recovered. Importantly, the performance outcomes of a mixed waste processing facility conflict with the City's goal to increase diversion at source, since any improvements to resident participation in the Blue Bin and Green Bin programs will reduce a facility's ability to meet its recovery and diversion targets.

- **Thermal Processing Considerations:** The jurisdictional scan undertaken examined 58 facilities, of which 40 facilities included a thermal process either on or off-site as part of the recovery strategy. Based on current composition data,

there may be between 57,000 and 74,000 tonnes of material in Toronto garbage that could be used to create a refused derived fuel product (RDF). The production of RDF involves processing residual solid waste into a refined, homogenous solid fuel that can then be used by a thermal process (such as a cement kiln) to produce energy. However, it is unclear if existing technology could effectively target these materials while also maximize material recovery in the form of recycling and organics diversion. Additionally, it is unclear if a market exists for RDF generated from municipal garbage in Ontario, or whether the City could market such a significant quantity of RDF.

- **Social and environmental impacts**: Depending on the site selected for a facility, there could be a range of social and environmental impacts that would need to be explored further. Social impacts could include job creation, noise and odour impacts to communities, and consideration for impacts on and/or opportunities to support relationship building with surrounding First Nations should a facility be constructed outside of Toronto. Environmental impacts could include operational impacts on surrounding areas and impacts on greenhouse gas emissions from facility building, operations, and reduction of landfill gas emissions through organics diversion.

Conclusions

For these reasons, Solid Waste Management Services recommends that infrastructure funds are best allocated to higher priority, higher impact projects such as residual disposal planning and the expansion of Green Bin processing capacity. Although Solid Waste Management Services has concluded its study of mixed waste processing as a standalone infrastructure solution, the Division will continue to explore opportunities to reduce waste, increase diversion, and maximize resource recovery through policies, programs, and infrastructure investment, consistent with the City's goal to transition to a zero waste circular economy.

Figure 1: Diagram of the Estimated Composition of Garbage Managed by a Mixed Waste Processing Facility, and Estimated Landfill Requirements for the Most Likely Recovery Scenario

Collected Garbage: 279,000

Garbage: 139,000

Recyclable Material: 63,500

Clean Recycling: 45,000

Contaminated Recycling: 18,500

High-Value, Marketable Recycling: 7,800

Recycling Processing Loss: 4,100

Organic Material: 76,500

Organics Processing Loss: 27,300

Diverted Organics: 49,200

Diverted Recycling: 3,700

Landfill: 226,100

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