

To: Joel Clary, Director of Engineering and Public Works**Date:** September 17, 2024**c:****Memo No.:** 02**From:** Sam Huang
Wilbert Yang
Peter Klaassen**File:** 704-SWM.PLAN03237-02**Subject:** Township of Esquimalt – Gasification Pilot Testing

1.0 INTRODUCTION

The Township of Esquimalt (ToE) retained Tetra Tech Canada Inc. (Tetra Tech) to investigate the feasibility of conducting pilot scale gasification testing on municipal solid waste (MSW).

1.1 Objective

The objective of Tetra Tech's work is to reach out to vendors and institutions regarding the possibility of carrying out pilot scale gasification testing on MSW and prepare a scope for the ToE on costs and timelines of conducting these tests.

1.2 Deliverable

Tetra Tech undertook the above noted assignment to provide the following deliverable.

- A memo on findings from reaching out to various vendors and institutions regarding pilot scale gasification testing of MSW.

2.0 BACKGROUND

The ToE wants to investigate the feasibility of using gasification as a waste management technology to process MSW in order to reduce reliance on landfills as well as to produce renewable energy and value-added products from MSW.

Gasification involves the conversion of solid waste materials into a gaseous fuel known as synthesis gas (syngas) through a high-temperature process in an oxygen limiting environment. This process typically involves heating the waste material to very high temperatures, usually above 700°C (1292°F), in the presence of a controlled amount of oxygen or steam. This process produces syngas, which primarily consists of carbon monoxide (CO), hydrogen (H₂), and other combustible gases. This syngas can be used as a fuel for generating heat and electricity or as a chemical feedstock for producing various products. Gasification offers the potential for energy recovery through the combustion of syngas to generate electricity and heat, which can be used for various purposes.

3.0 GASIFICATION PILOT

Tetra Tech reached out to a range of vendors and academic institutions regarding the possibility of carrying out pilot scale testing for MSW gasification. The vendors and institutions include:

- ICM Gasification Technology;
- Nexterra/University of British Columbia (UBC);
- Environeta;
- CHAR Technologies;
- University of Toronto; and
- University of Calgary.

3.1 ICM Gasification Technology

ICM is a US based gasification technology provider with various patented technologies. The contact person was Dr. Bert Bennett, PhD, who is the senior engineer/principal scientist. ICM had a pilot system that operated from 2009 to 2012 where they tested a wide range of feedstocks including Refuse-Derived Fuel (RDF) that was made from MSW. However, no testing was done with raw MSW. Additionally, ICM no longer operates this pilot system and is not able to carry out any testing of raw MSW.

3.2 Nexterra

Nexterra is a Canadian based company and has a demonstration facility on the UBC campus. The contact person is Phil Beaty, who is the VP Strategic Relationships. The facility at the UBC campus processes urban wood residues and generates 2MW of electricity through Combined Heat and Power (CHP) engines. Through communication with Nexterra, they indicated that their technology can only gasify RDF pellets and not raw MSW.

3.3 Environeta

Environeta is an Alberta based company, the contact person is Wayne Pratt. Although they indicated that there may be a unit available for pilot scale testing when first contacted, they have later confirmed that they in fact do not have a system that could carry out a trial for MSW. The recommendation was that with a proper survey and assessment of the waste, an accurate calculation and prediction can be made about the end products. The basic full-scale unit that Environeta produces can process 20,000 tonnes per year as an absolute minimum, and depending on a variety of factors the system is flexible enough to process more during peak hours and less during off hours, if needed. Generally, there are still many uncertainties and unknowns at this point in time, especially how and where the energy would be used from the process.

3.4 CHAR Technologies

CHAR Technologies (CHAR) is a Canadian based company with pyrolysis technology to process biomass and wood waste. The contact person is Andrew Friedenthal, Director of Business Development. In discussions with CHAR, they were very clear in that they do not do any work with MSW and only focuses on wood waste and organic waste.

3.5 University of Toronto

Prof. Nikolai DeMartini is a professor in the Department of Chemical Engineering & Applied Chemistry at the University of Toronto and his research focuses on biofuels, Waste-to-Energy (WtE) with focuses on gasification and pyrolysis. In discussions with Prof. DeMartini, he indicated that he is not aware of any facilities that can gasify a big enough sample of MSW to get meaningful results, and it would also be very challenging to conduct tests with raw MSW at a university laboratory as the MSW will be considered a level 2 biohazard and will make the testing very difficult to be carried out from an administrative perspective.

3.6 University of Calgary

The University of Calgary has an Energy and Environment Research Group (EERG) with the lead researcher being Dr. Nader Mahinpey. In a phone conversation with Dr. Mahinpey, he indicated that he may have some connections in industry that could carry out this pilot, although he did mention that it was unlikely. Unfortunately, he has been away and has not provided any further info.

3.7 Others

In addition to the vendors and institutions listed above, Tetra Tech also reached out to a number of other waste industry professionals who have experience with gasification and pyrolysis technologies, the general consensus was that there is unlikely to be any vendor that could carry out pilot scale gasification testing of MSW, especially given that gasification has yet to be proven as a successful technology at full scale for the processing of raw MSW.

4.0 INDUSTRIAL FACILITIES

There have been two gasification facilities that were built in Canada over the past two decades. These facilities are Plasco in Ottawa and Enerkem in Edmonton. Both facilities have either been shut down or are in the process of being shut down.

- Plasco had an agreement with the City of Ottawa. This facility used plasma torch gasification and was built and operation in 2007. It was a \$27 million dollar demonstration plant. There were many issues and challenges that hindered the company's ability to meet the City's requirements. By February 2015, the City dissolved its contract with Plasco and the company filed for creditor protection.
- The City of Edmonton signed a 25-year agreement with Enerkem in 2010 to build a gasification facility that would turn waste into ethanol. The facility cost an estimated \$200 million dollars and was commissioned in 2014. The facility had many problems that it was not able to resolve and is scheduled to close in 2024. The facility was only able to process less than 1% of the material it was designed to process.

5.0 SUMMARY

Through our research into conducting the pilot scale gasification of raw MSW, Tetra Tech has not been able to identify any vendor or institution that has the capabilities to carry out these tests. It should be noted that responses from University of Calgary and Environeta has yet to be received.

6.0 CLOSURE

We trust this technical memo meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech Canada Inc.

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Enclosure: Appendix A Limitations on the Use of this Document

APPENDIX A

LIMITATIONS ON THE USE OF THIS DOCUMENT

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GEOENVIRONMENTAL

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