

Green Municipal Fund

No: 15187

Southwestern Manitoba Zero Waste System

Pilot Project Report

December 2021

Between

RURAL MUNICIPALITY OF MINTO-ODANAH

- and -

FEDERATION OF CANADIAN MUNICIPALITIES

“The preparation of this pilot project was carried out with the assistance from the Green Municipal Fund, a Fund financed by the Government of Canada and administered by the Federation of Canadian Municipalities. Notwithstanding this support, the views expressed are the personal views of the authors, and Federation of Canadian Municipalities and the Government of Canada accept no responsibility for them.”

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SOUTHWESTERN MANITOBA ZERO WASTE Pilot Project Completion Report

GMF number	15187
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Date of the Report	December 17, 2021

1. Introduction

- a) Who was involved in doing the Pilot Project, and what are their affiliations? Please include name, title and contact information. Those involved could include municipal staff, engineering and other consultants, a representative from a nongovernmental organization, and others.

Southwestern Manitoba Zero Waste Pilot Project Committee Members – 2017 to 2021	Contact Information
Representing the R.M. of Minto-Odanah Aaren Robertson - CAO (office staff) Krista Dillabough (office staff) James Andersen (former Reeve to 2018) Doug Dowsett (Reeve from 2018 to present) Brion Pollon (councilor on committee to September 2021) Barry Cook (councilor on committee to September 2021) Bill Hopkins (councilor on committee to September 2021) Ron Carr (councilor on committee to September 2021) Monty Peckover (councilor on committee to now) Dennis Pearson (councilor on committee to September 2021)	R.M. of Minto-Odanah 49 Main Street South, Minnedosa, MB R0J 1E0 T: 204.867.3282 E: mintoodanah@wcgwave.ca
Other Southwestern MB Zero Waste Pilot Project Members Representing Evergreen Environmental Technologies (EET) Dave McDonald (manager of EET) 2017 to 2021 Representing former SRDC and citizens at large Jon Lewis – Minnedosa, Manitoba 2017 to 2021 Blake McCutcheon – Mayor of Neepawa (2020 to 2021)	EET T: 204.867.7161 E: evergreentech@xplore.net.ca J. Lewis T: 204.867.7830 E: linoz@goinet.ca
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2. The Pilot Project

- a) Please describe the project objectives and the approach used to meet these objectives. Include details on what technology or solution was tested during the Pilot Project. (Indicate relevant sections/pages of the Final Pilot Project Report)

Project Objectives

The Rural Municipality of Minto-Odanah conducted a ‘zero waste’ pilot project to divert the majority of their municipal solid waste (MSW) stream into a modular gasification unit, which will convert the waste into a clean-burning gas, called syngas. Potential by-products of gasification were believed to include aluminum, steel, glass and ash, which are recovered as scrap metal, or converted into materials such as road aggregate. At the outset of the project, the municipal waste diversion rate for Minto-Odanah was just over 50 percent, and it was thought that the pilot would increase it to nearly 95 percent, diverting more than an estimated 2,000 additional tonnes of MSW per year.

From a technological standpoint, the system is innovative in that it can process unsorted MSW, while other gasification systems are targeted toward a specific waste stream. The system has the potential to be replicated in other rural or remote municipalities and has generated interest from over 45 municipalities in Manitoba. It also offers significant knowledge value as an interdisciplinary collaboration between regional policy makers, technology developers, and members of the academic community.

For the purposes of the pilot project, the modular gasification unit was located at the Evergreen Regional Landfill site just east of Minnedosa for testing and evaluation. The system that was proposed is ideally suited to small landfill sites because it is modular and built within a standard shipping container, with site preparation limited to a level area with compacted gravel for the shipping container to rest on.

Minto-Odanah and the other project partners currently transport most of their waste to a regional landfill (Evergreen) site east of Minnedosa. Licences for small landfill facilities, which are nearing capacity, are not being renewed as they expire. This forces rural communities to haul their MSW long distances to the central landfill. For the purposes of the pilot project, the modular gasification unit will be located at the central landfill for testing and evaluation. The municipality’s long-term plan would be to situate a modular gasification unit at smaller landfill sites (since one of the main advantages of the unit is its portability) throughout the region, which would lower greenhouse gas emissions by reducing truck traffic as well as extending the lifespan of the local and regional landfill. The system being proposed is thus ideally suited to small landfill sites because it is modular and built within a standard shipping container, with site preparation limited to a level area with compacted gravel for the shipping container to rest on.

Dillon Consulting Source Testing Program

Dillon Consulting Limited (Dillon) was retained by the Rural Municipality of Minto-Odanah (Minto-Odanah) to conduct source testing for the pilot prototype gasifier unit, set up at the Evergreen Environmental Technology (EET) Class 1 Landfill site (regional landfill site), located between the communities of Neepawa and Minnedosa in Minto-Odanah. The gasifier project is being conducted to aid the diversion of their municipal solid waste (MSW) stream by converting the waste to a clean burning fuel (syngas).

The source-testing program was conducted per the EET Environment Act Licence # 2612RR with the objective of quantifying contaminant emission concentrations in the gasifier exhaust for assessment against the Manitoba Conservation and Climate (MCC) proposed Thermal Treatment Systems Regulation limits (Test Program Limits).

The subject equipment for this source-testing program is the pilot-scale gasification unit that was mobilized and installed at the EET landfill site. The gasification unit was operated using municipal solid waste as the feedstock. The Test Contaminants were as listed in Schedule A of the Notice of Alteration to Licence # 2612 RR approval letter from MCC.

Notification of the planned source testing was provided to MCC by Wendy Bulloch, Project Manager, Southwestern MB Zero Waste Project on July 29, 2021. This correspondence followed a March 25, 2021 electronic mail from Bulloch to MCC in which a Pre-Test Plan for the testing program was provided.

Dillon performed sampling for the test contaminants according to approved Manitoba, Environment and Climate Change Canada (ECCC) and US EPA methodologies. The on-site sampling for this testing program was conducted on August 10 to 12, 2021.

Dillon successfully completed the source-testing program to quantify test contaminant concentrations and emission rates for the subject equipment at the facility. All testing was conducted in triplicate with the average results compared to the Test Program Limits.

All source testing was conducted in accordance with MCC-approved methodologies without variation during the processing of a municipal solid waste feedstock. The test results should be accepted as compliance quality data.

(For the complete results of the field test, please see R.M. Minto-Odanah - Source Testing Program – Evergreen Environmental Technologies - Environment Act Licence # 2612 RR and R.M. of M-O Gasifier Testing GHG Assessment Memo)

- b) Did the pilot project include a methodology or approach for verifying or testing the performance of the technology or solution? Please respond Yes or No.

Yes [] No []

If you answered yes to Question (b), which methodology did you use in this pilot project for testing the performance of the technology or solution?

- Environmental Technology Verification Program
- Engineering Consultant
- Other (please specify) _____

For the methodology involved in the emissions testing, please refer to the attached reports from Dillon Consulting – **R.M. of Minto-Odanah- Source Testing Program – Evergreen Environmental Technologies - Environment Act Licence # 2612 RR and the R.M. of M-O Gasifier Testing GHG Assessment Memo)**

3. Pilot Project Results:

- a) What are the Pilot Project’s recommendations? (You may point to the relevant sections/pages of the Final Pilot Project Report if relevant.)

RM / Project Managers (Wendy Bulloch & Eco-West Canada):

- The test data from Dillon Consultants, i.e. ‘Source Testing Program-Evergreen Environmental Technologies Environment Act License #2612RR and the separate results of Testing GHG Assessment,’ should be sent to the Conservation and Climate Department, Province of Manitoba (contact: Eshetu Beshada, P.Eng) for approval. The Pilot Project gasifier unit cannot be used for waste management until the Province of Manitoba grants approval as to meeting the particulates requirements as set out by the province and upon final approval from Manitoba Conservation and Climate. RM of Minto-Odanah should maintain ongoing discussions with Dillon and Celtic as to what the next best steps will be once approval is granted by the province.
- The Pilot Project’s main focus was to determine if the gasifier unit would indeed function as intended, while the second focus was to determine if GHG emissions could be decreased using the unit, which could have long-term positive financial impacts (avoided or deferred capital costs, i.e. the municipality not having to dig a new landfill cell). Since Dillon Consultants have concluded that the gasifier unit will indeed lead to a decrease in GHG emissions, and that Celtic Power & Machining can further adjust the unit so that it will be ready for easy start-up as a “push button operation,” it is recommended that the RM of Minto-Odanah and its partners wait for final approval from the Province of Manitoba before making any strategic decisions concerning local/regional MSW management options.
- Once the province has given the “green light” to the RM and Celtic Power & Machining to move ahead with the use of the gasifier, two options should be considered: a) move ahead with plans for the commercialization and eventual construction of other units for

purchase by other municipalities, and b) RM of Minto-Odanah could lease its unit for operation by other municipalities for use at local and regional landfills elsewhere across the province.

- The R.M. of Minto-Odanah, in partnership with the other municipalities involved in Evergreen Environmental Technologies (EET) Class One Landfill Site, need to identify and determine a plan of recycling educational awareness to all citizens using the EET Class One Landfill Site so that materials unfit for loading into the gasifier be kept out of the waste stream (for ex., as shown in pictures and the report from Celtic, paint cans etc. were in the cage from the Municipal Solid Waste that was loaded in August 2021. These paint cans caused some higher emission readings than would have otherwise been observed.)
- EET Class One Landfill Site should be used as a learning/educational viewing site for other municipalities to observe the unit at work (in compliance with Celtic Power & Machining's Intellectual Property agreement).
- Industry associations such Manitoba Environmental Industry Association (MEIA) and Solid Waste Association of America (SWANA) should be made aware of the potential and benefits of this waste treatment technology as compared to traditional waste disposal methods and practices.
- Opportunities arising out of carbon offset market for GHG emissions reductions related to waste disposal practices in both the private and public sectors should be explored.

Celtic Power & Machining (design and construction, emissions testing):

- The existing machine is set up for manual operation only. This was to allow operators to make adjustments according to operational conditions within the gasifier during the initial testing phase. To make the machine user friendly it must be automated an aspect that can now be developed since there is now actual operational data from the test run.
- The test run highlighted the possibility of significantly improving the operation of the secondary chamber. This would improve the flow of syngas and reduce the requirement for propane, which could potentially further improve emissions.
- Consideration should be made for improving and possibly automating the loading / unloading process. It is currently entirely manual. This was done to fully understand how the load is processed. Now that the initial testing phase has been completed, this and other minor improvements could make the unit even more user-friendly.

Dillon Consulting (Emissions testing):

- Relating to GHG emissions, Dillon recommends that the RM of Minto-Odanah continue assessing the feasibility of using the syngas generated by the gasification unit as a fuel source supplement to heat or power systems that would otherwise rely on fossil fuels to increase the overall net benefit of GHG emission reduction.
- Celtic Power should seek additional opportunities to operate the unit using MSW as the feedstock, and utilize the knowledge gained from the initial unit runs to optimize the controlled operation of the unit and efficiency of the syngas combustion.
- There should be initiated a follow-up emissions testing program of the unit with MSW as the feedstock but with no undesirable contaminants in the waste to re-assess compliance with the MCC proposed 'Thermal Treatment Systems Regulation' in-stack emission limits.

b) Is the Pilot Project *technically feasible* for full-scale implementation? Please comment on why or why not.

Yes, the results of the initial operational run indicate that it would be technically feasible at full-scale implementation, since the unit that was built by Celtic for the pilot test is a full-scale model of the gasification technology. Further use by the RM of Minto-Odanah and its regional partners as well as other municipal jurisdictions in the province will have to wait until the technology and emissions thereof has been approved by the province.

- c) What were the financial results of the Pilot Project and is the Pilot Project *financially feasible* for full-scale implementation? Please comment on why or why not.

All indications are that the implementation of a full-scale zero waste disposal unit could be affordable when considering long-term operating expenses. What is lacking at this time in this assessment are these long-term maintenance costs and other operating costs involving human resources in various areas - operations, mkt/education campaign, collections, etc. - in order to be compliant with provincial regulations that regulate this sector of activity.

Once the province has completed its ongoing waste programs framework review, it will be easier to establish long-term viability of replicating the initiative. In addition, unknown at the present time are opportunities related to carbon-offset credits, although legislation is forthcoming in this regard at the federal level.

For the pilot project, the municipality found itself compelled to absorb a larger amount of the costs than was initially expected. This was due to unforeseen events such as COVID affecting the availability and cost of supplies, leading to time overruns on production, underestimates of unit certification costs (locating and retaining the services of qualified engineers), as well as a shortfall of funds due to a lack of support on the part of provincial and federal funders. This made cash flow difficult to manage.

- d) Please complete the following table that was part of your pilot project application with the actual results from your pilot project.

Environmental results table

A	B	C	D	E	F	G
Project defined parameter	Units relevant to performance of parameter	Baseline performance before project	Anticipated performance after project completion	Revised baseline performance before project	Revised anticipated performance after project completion	Actual performance of the project
Waste diverted from landfill (weight)	tonnes	2,816	4,881	n/a	n/a	1.7 (project) 280 (projected annual*)
Greenhouse Gas Emissions	Tonnes CO ₂ e	2,277	1,158	n/a	n/a	3.9 (project) 648 (projected annual**)

* based on the average net diversion rate for the 3 day pilot-scale project projected for 24 hr/day, 5 day/wk. and 50 wk./yr. operation and assuming no scaling (increase) of waste processing rate for a full-scale permanent gasification unit.

** represents an estimated net reduction in GHG emissions of ~0.8 tonnes CO₂e per tonne of waste diverted, which based on the annual projected waste diversion quantity of 280 tonnes, would represent a net reduction of ~220 tonnes CO₂e.

- e) Please describe all the environmental results including any potential negative results or trade-offs that need to be considered.

The gasifier processed 1890 kg of waste over the 3-day (~36 hours of unit run time) for an average waste processing rate of 52.5 kg/hr. Based on three 1-hour CO₂ emission concentration tests during the 3-day testing program, Dillon Consulting determined an average emission factor for CO₂ emissions from the gasifier to be 2310 kg/tonne of waste processed. With negligible quantities of methane anticipated in the exhaust, the total GHG emission factor for the gasification system is 2310 kg CO₂e/tonne.

To determine if the project technology results in a net reduction in GHG emissions, Dillon first estimated the quantity of GHG emissions that would result from the landfilling of a tonne of MSW. Using a standard default methane generation potential value of 170 m³/tonne and a 50/50 volume split for methane and CO₂ in landfill gas, a total GHG emission factor of 3100 kg CO₂e/tonne of landfilled waste was determined. The difference between this factor and the gasification system GHG emission factor of 2310 kg CO₂e/tonne provided the basis for Dillon to state, “Based on a default methane generation potential for municipal solid waste, a net reduction potential of GHG of 790 kg CO₂e/tonne of waste was estimated for the gasifier system.”

One trade-off to the reduction of GHG emissions through waste diversion and gasification technology is the need for an alternate fuel, in this case propane, to provide the initial heating of the gasification chamber until the gasification process begins, and to supplement the combustion of syngas in the secondary combustion chamber. The combustion of propane (or other fossil fuel used for heating) results in the release of CO₂, and therefore GHG. Note that the GHG emission factor determined for the gasification unit discussed above includes the contribution of propane combustion emissions.

- f) Based on the experience gained in the pilot, please update the anticipated social and economic outcomes (community benefits) of full-scale implementation of the pilot project. Column B of the following tables shows the anticipated economic and social benefits you noted in your application.

Please complete the table below by describing in Column C the anticipated economic benefits of the pilot project at full-scale implementation. Please complete for all that apply in the list below. If there are additional economic benefits, please describe these in the last row of the table.

Figure 1 – Economic benefits

A	B	C
Economic benefit	As described in your GMF application	Anticipated economic benefits of the pilot project at full scale based on pilot experience. If the result is different than what was expected in the application form, please indicate why .
Increased return on investment	Shared operating costs among the project partners; on-site generation of recoverable energy (syngas, electricity and steam)	Once approved for use by the Province of Manitoba (Conservation and Climate), the system could result in shared costs by the project partners, and potentially other municipal jurisdictions since the system is modular and transportable since there is no fixed infrastructure. Dillon is of the opinion that cogeneration of energy is definitely possible with such a unit.
Deferred or avoided capital expenditures	Construction of new landfill cell(s) deferred or avoided altogether	This is one of the major objectives of the pilot, to show that the use of such a unit will provide an alternative means of eliminating MSW, thereby avoiding the need for new landfill cells at Evergreen Regional (N.B. Licences for the other small regional landfill facilities, which are nearing capacity, are not being renewed as they expire).
Decrease in facility operating or maintenance costs		
Extended lifespan for facility	Active landfill cell lifespan extended beyond the projected waste disposal capacity	There is no question that this will be a direct result of operating gasifier units at local/regional landfill sites.
Increased municipal revenue streams (e.g. property tax, user fees, etc.)	Municipalities could potentially obtain contracts for the disposal (transfer) of waste at the landfill site	The diversion of organics from landfill is also a practical approach to GHG reduction in the waste sector, as well as the efficient transportation of diverted materials to recycling/processing facilities and end markets. Developing local and regional markets for diverted material - in addition to reducing GHGs - supports a local circular economy. Opportunities to maximize value of organics should thus be actively explored by the municipality.
Lower taxes		

Stimulus for local economy (use of local business, capacity for local business development)	Construction of energy-based facilities such as greenhouses at the site for use of recovered energy	Yes. Based on the potential of cogeneration. Battery storage may also be a good option here.
Increased employment options or job retention	Four to six jobs in the short term (at Celtic), and the potential for dozens more as 'zero waste system' units become operational in several Manitoba rural municipalities	There were indeed a number of jobs supported at Celtic for the past few years during unit design, construction and preliminary on-site (at Celtic) start-up testing. In the end, the potential remains for the creation of dozens of jobs across the province for the production and subsequent operation of new gasifier units.
Increased transit ridership		
Attraction of new businesses		
Other (please specify)		

g) Please complete the table below by describing in Column C the anticipated social benefits of the pilot project at full scale implementation. Please complete for all that apply in the list below. If there are additional social benefits, please describe these in the last row of the table.

Figure 2 - Social benefits

A	B	C
Social benefits	As described in your GMF application	Anticipated social benefits of the pilot project at full scale implementation based on pilot experience If the result is different than what was expected in the application form, please indicate why.
Improvements to public health	Less contamination from regional landfill leaching into the surrounding environment, reduction of GHG emissions for improved air quality	Organics are big contributors to GHG emissions when landfilled because the breakdown of organics in a landfill (anaerobic, without oxygen) generates methane, which is a powerful GHG. Diverting organics from landfill therefore has a GHG benefit. In addition to preserving landfill capacity, extending landfill lifespan it creates by-products such as compost or digestate, which are beneficial soil conditioners, which contribute to a circular economy by returning soil amendment to the soil, and displaces chemical fertilizers and other additives.
Improvements to public safety		
Improvements to community quality of life	In the long run, no need for landfills as communities can potentially attain a waste diversion rate of 100%	This is theoretically possible (a near 100% waste diversion rate) if recycling and composting programs are combined with the operation of such a unit.
Increased opportunities for community engagement	Engage residents by launching new curbside recycling services, composting and green bin programs	The participating municipalities, in partnership with EET, will likely explore opportunities and develop plans (local and/or regional) for increased awareness as concerns recycling and organics diversion.
Increased public education or awareness	Through development of a regional, community-oriented strategy for sustainable management that supports current and future service expectations	Increased awareness of initiative at the municipal level will surely occur; Social engagement will need to be increased for future services related to product (battery storage, batch heat/energy production for greenhouses, etc.)
Community revitalization		

New housing and infrastructure		
New or enhanced public space or public facilities		
Improved access to recreation and physical activities		
Reduced urban sprawl		
Increased civic pride, ownership and participation		
Improved quality and efficiency of service provision to residents		
Reduced opportunities for crime		
Other (please specify)		

4. Lead Applicant's Next Steps:

- a) What next steps does your municipality plan to take based on the findings and recommendations of the Pilot Project?
- Meetings with the Province of Manitoba to:
 - o Secure all rights and permissions to fully operate the system on an ongoing basis
 - o Establish stringent accounting/reporting practices for GHG emissions reductions (unit operation, waste collection, etc.)
 - Education/awareness campaign
 - o Community engagement/education
 - R&D
 - o Energy use and storage
 - o Use/value/sale of biochar and other post-operational residual matter
 - Planning
 - o Municipal engagement
 - o Production facility / supply chain management
 - o Permits and operation flows

5. Lessons Learned

In answering the questions in this section, please consider all aspects of the Pilot Project—from the initial planning through each of the essential task until the Final Report of the Pilot Project was prepared.

- a) What would you recommend to other municipalities interested in doing a similar Pilot Project? What would you do differently if you were to do this again?
- o The appointment of a project manager at the outset of the project
 - o Emphasize the importance of both sides (R.M. and the builder) meeting to discuss and share the budget, identify any potential challenges, new costs and a realistic budget based on the Minto-Odanah experience
 - o Grants such as these need an inflation factor, risk management for unforeseen events (i.e. COVID, disruption in the supply chain, etc.) and budget overruns.
 - o Improved support from the FCM as to what steps or items requiring attention at the beginning and what is expected – i.e. lay out some basic information as to how municipalities unfamiliar with its programs should work on projects such as these.
 - o A workshop for municipal councillors on how proposals work, what to do, what steps to take and how to proceed to achieve grant-funding outcomes would improve communication, leadership and dispel frustration for council members who volunteer their time

- A formal contract between municipality and service/equipment providers is paramount; no project with a scope such as this one had should be without one...
- b) What barriers/challenges (if any) did you encounter in doing this Pilot Project? How did you overcome them?
- This project dragged on due to COVID and the lack of a contract with clearly defined roles, resulting in trust issues between the R.M and the builder (Celtic) – this issue has yet to be resolved to the satisfaction of both parties
 - A contract between RM and the builder needs to be worked out and signed at the very outset of this type of project
 - There were barriers when it came to convincing the various provincial departments in recognizing the potential of this project – communication with the province is ongoing
 - The participating municipalities and any potential funding bodies need to know and understand the scope of work involved in order for funding grants to be received and accepted.
 - Most municipal councillors do not have the knowledge and expertise of how a project should unfold and what are the responsibilities.
 - It was difficult to get concrete answers from provincial bodies that oversee this type of work - communication with the province is ongoing
 - It was and remains disappointing to see the reluctance shown by many provincial bureaucrats in the overall project potential this project could have in waste management and the reduction of GHG emissions for local municipalities – educating the province in this regard is ongoing
 - The lack of a contract with the builder presented an enormous challenge that required a great deal of time in order to arrive at some sort of consensus. Designating a new project manager in the summer of 2020 (Wendy Bulloch) was key in this regard

6. Knowledge Sharing

- a) Is there a website where more information about the Pilot Project can be found? If so, please provide the URL.

Project overview with results will be uploaded to RM of Minto-Odanah and Eco-West Canada websites.

In addition to the Pilot Project results, has your Pilot Project led to other activities that could be of interest to another municipality (for example, another pilot project, sharing of the results of this pilot project with other municipalities formally or informally, changes to existing policies and/or practices etc.)? If so, please list these outcomes and include copies of the relevant documents (or website links).

Sharing of results with other municipalities is currently occurring with the help of Eco-West Canada by way of delegations to municipal councils throughout Manitoba and Saskatchewan.

Based on province's waste management framework review, additional opportunities to share project results with others should be considered via industry associations such as MARR, SWANA, etc.

Southwestern Manitoba Zero Waste Pilot Project Gasifier Unit Pictures



Completed Gasifier Unit System – 2021



Dillon Testing Equipment in place/Stack created to conduct emission tests. August 2021



Above
A load of Municipal Solid Waste (MSW) loaded in cage prior to cage being placed in the gasifier unit. August 2021

Side picture
Following test run – empty cage with various recyclables left (aluminium cans, glass, metal cans, ash). August 2021



Picture to Left – close up shot of items left in the cage following emission test run. Note decals/color on aluminium cans not visible, but aluminium is still in place. Glass bottles/jars still in place. Fully recyclable. August 2021



Following system run, bio-char, discovered, as a by-product of wood pallets placed in cage.