

Landfill Gas Project Update

ISSUE

Saskatoon Light & Power (SL&P) and Water and Waste Operations (WWO) implemented the Landfill Gas (LFG) Project in April 2014. This report provides an update on its performance to date, highlights some of the challenges faced during operations, and discusses the future plans for the project.

BACKGROUND

June 2009	City Council adopted the Energy and Greenhouse Gas Management Plan to achieve a diverse and environmentally sustainable energy system using local renewable energy supplies. Implementation of the LFG Project was identified as an action.
2010	The City of Saskatoon (City) received \$5.05 million of Government of Canada funding through the Canada-Saskatchewan Provincial-Territorial Base Fund, to implement the LFG Project which included: <ul style="list-style-type: none">• Landfill Gas Collection System (LFG-Collection System); and• Landfill Gas Power Generation Facility (LFG-Power Generation Facility). City Council approved implementation of the LFG Project.
2011	City Council approved the Landfill Optimization Project, which provided funding for the ongoing operation and maintenance of the Saskatoon Landfill, and help it reach its full capacity.
2013	The LFG-Collection System was commissioned by WWO and comprised of 29 vertical wells, interconnected piping, a compression and treatment facility, and an enclosed flare to collect and destroy landfill gas.
2013	City Council approved the sale of renewable electricity from the LFG-Power Generation Facility to SaskPower through the Green Options Partner Program until 2034.
2014	The LFG-Power Generation Facility was commissioned by SL&P and comprised of two 815-kilowatt gas engine generators.
2018	City Council approved a new reserve contribution to the Landfill Replacement Reserve to provide for sustainable funding to implement the Landfill Optimization Project.
2018	Two additional horizontal extraction wells were added to the LFG-Collection System to increase collected landfill gas volumes. These wells will be able to be put in service once sufficient waste is placed above them, anticipated in fall 2022. The project cost was \$325,000.
2019	An air-fuel controller was added at the LFG-Power Generation Facility to improve operation under low methane concentration percentages in the landfill gas. The project cost was \$120,000.
2020	12 additional vertical extraction wells were added to the LFG-Collection System to increase collected landfill gas volumes. The project cost was \$1,444,000.
Spring 2021	City Council approved \$4.02 Million for phase 1 of the Landfill Gas Expansion Project, which includes \$2,742,500 from the Investing in Canada Infrastructure Program.

Future Landfill Gas Work

As the Saskatoon Landfill grows, it will continue to produce and release landfill gas into the atmosphere if it is not collected and destroyed. Future projects will be undertaken to mitigate the environmental impacts from the operation and existence of the landfill.

Expansion of the LFG-Collection System is included in the Integrated Landfill Management Plan with expansions planned to be funded from landfill tipping fee contributions to WWO reserves.

CURRENT STATUS

The LFG Project achieves the following benefits:

- Reduction of emissions from the Saskatoon Landfill through the collection and destruction of landfill gas generated by the decomposition of organic waste. Landfill gas contains approximately 50% methane (CH₄) which is twenty-five times more potent than carbon dioxide (CO₂);
- Processing and distribution of landfill gas between all facilities;
- Combustion of landfill gas using two gas engine generators to produce electricity which is sold to SaskPower until 2034;
- Flaring of unutilized landfill gas when power generation is not possible; and
- Control of flue gas emissions from LFG Project facilities in accordance with Ministry of Environment regulations.

A summary of the LFG Project's environmental and operational performance is shown in the table below. A detailed LFG Project proforma is provided in Appendix 1.

Year	Total Gas Collected (Million SCF)	Average CH ₄ (%)	Average Flow Rate (SCFM)	Gas Utilization (%)	Total Gas Flared (Million SCF)	Landfill Emissions Reduction (tonnes CO ₂ e)	Total Energy Generated (GWh)
2014	193	52	438	74	50	50,193	8
2015	204	57	443	90.1	20	53,622	11
2016	213	57	422	98.0	4	55,794	12
2017	200	57	382	84.1	32	52,423	9
2018	195	56	376	78.4	42	49,946	9
2019	189	53	375	78.1	42	46,920	8
2020	204	51	387	94.9	10	47,718	11
2021	216	52	411	83.8	35	51,870	10

Preliminary engineering is underway for the Landfill Gas Expansion project that was approved by City Council in the spring of 2021. Further reporting on the project will occur once details are finalized.

DISCUSSION/ANALYSIS

The final cost of the LFG Project was \$13.5 million. Approximately \$5.05 million was funded by the Government of Canada, through the Canada-Saskatchewan Provincial-

Territorial Base Fund, and \$8.45 million was funded from SL&P and WWO reserves. The original financial model projected annual revenues of \$1.3 million from the sale of electricity to SaskPower, and an operating expense of approximately \$400,000, allowing for repayment of approximately \$900,000 to the reserves annually. This would have resulted in a simple payback period of about nine years.

As seen in the LFG Project proforma report in Appendix 1, the LFG Project has experienced lower than expected revenues and higher expenses. Revenues are generated through the sale of electricity to SaskPower. Over the years, revenues have fluctuated for the following factors:

- Gas volumes and methane concentration have been lower than originally predicted;
- Reoccurring SaskPower maintenance on the transmission line caused unexpected shutdowns of the generators;
- The cost of specialized generator maintenance has increased significantly, with fewer qualified contractors available in the market;
- The generators encountered numerous outages caused by different fault conditions; and
- Generator shutdowns for any of these reasons resulted in a revenue loss of approximately \$45 per hour for each generator.

Efficiencies have been incorporated into the project to improve revenues including:

- Installation of an air/fuel controller in the LFG-Power Generation Facility in 2019, to allow generator operation with lower methane levels;
- Expansion of the collection wells in the LFG-Collection System in 2020, to improve gas volumes;
- Improved coordination of facility maintenance and transmission line downtime with SaskPower;
- Reduction in contractor maintenance costs by undertaking more work internally; and
- Improvement with monitoring systems to automatically restart generators after facility trips.

Carbon Offset Program

In 2020 the Saskatchewan Ministry of Environment started development of the Saskatchewan Greenhouse Gas Offset program and the Government of Canada is currently working on its own offset program. Landfill gas projects are one type of protocol that can be included in offset programs, but are subject to many eligibility criteria, and so projects are evaluated on a case-by-case basis depending on the protocol.

Further information on the Saskatchewan GHG Offset program was provided to City Council in August 2021.

FINANCIAL IMPLICATIONS

The proforma presented in Appendix 1 shows that in 2034, approximately \$538,000 will still be owing on the original loan that funded the project. Power generation and

revenue after 2034 is dependent on obtaining new power supply contracts, allowing for further loan payments.

Beyond 2034, GHG emission reduction will remain possible as the infrastructure for landfill gas collection will still be in place. The LFG-Collection System will continue to destroy gas from the landfill and provide the associated environmental benefit.

ENVIRONMENTAL IMPLICATION

The LFG-Collection System has reduced emissions from the Saskatoon Landfill by approximately 50,000 tonnes of CO₂e each year, which is equivalent to removing 10,800 cars from the road annually. The LFG-Power Generation Facility has generated approximately 10 gigawatt-hours of renewable electricity each year, which is equivalent to powering 1,200 homes annually.

Community emissions associated with waste for 2019 were 144,703 tonnes CO₂e, which is calculated before 46,920 tonnes of CO₂e were destroyed through LFG capture (waste emissions reduced by 32%). 46,920 tonnes of CO₂e from LFG capture represents 1.52% of the 2050 GHG reduction target (3,081,800 tonnes CO₂e reduced over 2014 emissions). The LFG-Collection System reduced Landfill GHG emissions by about 35% since commissioning in 2014.

The LFG Project's landfill final cover and extraction systems also help reduce odours and other hazards associated with the emission of LFG coming from the landfill to surrounding areas.

TRIPLE BOTTOM LINE IMPLICATIONS

A triple bottom line review was performed on this project and is included as Appendix 3. In addition to the significant environmental benefits, the project has indirect benefits in improving air quality, prevention of potential health and wellbeing implications by the reduction of GHG emissions and odours. The project has also been instrumental in creating jobs, adding significant increases in local economic output and tax revenue within the region.

The following are future considerations and potential improvements:

- The amount of gas will decrease over time with usage and increased organic waste diversion; however, the system is designed for long-term use;
- Install additional equipment to maximize power generation and allow flexibility to simultaneously burn excess gas production; and
- Sale of carbon credits is being investigated.

OTHER IMPLICATIONS

There are no privacy, legal or social implications identified.

NEXT STEPS

The Administration will bring forward reports regarding further development opportunities for expanding the LFG Project and participation in the Saskatchewan GHG Offset program at the appropriate time.

APPENDICES

1. Landfill Gas Project Proforma
2. Landfill Gas Project Photographs
3. Landfill Gas Project Triple Bottom Line Review

Report Approval

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