



## HARTLAND LANDFILL GAS UTILIZATION PROJECT

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## EXECUTIVE SUMMARY AND BACKGROUND

The Capital Regional District (CRD) owns and operates Hartland landfill, the only municipal solid waste landfill for Greater Victoria, British Columbia, which services about 340,000 people. With over 5 million tonnes of refuse in place, Hartland landfill receives approximately 150,000 tonnes of refuse each year and is expected to operate until 2045.

The CRD has an overall landfill gas (LFG) management strategy for Hartland landfill. The original LFG collection and flaring system was installed in 1991. In 1998, the system was upgraded at a cost of \$3 million. The next step was to utilize the energy in the collected LFG rather than continuing to flare the gas. This would continue to reduce Greenhouse Gas (GHG) emissions from the site and create green power rather than wasting a valuable resource.

The CRD entered into a private/public partnership with Maxim Power Corporation (Maxim) to co-own a Landfill Gas Utilization Facility. The CRD entered into agreements with Maxim in 2003. The LFG Utilization Facility was commissioned in February 2004. The Facility collects approximately 650 scfm (18 m<sup>3</sup>/min) and produces 1.6 MW of green power, enough to power 1,600 homes. Collection and utilization of the LFG results in a reduction in GHG emissions of 83,000 tonnes of CO<sub>2</sub> equivalents. The total capital cost for the project was \$2.8 million. The joint project has a lifespan of 20 years.

The main project obstacles were financial viability because of the inherent risks of the project and lack of in-house expertise and business know-how. The CRD resolved these issues by creating a highly innovative financial model and by developing a cooperative private/public partnership. This template could also benefit other small and medium sized communities across the country.

The main goals of the Hartland Landfill Gas Utilization Project are to reduce the environmental impacts of landfill gas production and to protect public health and safety. The project objectives are based on the three domains of sustainability: economic - to procure maximum revenue for all participants; environmental - to reduce or eliminate the environmental impact of GHG emissions generated by landfill operations; and social - to benefit the community by providing green power to local homes.

The Hartland Gas Utilization Project is an excellent example of a truly cooperative effort and creative approach toward sustainability.

## **INNOVATION AND EXCELLENCE**

The Hartland Landfill Gas Utilization Facility is a highly innovative project that can serve as a model for other communities with landfills across the nation.

The project itself was an exercise in “thinking outside the box.” The production of green power from LFG is not a traditional or essential service provided by regional government. The CRD chose to partner with the private sector to bring external expertise to the project. This resulted in new and broader-based knowledge acquired by regional staff who worked on the project.



The procurement of the generator which converts gas to electricity represented a novel opportunity to the project, both in terms of acquiring new knowledge and testing new technology.

The generator used for this project is a new model manufactured by Caterpillar. It is designed to operate on low BTU fuel, such as LFG.

Caterpillar wanted to test and monitor the first 12 months of operation with this unit to gather detailed performance specifications. In return, Caterpillar and Finning (the area representative) offered a one-year deferred payment on its equipment, representing approximately \$1.6 million.

One of the main obstacles of the project was financial viability and risk. Historically, LFG utilization has been only feasible for large landfills of similar size across the nation. Hartland landfill does not have large industries close by to utilize the energy and support such a facility. The landfill is located in a rural area with no access to commercial infrastructure. Despite several proposal calls to the private sector, it became apparent that it would be difficult to find partners.

The CRD solved this problem by developing an attractive creative financial and practical model and taking a cooperative approach. The Facility is co-owned 70% by the CRD and 30% by its private sector partner, Maxim. Maxim operates the Facility at its cost and repays the CRD for its contribution through lease payments over the 20-year project life. The lease payments essentially represent principal and interest on the CRD's contribution to the project. As a result of this arrangement, Maxim substantially reduced the amount of up-front capital required, and the project was able to proceed.

Maxim also has an agreement with BC Hydro and receives revenues for the sale of power. The company has assumed all operational risks associated with maintaining the Facility.

The company pays royalties to the CRD for the LFG supplied and leases the CRD-owned equipment. Royalty payments are based on a percentage of the revenues generated by Maxim and escalate as power production increases. If the CRD wants to increase its royalty payments through the production of more power, it can upgrade the existing generator or install a second unit. Piping for the second unit was included in the construction of the Facility. This is a decision that will be dependent on practice and performance. It offers the advantage of gradual expansion based on business sense and reduces financial risk for both partners.

Although the CRD does not provide any guarantee to Maxim regarding the quality or quantity of LFG, it does provide Maxim with the option to sell its portion of the facility to the CRD for fair market value, if production of power drops below a pre-determined threshold for a pre-determined period of time. This innovation again reduced the level of risk for the participants and gave our partners confidence to proceed.

## IMPLEMENTATION, RESULTS AND LESSONS LEARNED

The LFG Utilization Facility was commissioned by the CRD and Maxim in February 2004. Up until that point, the LFG had been collected from a network of gas wells installed in the refuse and directed to the CRD's flaring station.

The LFG now bypasses the flare and is directed to Maxim's Utilization Facility.



The LFG passes through a gas conditioning unit which cools the gas and removes moisture and entrained particulate (siloxanes) that would otherwise degrade engine performance over time. No other pre-treatment of the LFG is necessary to protect the engine. The methane component of the LFG fuels a 20-cylinder engine to generate electricity; much like a spark engine in a car uses gasoline to create energy. An on-site transformer converts 600 volts into 25 kilovolts, which is fed into the BC Hydro grid. Master controls interconnect the CRD's gas collection system with Maxim.

The Hartland Landfill Gas Utilization Project has been very successful. Collection and utilization of the landfill gas has resulted in a reduction in GHG emissions of 83,000 tonnes of CO<sub>2</sub> equivalents. The Facility currently generates 1.6 MW of green power, the equivalent of supplying 1,600 homes. The CRD has partnered with the British Columbia Buildings Corporation (BCBC), Green Buildings Division, on this project. BCBC has sold the green power to a number of its tenants, thus promoting environmental sustainability by allocating green power locally and reducing the consumption of non-renewable resources.

In order for the project to be certified as “green” by BC Hydro, several environmental and social aspects had to be demonstrated: the project had to be in conformity with community values, contribute to the local community, make a commitment to quality health and safety programs, and operate in an ethical manner. The CRD met all of these requirements.

The total capital cost for the project was \$2.8 million. The CRD contribution was \$1.96 million which will be paid back to the CRD with interest by Maxim over the life of the project. Maxim’s contribution was \$840,000. Maxim operates the Facility at its cost, leases the CRD-owned equipment and pays royalties to the CRD for the LFG supplied. CRD royalties are estimated at \$350,000 over the project life, depending on the quantity of power produced.

The price for the 1.6 MW of power generated is made up of two components: a base price for power and a “green premium.” The British Columbia Buildings Corporation pays the green premium for 1.0 MW of the power produced and BC Hydro pays the premium for the remaining 0.6 MW.

The financial and technical viability of the project was further enhanced by the fact that Finning provided a one-year deferred payment on its new generator model in exchange for monitoring over the first 12 months of operation. This arrangement resulted in cost savings and enabled Caterpillar (Finning) to test its new technology to maximize its performance. Caterpillar and Finning have been able to identify several equipment components that require some redesign.

Management of this project was provided by existing CRD and Maxim staff. As an additional benefit to the community, contractors were hired for the construction of the facility which resulted in new local jobs and economic benefit to the region.

The regulatory framework for building a LFG facility at Hartland landfill was in place prior to project start. The CRD demonstrated its commitment to continual improvement by introducing an environmental management system that is ISO 14001 compliant for the Facility. Furthermore, in order to meet the green criteria stipulated by BC Hydro, the emissions from the Facility do not exceed the upper limit (6) of load points as mandated in the federal Ecologo Renewable Low-Impact Electricity guidelines.



One of the main reasons for the success of the Hartland Landfill Gas Utilization Project is the cooperative approach taken to make it happen. When it was realized that the project would not proceed if Maxim had to pursue traditional sources of financing, the CRD showed flexibility by taking over 70% ownership of the Facility. Maxim also proved its willingness to cooperate by agreeing to provide the CRD with a four-month window to expand the collection system during contract negotiations. The CRD was able to expand its gas collection system and increase LFG production by 20% over this period, which provided Maxim with the assurance it needed to enter into agreements for this project.

Measures of success of the project include the quantity and quality of the LFG generated and the royalties paid to the CRD. At this point, it appears very likely that a second generator unit will be installed at the Facility over the 20-year life of the project, as LFG quantities have been modeled to increase over this period. In 2005, the operating efficiency of the engine was over 90%.

The project is meeting its goals of reducing the environmental impacts of landfill gas production and protecting public health and safety. GHG emissions are captured and converted to green power instead of being wasted to the atmosphere. Health and safety have been improved through reduced LFG emissions (e.g., VOCs), reduced odours and reduced LFG migration to buildings on- and off-site.

## **PROJECT SUSTAINABILITY AND POLICY FRAMEWORK**

This project demonstrates sustainability by reducing GHG emissions generated for power production. Collection and subsequent flaring and/or utilization of LFG is an essential component of Canada's strategy to meet Kyoto targets.

The CRD Board adopted the Regional Growth Strategy (RGS) in 2003. It is an agreement on social, economic and environmental goals and priority actions in the region. The Board supported eight initiatives, including managing natural resources and the environment sustainably. The Hartland Landfill Gas Utilization Project is one of the indicators used to measure progress in the RGS.

The gas utilization project is a key program identified in the CRD Solid Waste division's strategic plan. The division's mission is to protect human health and the environment by efficiently and effectively managing the region's solid waste in an environmentally and economically responsible manner.

The collection and utilization of landfill gas is also included in the CRD's 1991 and 1995 Solid Waste Management Plans (SWMP). One of the goals of the current SWMP is to provide residents with cost-effective solid waste management services, including residual disposal, in an environmentally sound manner.

The current project life is 20 years. It may be extended in the future. Hartland landfill is projected to close in approximately 2045; LFG quantities are anticipated to increase up to this time and then gradually decline over subsequent decades. Piping is in place to allow the addition of a second engine at any time in the future.

The financial model of the project may be applicable for any local government or landfill owner partnered with a private sector company that may be unable to secure traditional financing. The Facility has generated much interest and has been toured many times by other landfill owners considering a similar facility and other professionals working in the alternative energy field.



The project started with the CRD's commitment in the 1991 SWMP to develop a gas collection system with the possibility of energy recovery. Over the next 13 years it became reality due to integrated planning by staff and decision-making by the CRD Board.

The project is an excellent example of a holistic approach toward sustainability.

## **COMMUNICATION/PARTNERSHIPS**

The CRD has a Solid Waste Advisory committee (SWAC) comprised of representatives from local municipalities, industry, community groups and members-at-large. SWAC is mandated by the CRD Board to review and evaluate solid waste initiatives. SWAC recommended that the CRD Environment committee and Board proceed with the gas utilization project and is engaged in any ongoing discussions about its progress.

The CRD Board is kept informed of the project via regular staff reports. The Board is made up of representatives from all 13 CRD municipalities and three electoral areas and meets every two weeks. There are also regular monthly liaison meetings with local municipal engineers.

The local community has been informed of the project through media releases and articles in publications like the *Hartland Happenings* newsletter. The project has received much interest from the local media and from professionals across North America. It is one of the highlights of the approximately 50 landfill tours conducted every year. Tour participants (approximately 1,500/year) include local school children and adults as well as professionals and groups from countries such as Malaysia, Russia, China, Korea, Bosnia, Nicaragua and Thailand.

The Hartland Gas Utilization Project has resulted in several new direct and indirect partnerships for the CRD. Maxim Power Corporation is a major partner who co-owns the Facility and has contracted its operation and maintenance services to Finning Canada. Maxim also has an Energy Purchase Agreement with BC Hydro that governs the sale of power produced at the Facility. The CRD has partnered with British Columbia Buildings Corporation (BCBC) to purchase green power. BCBC in turn is selling the power to a number of its tenants, including the Vancouver Island Technology Park and Ministry of Environment offices.

## CONCLUSION

The Hartland Landfill Gas Utilization Project proves that it is possible for smaller and medium-sized communities with landfills to beneficially use landfill gas through innovative financing and co-operative partnerships. Other municipalities and regional districts are encouraged to consider a LFG utilization facility to generate revenues to help off-set capital and operating costs for installation or expansion of LFG collection systems.

