Upper Gibsons Geo-Exchange District Energy Utility

Final Report

January 25, 2013

"It all goes back to the first law of thermodynamics: energy can be transformed, but cannot be created or destroyed. Geoexchange systems very efficiently concentrate and shift usable energy from outside your home into your home, making it comfortable to live."

Dave Lovekin
Pembina Institute
July 29, 2010

Ian C. Poole, CA
Director of Finance
Town of Gibsons
Box 340
Gibsons BC V0N 1V0
www.gibsons.ca

T: 604.886.2274
F: 604.886.9735

Table of Contents

.

1. PROJECT OVERVIEW

With homes in Upper Gibsons neighbourhood heating with electricity or natural gas, and the Town needing to reduce its greenhouse gas (GHG) emissions while finding additional non-taxation sources of revenue, the Town set out to provide an alternative energy source through construction of a Geo-Exchange District Energy Utility (GDEU). The resulting award-winning system (Community Energy Association's 2009 Energy and Climate Action Award) — the first municipally-owned system of its kind in North America — positioned the Town of Gibsons at the forefront of the green energy movement, drew attention to the municipality from academics, realtors and municipalities interested in replicating the model.

The utility will generate revenue while reducing GHG emissions. The Town installed and owns the geoexchange field and pumphouse; the developer of the residential subdivision (Parkland) was responsible for installing the distribution pipes which are owned by the Town to property lines. The homeowner owns the pipes beneath the yard and in-house heat pump. In essence, a three-way partnership.

Due to a slow economy it was necessary to reduce the size of the development's first phase to 36 homes instead of the planned 55; however, the project's overall scope has increased from 110 to 140 homes. Due to these market uncertainties and the resulting delay to implementation of Phase II of this development, the initial project was amended (with ICET Board approval October 21, 2011) to include construction of a Ground Heat Exchanger (GHX) field for the new RCMP building, which will ultimately become part of the GDEU.

Currently only about a dozen residences (including a cluster dwelling) have been completed in the Parkland subdivision while the initial business case financial projections assumed a more rapid build-out. The RCMP GHX facility is complete, functional, and servicing the RCMP facility which opened in December, 2012.

While the Town's vision is to service a much larger area with geothermal, feasibility analyses have not been undertaken.

a. Technology:

The Upper Gibsons Neighbourhood Geo-exchange District Energy Utility (GDEU) is a renewable energy resource system in which 25mm pipes configured in a series of coils, like a flattened Slinky™, are filled with an ethanol/water mix and buried two metres beneath public greenspace. The coils absorb the earth's stored solar and thermal energy and deliver it from the central pumphouse via 150mm supply-and-return lines to buildings throughout the subdivision, where pumps at each connected home extract the heat.

The first GDEU field serves the first 36 homes of the model subdivision. The pumphouse was sized for the full projected build-out of 140 homes. A second GDEU field, installed under a nearby park, currently services the Town's new RCMP facility. Future development in the area may tap into either existing field.

The initial design called for grid-style collection pipe layout (similar to that on a refrigerator) but proved inefficient and costlier than planned. The final constructed layout used an innovative series of coils, like a flattened Slinky™ for more cost effective heat collection, and more efficient use of space,

Additionally, plastic particle debris from pipe construction began collecting in heat pump filters at the individual service connection points, causing units to run inefficiently. To overcome this problem, filter screens were installed to catch debris before it could enter the pumps, and high-velocity flushing of the entire system resolved this challenge.

b. Project History:

The Parkland subdivision project launched in September, 2009; initial start-up delays were exacerbated by changes to scope of development due to initial tenders exceeding the budget, resulting in design changes. By September 2010 the pumphouse building and GHX fields were completed, fluid had been delivered and installed, and system testing began. The first home was connected to the system and operational by December, 2010.

A second GHX field was constructed in 2012 at Brothers Park, adjacent to the site of the new Gibsons RCMP Facility. The system was connected, tested and operational in October 2012; the LEED RCMP facility officially opened December 6, 2012,

c. Town Priorities:

i. Reduce environmental footprint:

GHG emission reductions are estimated at 335 tonnes at Phase One build-out of 140 dwelling units, assuming natural gas as the alternative.

ii. Economically sustainable:

Gibsons District Energy Utility Bylaw No. 1128 sets the rates and areas subject to a mandatory connection. Rates are designed to undercut natural gas rates by 10-20%, and are based on a heat loss calculation for each dwelling provided with the Building Permit Application. Consumption is not metered, rather, there is a basic charge of $34.50 quarterly, and a quarterly charge of $22.32 per KW of peak heating capacity, which is the required capacity of heating appliances for the house as set out in the 2006 BC Building Code. This translates to an annual bill of about $500 for a 1,500 sq. ft. home, or $0.33/sq. ft.

2. OBJECTIVES

a. Measurable Objectives

i. Reduce environmental footprint:

Residential and commercial buildings account for about one-third of Gibsons GHG emissions profile. The GDEU is expected to result in a 63% reduction in energy consumption and a 93% reduction in GHG emissions in comparison to natural gas heating, the current standard for residences and buildings in Gibsons. Since the GDEU will eventually serve 25% of the homes in Gibsons and a significant number of businesses and institutional facilities, this will result in overall community-wide GHG reductions of nearly 8%.

ii. Economically sustainable:

- Provides a long-term stable source of non-taxation revenue to the Town
- Reduces and stabilizes energy costs to homeowners and businesses

iii. Economic diversification:

This project is easily replicated by other communities of similar population or greater. It is expected that other municipalities will be interested in developing similar systems. These communities may choose to draw on the newly-developed expertise of Gibsons-area contractors who were involved in the construction of the project. Other project benefits tied to economic diversification:

- Installation of GDEU, the first of its kind in North America, positions Gibsons as a leader and innovator in alternative energy
- Provides cutting-edge infrastructure to draw future economic development
- Marketing benefits to developers of energy-efficient homes and buildings utilizing the technology
- Development expertise in installing geo-exchange systems can be marketed to other communities

iv. Employment during construction phase:

Total person-days employment during the initial project construction: 447

As this phase of the completed project requires minimal ongoing administration or maintenance, the required duties have been absorbed by existing staff. At completion of buildout in 2026, operations and management may require 0.5 FTE (one half-time employee) per year.

3. FUNDING PARTNERS

The system has had five funding sources, including senior government programs contributing toward the cost:

Island Coastal Economic Trust:	$244,080
Innovative Clean Energy Fund	$325,115
Community Works Fund (Gas Tax)	$256,000
Parkland developer (in-kind)	$385,000
Town of Gibsons	$168,527

4. ENVIRONMENTAL PERFORMANCE REPORT

As Phase 1 of the project has been completed for less than a year (and the model housing development is not fully built out due to the continuing market downturn) it is not possible to provide measured quantitative impacts on GHG emissions. Although Phase 1 of the project is relatively small, future expansion matched to the development of the Upper Gibsons neighbourhood will greatly increase the benefits.

Residential and commercial buildings account for about 33% of Gibsons GHG emissions profile. The GDEU is expected to result in a 63% reduction in energy consumption and a 93% reduction in GHG emissions in comparison with natural gas heating, the current standard for residences and buildings in Gibsons. Since the GDEU will eventually serve 25% of homes in Gibsons and a significant number of businesses and institutional facilities, this will result in overall community-wide GHG reductions of nearly 8%. There will also be minor improvements in air quality through reduced burning of natural gas.

There are no negative environmental impacts.

Projected Quantitative Benefits	Phase 1	Complete System
Annual energy savings retained within the community	60,400	359,000
Investment in green infrastructure and community-owned revenue generating utility	976,320	2,718,000
Person-days construction employment	447	2,671.5
Permanent employment for O&M	0.1 FTE	0.5 FTE
Annual GHG reductions	272 tonnes	1,444 tonnes

5. NEXT STEPS

Project build-out beyond Phase 1 is expected to be completed by 2026. Within this period, the Town's Engineering and Public Works departments will continue to monitor technological advances within the industry to ensure the Town maintains its position at the forefront of the GDEU green energy methodology.

Within the first year of operations, staff will establish benchmarks for current air quality and utility consumption, to provide a basis of comparison for future measurements.

Staff will continue to work with the developer, realtors and local media to educate the public about the GDEU system and its benefits.

6. PROJECT PROGRESS IN PHOTOS

After collector pipe arrives on site, crews coil it into flattened “Slinky” collectors – a more ecost-efficient configuration (above left). The Slinkies are then rolled up for èase of transport (above right).

With trenches ready to receive the coils, crews unroll and position the Slinkies.

The coils were buried and filled with an ethanol/water mix (below right),

Heat absorbed by the ground will be transferred to the coils, and the warmed liquid pumped to collection points in the network where individual residential heat pumps will transfer the energy within the home.

Pumphouse construction

During the course of construction, Town staff conducted a number of public information sessions, posted articles to the website, and worked with local realtors and media to explain the process and benefits of GDEU.

Website links to public information sites are provided at the end of this report.

7. FINANCIAL STATEMENT

TOWN OF GIBSONS

UPPER GIBSONS GEO-EXCHANGE DISTRICT ENERGY UTILITY

Project Period: October, 2009 – December 2012

Project Expenditures

Construction, materials and equipment	$ 766,405
Engineering and Design	133,754
Project Management	67,123
System Charging and Other Misc.	26,687
Total Expenditures	**$ 993,969**

Project Funding Sources

Island Coastal Economic Trust (ICET)	$ 244,080
Innovative Clean Energy Fund (ICE)	325,113
Community Works Fund (Gas Tax)	256,247
Town of Gibsons	168,527
Total Funding Sources	**$ 993,969**
Balance	$ 0

I hereby certify that this statement accurately represents all project expenditures and all sources of project funding.

Signed: _____ _____

Ian C. Poole, CA Date

Director of Finance

8. PUBLIC REFERENCE MATERIAL

i. Town of Gibsons Website and links

- http://www.gibsons.ca/geoexchange-district-energy-utility.html
- January 4, 2012 Geo-exchange Webinar sponsored by Federation of Canadian Municipalities (link posted on Town of Gibsons website: https://cullbridge.adobeconnect.com/_a782512023/p2k76wc5d6u/?launcher=false&fcsContent=true&pbMode=normal)
- September 2010 Public Information Package (attached**)**
- July 2010 Public Information Package (attached)

ii. Realtor Jon McRae Website Q&A (available online)

- http://www.jonmcrae.ca/Parkland/Geo-thermal-HeatingandHotWaterQuestionsandAnswers.pdf

iii. Federation of Canadian Municipalities GHG Reduction Initiative of the Month (online)

- http://www.fcm.ca/Documents/case-studies/PCP/Gibsons_Geoexchange_District_Energy_Utility_EN.pdf

iv. Coast Reporter (Sep 1, 2010): Gibsons geoexchange holds promise, risk (archived online)

- http://www.coastreporter.net/article/20100901/SECHELT0101/309019999/-1/SECHELT/gibsons-146-geoexchange-holds-promise-risk

v. The Partnership for Water Sustainability in BC (Oct. 9, 2009): Town of Gibsons receives 2009 Energy and Climate Action Award for Upper Gibsons Geo-exchange District Energy Utility (available online)

- http://waterbucket.ca/gi/2009/10/09/town-of-gibsons-receives-2009-energy-and-climate-action-award-for-upper-gibsons-geo-exchange-district-energy-utility/

vi. Project cited by Peter Ostergaard in <u>The Regulation of District Energy Systems,</u> published by Pacific Institute for Climate Solutions, University of Victoria, presented as part of the Fraser Basin Council's Smart Planning for Communities program (May 2012,) Report available online:

- http://pics.uvic.ca/sites/default/files/uploads/publications/WP_District_Energy_May2012.pdf

vii. Project referenced by Real Estate Board of Greater Vancouver website article: Gibsons: Most liveable town in the world

- http://www.rebgv.org/gibsons-most-liveable-town-world