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Sifton Properties: From Solar to Sewage

Derek Butcher, Francine Schlosser, and Nicole Anderson wrote this case solely to provide material for class discussion. The authors do not intend to illustrate either effective or ineffective handling of a managerial situation. The authors may have disguised certain names and other identifying information to protect confidentiality.

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On August 17, 2012, Ryan Troup had been working tirelessly for the past 14 weeks during his MBA internship placement with Sifton Properties Limited (Sifton). As the sustainable community development assistant, Troup was responsible for developing financial projections for various renewable community energy systems being considered for implementation in Sifton’s new community development project: RiverBend Heights. This development project was to be Sifton’s first large-scale venture into the sustainable construction industry and, as such, Troup’s background in sustainable business instantly made him the resident expert at Sifton. Consequently, Troup’s recommendations would have a significant impact on top management’s decision with the project. Troup knew he had to be thorough and accurate with his research, given the distinct possibility that a poor recommendation could cost Sifton hundreds of thousands of dollars. While he was wrestling with the possible outcomes in his head, the project manager of Sifton’s neighbourhood developments department, Maureen Zunti, came into his office.

Troup, the president of the company has to go out of town next Tuesday, so we had to reschedule your presentation to next Monday, the 20th. He is very interested to see what you have come up with, specifically for the ATES [aquifer thermal energy storage] system the two of you discussed at the start of your internship. You’ll still be presenting to me, the president, and the department VPs for now. If you need anything just let me know; I’m happy to help.

Troup put down his notes and leaned back in his chair. He had all of the financial projections complete but had yet to decide which energy system to recommend to top management. Of the three options available to Sifton, some systems were more financially feasible than others. However, the environmental performance and social aspect of each had to be considered to determine marketability to consumers. Troup knew that top management was interested in the number of residents who could be provided with energy, the recommended system’s overall cost, and the system’s payback period in comparison to traditional electricity or natural gas costs. Furthermore, he knew that top management was keen on the ATES system. The company had a flair for innovation and would be one of the first communities in Canada to implement such a system. Consequently, the company had already paid for a feasibility study on the system. However, in comparison to the other two systems, this system might cause more disruption to the environment. Troup was unsure whether he should recommend the ATES system.

SIFTON PROPERTIES LTD.

In 1923, Harry Sifton built his first house at 587 Rosedale Avenue in London, Ontario, Canada—where it still stands today. This house acted as the pillar upon which he founded Sifton. The company maintained its roots in London and steadily expanded because of Harry’s practice of building several homes simultaneously on speculation combined with his unique flair for design. “In those days, there wasn’t a lot of design flair,” said Richard Sifton, current chief executive officer of the company. “He wanted a house that people didn’t simply live in but would be proud of.”[[1]](#footnote-1)

This practice proved to be so popular that, by 1940, the company was building 20 homes per year. However, roughly 500 homes later, Harry stepped down and handed control of the company over to his son Mowbray. Under new leadership, Sifton’s operations rapidly expanded and began its evolution into the construction and land development company it is today. Mowbray’s strategy of assembling large tracts of land proved critical to company growth. While Harry had once considered half a dozen houses to be a large commitment, the company had grown to such a point that it began developing entire communities. Along with residential housing, these communities included features such as recreational areas, shopping centres, and commercial services—allowing for the creation of a true community feel among residents.

Mowbray Sifton continued to lead the company until 2004, when he stepped down as chairperson of the board. While Glen Sifton assumed Mowbray’s position on the board, Glen’s brother, Richard Sifton, assumed the role of president.

By 2012, the company had experienced significant growth since its inception. Sifton employed over 1,200 people and served as one of Southwestern Ontario’s premier construction and land development companies, with development projects in Guelph, Brantford, Kitchener, Mississauga, and, of course, London. Founded nearly a century ago, the company had experienced multiple periods of economic growth and downturn. However, Sifton’s diversification strategy allowed the company to not only survive the test of time but also thrive under it. For instance, during the Great Depression of the 1930s, Harry Sifton shifted the business model to renting his homes rather than selling them. A testament to this strategy still stood in the company’s corporate office, where a grandfather clock, which was used in lieu of rent payment to Harry Sifton, still ticked the working hours away.[[2]](#footnote-2) The company had since diversified to encompass multiple business operations to smooth out fluctuations during periods of growth and downturn. Sifton’s five business branches included the following:

* retirement residences
* residential rentals
* new home construction
* neighbourhood developments
* commercial properties

Afterwards, the company experienced strong growth due to Mowbray’s willingness to develop entire communities through the neighbourhood developments department.

NEIGHBOURHOOD DEVELOPMENTS

The neighbourhood developments department was responsible for the development of countless neighbourhoods in London, and five additional communities were being developed in 2012 (see Exhibit 1). Accordingly, the department was responsible for thousands of acres of property in London. Additionally, the department stayed true to the innovation and flexibility of Harry and Mowbray and developed beautiful and comprehensive community development projects throughout London and the surrounding area. Furthermore, the department was efficiently staffed and the workload was primarily handled by four employees:

* vice-president, neighbourhood developments—Phil Masschelein
* project manager, neighbourhood developments—Maureen Zunti
* land technician, neighbourhood developments—Matt Robertson
* administrative assistant, neighbourhood developments—Maureen Gunton

Each individual employee acted as a key contributor to the proper functionality of the department. However, the employees also relied upon one another and were in constant communication—whether through email, regular meetings, or simply popping into one another’s offices.

The department prided itself on providing consumers with a multitude of choices. Homes were available in multiple price brackets and design styles. Some homes were built by Sifton, and others were outsourced to local homebuilders. Consumers could choose to live in a private community setting or opt for a country-like atmosphere in the middle of London.

The success of the department was attributed to the flexibility, innovation, and customer focus promoted by the company president, Richard Sifton. Sifton was the first real estate developer in Canada to install utilities and develop the first-ever gated golf community in Southwestern Ontario. Additionally, the company was responsible for the development of Canada’s first-ever planned community, Oakridge Acres, and London’s first-ever solar home.

The development of the solar home came as no surprise to those familiar with the company. Sifton had long been an environmentally and socially responsible company that readily contributed to community betterment. In 1962, Mowbray donated the Sifton Bog to the City of London, and the company continued to donate acres of parkland and environmentally sensitive lands. The company preserved Kains Woods in conjunction with the City of London and regularly held charitable events to benefit the community.

Although environmental responsibility was always important to Sifton, the company’s environmental advocacy and performance had previously focused on land conservation. The development of London’s first solar home was the company’s first foray into the growing sustainable building industry.

SUSTAINABLE BUILDING INDUSTRY

Sustainability, in its simplest form, was best defined as the ability to meet societal needs of the present without compromising the environmental, economic, and social needs of the future. Concerns over topics such as ozone depletion, climate change, human rights violations, war, famine, and social inequality had combined to bring this concept to the forefront of the mind of the consumer. Consequently, many individuals were becoming aware of their own impact on the future of the planet. A new option had emerged to cater to consumers seeking to live in a home and community that did not compromise the future viability of the planet.

Sustainable building, like sustainability, was also about meeting the needs at the time without compromising the needs of future generations. However, the incorporation of the term “building” ensured that the needs of tomorrow were growing. As the human population grew, so too did the need for infrastructure to support society. However, the creation of new infrastructure, whether it was homes, office buildings, or roads, required the use of new resources and new land on a planet that had a finite amount of both. Thus, in order to meet the needs at the time without compromising the needs of future generations, companies were engaging in sustainable building practices in order to limit the amount of resources used for the sake of growth. Given Sifton’s history of environmental and societal awareness, it came as no surprise when the company began planning its first sustainable community.

RIVERBEND HEIGHTS

RiverBend Heights was one of Sifton’s newest community development projects. The development site was situated on 70 acres of land between Oxford Street West and Shore Road in London, Ontario. Sifton was already established in this particular area of London, as the company’s RiverBend Park community was situated nearby.

The neighbourhood developments department had a clear vision of RiverBend Heights and the role it would play in the lives of those in the region. With RiverBend Heights, the department sought to create a true community feel where inhabitants could meet all of their daily needs while simultaneously maintaining a healthy and environmentally friendly lifestyle. In order to create this community feel, a main street, RiverBend Road, was created. This road would house many of the businesses in the community and act as a community hub.

The development would create a community feel through the housing available to potential community inhabitants. RiverBend Heights would contain a mixture of medium to high-density residential housing structures including townhouses, apartment buildings, and even some live and work complexes. Using the estimates from the City of London, RiverBend Heights could house approximately 3,200 permanent residents.[[3]](#footnote-3)

To further enhance the community feel in RiverBend Heights, the neighbourhood developments department sought to install numerous features found in sustainable communities. Features such as recreational parks, bicycle paths, and even a nature path were all being considered for installation in order to promote a sustainable lifestyle in the community. However, in order to make the community a truly sustainable one, the company decided to incorporate a sustainable community energy system for the residents and business owners of RiverBend Heights.

The infrastructure in place at RiverBend Heights was worth approximately $30 million,[[4]](#footnote-4) not including buildings. Clearly, the development of this community was not a small project for Sifton. Although the company was committed to the installation of a sustainable community energy system in RiverBend Heights, given the financial scope of the project, the cost of such a system was of great importance. Additionally, the community energy systems that were being considered for implementation were designed to preserve the environment; all of them did so to varying degrees. Consequently, the environmental impact of each system would need to be considered in conjunction with financial costs when deciding which system to install in RiverBend Heights.

COMMUNITY ENERGY SYSTEM

Sustainable community energy systems supplied a community with clean and environmentally friendly energy by generating energy using renewable resources. The energy generated in such systems could take the form of electricity, heating, cooling, or a combination of these forms.

In the case of RiverBend Heights, top management at Sifton did not have a particular preference for the form of energy generated. However, budgetary concerns were associated with any system installed in the development project. First, the cost incurred by the company for the entire system, excluding ongoing maintenance costs, could not exceed $3 million. Second, as the owner and operator of most of the buildings in RiverBend Heights, Sifton would generally be responsible for ongoing energy generation costs. This dictated a 10-year payback period for the system as a result of cost savings from traditional energy sources (hydroelectric power and natural gas).

With these criteria in mind, the company investigated the installation of one of three different energy generation systems: ATES, sewer heat recovery, or anaerobic digestion and cogeneration. While some systems possessed greater energy-generation capabilities than others, the environmental and social impacts of each potential system were also critically important to the company. Additionally, the size of the development project made it financially impossible to supply all community-resident needs with sustainable community energy sources. Consequently, top management was interested in seeing the average number of residents it could supply with clean energy.

In 2007, the average household in Ontario used approximately 32 gigajoules (GJ), or 8,888.88 kilowatt hours (kWh), per year of electricity. Additionally, the average household in Ontario used 90 GJ, or 25,000 kWh, of natural gas for heating.[[5]](#footnote-5) Considering the average household in Ontario contained 2.68 people,[[6]](#footnote-6) the company estimated that each resident of RiverBend Heights would require 11.94 GJ per year, or 3,316.75 kWh per year, for electricity; and 33.58 GJ per year, or 9,328 kWh, per year for heating.[[7]](#footnote-7)

Aquifer Thermal Energy Storage (ATES)—Solar Heating

In many locations throughout the world, water was stored underground in a layer of permeated rock or soil known as an aquifer. Mainly in Europe, the storage potential of aquifers had been leveraged for renewable energy generation. Aquifers acted as excellent energy storage systems because the underground layer allowed for the maintenance of water temperature. In an ATES system, warm water was circulated throughout a community’s infrastructure through piping in order to provide heat during winter months. As the water moved throughout the community losing heat, it slowly decreased in temperature. Once its circuit was complete, the now-cold water was stored in an underground cold-water well within the aquifer. In the summer, this cold water was recirculated throughout the community, and it absorbed heat from infrastructure. Similarly, once its circuit was complete, the now-warm water was stored in a warm-water well within the aquifer to be reused in the winter months. Typically, this cycle required additional heating to bring warm water to hospitable temperatures during the winter. This additional heating typically came from thermal solar panels mounted on infrastructure that generated additional heat throughout the year. This additional heat was transferred to the warm water, entering the community through a heat pump, ensuring that the affected infrastructure was heated to an appropriate temperature.

The added benefit from the ATES system came from the fact that it could supply both heating and cooling for infrastructure. Due to the cyclical nature of the ATES system, the system’s cooling capabilities were best interpreted as generating the same amount of energy in the form of cooling as they did in the form of heat (see Exhibit 2).

Air conditioning during the summer months made up a significant portion of the annual electricity consumption of London residents. In 2013, London Hydro estimated that a 6,000 British thermal unit (BTU) window-mounted air conditioner used 518 kWh per month.[[8]](#footnote-8) Although most of the buildings in RiverBend Heights would be equipped with much larger central air conditioners, because residents would be living in high-density housing, 518 kWh of electrical consumption per living unit due to air conditioning was a fair estimate. Based on RiverBend Heights’ projections of 3,200 residents living in 1,160 living units and using air conditioning for roughly three months, the company saw a clear opportunity for electricity cost savings.

The ATES system itself was quite innovative, and Sifton would be one of the first developers in Canada to implement such a system. Additionally, the system provided users with numerous environmental benefits. First, it reduced the need for natural gas heating that required the consumption of non-renewable fossil fuels. Second, the cooling capabilities of the ATES system reduced the electrical demand for air conditioners during warm summer months. Finally, the ATES system did not contribute any greenhouse gas to the atmosphere if thermal solar panels were used for the heat pump during peak loads or particularly cold days.

There were, however, some environmental and social concerns associated with such a system. First, because of the use of water for heating and cooling, if nearby populations required this source of water for consumption or agriculture, conflicts of interest might arise. Second, due to the pumping of water from the aquifer, changes in water pressure throughout the aquifer could potentially disturb water flow for humans, plants, and animals downstream. Additionally, changes in flow could disrupt soil settlement patterns in connected bodies of water, disturbing the natural habitat of plants and animals. Finally, because of water flow through piping, overall water quality could have a negative impact for plants and animals that relied on this water source downstream. (The energy output and financial details for the ATES system can be found in Exhibit 2.)

Sewer Heat Recovery

Because of the body temperature of humans and animals, the waste flushed down into city sewers was quite warm. Several cities around the world, including Vancouver, had realized this fact and, in an ingenious move, harnessed this energy from sewage.[[9]](#footnote-9) In a sewer heat recovery system, sewage was collected in pipes and filtered in order to remove contaminants. The sewage pipes then passed through a heat exchanger where the natural heat of the sewage was captured and transferred to water or coolant pipes. Similar to an ATES system, the water pipes, now containing warm water, made their way throughout the community in order to heat local infrastructure. As the water passed through the community, it lost energy in the form of heat and returned to the heat exchanger to collect more before being redistributed throughout the community.

The environmental benefits of a sewer heat recovery system were plentiful. First, it significantly reduced dependence upon natural gas for heating. Natural gas burners were required only on particularly cold days or during peak periods. Second, this system emitted greenhouse gases only during the aforementioned periods when natural gas combustion was required. Finally, the entire system ran off a renewable fuel source that would otherwise simply contribute to waste generation. Consequently, the system’s fuel source could run out only if humans stopped contributing to wastewater.

However, although this technology literally generated energy from waste, some concerns were associated with its implementation. First, there were societal concerns and preconceptions over sewage. Some individuals might simply find the technology to be unappealing due to the negative connotations associated with sewage. Second, there was the concern over odour. In order to reduce costs, the heat exchange and sewage system would be installed within the community or at least close by. Consequently, if mismanaged, the sewage could create an unpleasant smell throughout the area. Finally, there were the health and environmental concerns associated with a sewage leak. Although these concerns should have been no different from concerns over the sewage systems already installed all over the world, the high-profile status of this technology could bring such concerns to the forefront. (The energy output and financial data for the sewer heat recovery system are found in Exhibit 3.)

Anaerobic Digestion and Cogeneration

Various forms of waste could be treated through anaerobic digestion. In anaerobic digestion, microorganisms were used, in the absence of oxygen, to break down biodegradable materials such as organic waste. Additional forms of waste that could be treated included sewage sludge and fats, oils, and grease. Through various steps, multiple species of microorganisms broke down the waste and generated a product known as biogas. This biogas was largely made up of methane and carbon dioxide. Although the biogas generated through the digestion process could be used for multiple purposes, for the sake of this development project, it would be combusted in a gas engine in order to generate electricity.

The methane and carbon dioxide from the biogas were, indeed, two of the most common and damaging greenhouse gases contributing to climate change. However, the combustion process converted methane, the more harmful of the two greenhouse gases, into carbon dioxide. The entire process of anaerobic digestion and electricity generation was considered carbon neutral. In essence, because the largely plant-based materials entering the anaerobic digester had already absorbed carbon dioxide in the atmosphere through photosynthesis, the combustion of biogas simply released this carbon dioxide back into the atmosphere. Because the amount of methane was reduced through combustion, less-harmful emissions were created through the entire process. Additionally, a by-product of anaerobic digestion created an efficient fertilizer that could be used to plant new organisms to absorb atmospheric carbon dioxide.

Perhaps the most interesting characteristic of this system was that waste heat was generated during the electricity generation process—hence the name “cogeneration.” This heat could be harnessed to control the temperature of the digester and provide heating to the community. Thus, an anaerobic digester and cogeneration system was able to produce two forms of energy for human consumption. The additional benefits of a coupled anaerobic digestion and cogeneration system were, however, numerous. First, by using different forms of waste for energy production, this system acted as a means of waste diversion. Second, when the waste required to operate the system was simply disposed of, it released a great deal of methane into the atmosphere. However, when the waste went through anaerobic digestion and combustion, the methane was converted to carbon dioxide—a less-harmful greenhouse gas. Third, the by-product of the cogeneration process created a useful fertilizer for soils. Finally, the creation of biogas reduced the need for the combustion of fossil fuels—a key contributor to climate change.

Like any other form of energy generation, however, this system did possess some shortcomings. First, the efficiency of the system was dependent upon community participation. A previous feasibility report for such a system in RiverBend Heights concluded that the system would require a mix of organic and kitchen waste that would need to be donated by residents. Thus, if local residents were unwilling to collect and provide waste, the fuel source of the system would be depleted. However, if the number of participants were to increase, the system could become more cost efficient (see Exhibit 4). Second, the fuel source used to create the biogas was not consistent as there could be periods where less fuel would be available for input. Third, a small risk of explosion existed because the system required the handling of methane. Finally, although anaerobic digestion reduced the noxious odour of incoming waste by approximately 80 per cent,[[10]](#footnote-10) the waste being treated would likely possess an unpleasant odour during its transport to the digester.

STAKEHOLDER GROUPS

Due to the size of the project, several stakeholders would be affected by the community energy system installed in RiverBend Heights. Sifton would need to make a decision that was best for all of its stakeholders rather than for the company’s financial performance alone. Although the development project would have an impact on numerous stakeholders, Troup had identified several key groups that could have an impact on his recommendation:

* potential consumers
* environmentalists
* First Nations
* top management at Sifton

In Troup’s mind, the potential consumers of RiverBend Heights were of the utmost importance. Without satisfying the consumers, Sifton would be unable to effectively sell space in the community. Troup believed that the first priority for this stakeholder group was property costs. A more expensive community energy system would drive up prices for space within the community. The second most important aspect of such a system for potential consumers was likely the system’s social impact. Potential consumers would prefer a system that did not generate unpleasant sounds or smells and that did not require any additional effort on their part. Finally, Troup was confident that potential consumers would be concerned about the environmental impact of the community energy system. However, he believed that the environmental benefits of any system would likely take a back seat to financial costs and social impact for this particular stakeholder group.

The second stakeholder group that required consideration was the environmentalists. Environmentalists would not necessarily be interested in living in or commuting to RiverBend Heights, and thus would be concerned only with the environmental impact of any system. This stakeholder group would prefer the system that created the greatest environmental benefit with the smallest negative environmental impact. Some of the key environmental issues of concern to this group were greenhouse gas emissions, fossil fuel use, water use, and impact on wildlife. Meeting the concerns of environmentalists would be key to the success of RiverBend Heights, as this group’s opinion could sway the legitimacy of Sifton’s sustainability efforts.

The third stakeholder group that could influence Troup’s recommendation was the local First Nations population, whose members were primarily concerned with the ATES system’s effects on downstream bodies of water. They were concerned that the system would increase temperatures in the affected tributaries. The tributaries of the Thames River were home to various cold-water species that could die in warm water. The First Nations community had previously raised this concern with Sifton, and their concerns would have a significant impact on Troup’s recommendation.

The final key stakeholder group that could affect Troup’s decision was top management at Sifton. Sifton was concerned with the financial, environmental, and social impacts of each community energy system. The company sought to find a balance between these three issues and was not willing to sacrifice one issue for the betterment of another. The company had laid down strict financial criteria as a guideline for Troup’s recommendation, and profitability was the key concern for Sifton. However, the company’s environmental and social concerns were similar to those of potential consumers.

As the clock on his computer reached 5:00 p.m., Troup packed up his things and made his way to the elevator. He would use the weekend to make up his mind and, come Monday morning, have a system to recommend to the company. As he stood waiting for his bus home, Troup ran through the various receptions he could receive on Monday as a result of his recommendation.

Exhibit 1: Sifton Properities Ltd.—Neighbourhood Development Projects in Progress

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Neighbourhood** | **Region** | **Lot Size**  **(in feet)** | **Price Range** | **# of Builders** |
| RiverBend Heights | London West | N/A | N/A | N/A |
| RiverBend Village | London West | N/A | N/A | N/A |
| Timberwalk | Ilderton | 50–60+ | $300,000+ | TBD |
| Victoria on the River | London South | 40–55+ | $300,000+ | TBD |
| Warbler Woods at RiverBend | London West | 50–60 Frontage | Mid $300,000–$500,000+ | 2 |

Source: “Feasibility Study Report: Community Energy System, London, Ontario,” Science Applications International Corporation, 2007.

Exhibit 2: Aquifer Thermal Energy Storage—Energy Projections and Financial Information

|  |  |
| --- | --- |
| **Heat Production (GJ/year)** | 6,133.33 |
| **Cooling Production (kWh/year)** | 1,703,702.78 (6,133.33 GJ/year) |
| **Thermal Solar Panel Area (m2)** | 2,000 |
| **Cost of 7.32 m2 Thermal Solar Panel ($)** | 300 |
| **System Installation Cost ($)** | 1,368,620 |
| **Estimated Air Conditioning Load per Unit in RiverBend Heights (kWh/month)** | 518 |
| **Average Cost of Electricity in London ($/kWh)** | 0.0993 |
| **Natural Gas Heating Equivalent (m3/GJ)** | 26.137 |
| **Cost of Natural Gas ($/m3)** | 0.1878675 |

Notes: Cost estimates were developed by Derek Butcher during his time at Sifton Properties Ltd.

Sources: “Delivered Electricity Price Comparison,” Ontario Power Authority, 2008, accessed July 23, 2012, www.powerauthority.on.ca/sites/default/files/page /7555\_Delivered\_Electricity\_Price\_Comparison3.pdf;

“Feasibility Study Report: Community Energy System, London, Ontario,” Science Applications International Corporation, 2007;

“Natural Gas Rates—Historical,” Ontario Energy Board, January 2017, accessed April 11, 2017, www.ontarioenergyboard.ca/oeb/Consumers/Natural+Gas/Natural+Gas+Rates/Natural+Gas+Rates+-+Historical.

Exhibit 3: Sewer Heat Recovery—Energy Projections and Financial Information

|  |  |
| --- | --- |
| **Available Funding ($)** | 3,000,000 |
| **Estimated Installation Cost ($/GJ)** | 206.35 |
| **Natural Gas Heating Equivalent (m3/GJ)** | 26.137 |
| **Cost of Natural Gas ($/m3)** | 0.1878675 |

Source: “Natural Gas Rates—Historical,” Ontario Energy Board, January 2017, accessed April 11, 2017, www.ontarioenergyboard.ca/oeb/Consumers/Natural+Gas/Natural+Gas+Rates/Natural+Gas+Rates+-+Historical.

Exhibit 4: Digestion and Cogeneration—Energy Projections and Financial Information

|  |  |
| --- | --- |
| **Waste Input Mass (tonnes)** | 820 |
| **Biogas Generated for Given Input Mass (m3/day)** | 365\* |
| **Electricity Generation Rate (kWh/m3 of biogas)** | 1.7 |
| **Waste Heat Generation Rate (GJ/m3 of biogas)** | 0.0077 |
| **Cogeneration System Capacity** | 82.19 kWh\* |
| **System Installation Cost ($/kWh Capacity)** | 7,000 |
| **Average Cost of Electricity in London ($/kWh)** | 0.0993 |
| **Natural Gas Heating Equivalent (m3/GJ)** | 26.137 |
| **Cost of Natural Gas ($/m3)** | 0.1878675 |

Note: \*If enough interest is generated in the community, it is estimated that a larger system could process 4,000 tonnes of input waste annually. This would result in a system capacity of 126.11 kWh and the generation of 648,878.05 m3 of biogas per year.

Sources: “Economic Feasibility of Anaerobic Digesters,” Government of Alberta—Department of Agriculture and Rural Development, 2008, accessed July 27, 2012, www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex12280;

“Delivered Electricity Price Comparison,” Ontario Power Authority, 2008, accessed July 23, 2012, www.powerauthority.on.ca/sites/default/files/page /7555\_Delivered\_Electricity\_Price\_Comparison3.pdf;

“Natural Gas Rates—Historical,” Ontario Energy Board, January 2017, accessed April 11, 2017, www.ontarioenergyboard.ca/oeb/Consumers/Natural+Gas/Natural+Gas+Rates/Natural+Gas+Rates+-+Historical.

1. Hank Daniszewski, “Sifton Helped Build London,” London Free Press, March 22, 2010. [↑](#footnote-ref-1)
2. Ibid. [↑](#footnote-ref-2)
3. Altus Group, Employment, Population, Housing and Non**‐**Residential Construction Projections, City of London, Ontario, 2011 Update, September 7, 2012, accessed August 8, 2013, https://www.london.ca/business/Planning-Development/Official-Plan/Documents/RethinkLondon/FINAL-P4648-CityofLondonEmploymentPopulationandHousingForecast-FinalReport-4.pdf. [↑](#footnote-ref-3)
4. All currency amounts are in CA$ unless otherwise specified. [↑](#footnote-ref-4)
5. “Table 3-2: Household Energy Use, by Fuel Type and by Province, 2007—Average Energy Use,” Government of Canada: Statistics Canada, December 19, 2012, accessed August 10, 2013, www.statcan.gc.ca/pub/11-526-s/2010001/t004-eng.htm. [↑](#footnote-ref-5)
6. “Average Weekly Food Expenditure per Household, Canada and Selected Regions (2001) (Atlantic Region, Quebec, Ontario),” Government of Canada: Statistics Canada: Ontario, January 11, 2005, accessed August 10, 2013, www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/famil27a-eng.htm. [↑](#footnote-ref-6)
7. A kWh was a unit of energy equivalent to a kilowatt (1,000 watts) of power operating for one hour. A kWh was commonly used to express electricity in the form of a unit and 1 kWh was equal to 0.0036 GJ. A GJ was equal to 109 joules and was a unit of energy used to describe work, electricity, or heat. [↑](#footnote-ref-7)
8. “London Hydro Appliance Usage Chart,” London Hydro, 2013, accessed August 14, 2013, www.londonhydro.com/residential/applianceusagechart/. [↑](#footnote-ref-8)
9. David Dodge and Duncan Kinney, “Sewer Heat Keep Homes Warm in Vancouver’s False Creek Area: District Heating Plant Sits Right under the Cambie Bridge,” Green Energy Futures, January 29, 2013, accessed August 11, 2013, www.greenenergyfutures.ca/episode/28-sewer-heat-how-vancouver-harvesting-energy-what-goes-down-your-drain. [↑](#footnote-ref-9)
10. “Benefits of Anaerobic Digestion,” Agri-Food and Biosciences Institute, accessed August 14, 2013, https://www.afbini.gov.uk/articles/1-benefits-anaerobic-digestion. [↑](#footnote-ref-10)