Charlottetown Resource Recovery Facility

Photo credit: CBCL

Project Overview

The City's Pollution Control Plant, on Riverside Drive and adjacent to the Hillsborough River, treats the majority of wastewater from the City of Charlottetown and produces an exceptional Class A biosolid as defined by the US Environmental Protection Act (EPA) Standards. These biosolids are tested regularly to confirm compliance with the standard and contain valuable nutrients and soil conditioning properties.

The Plant is the City's largest energy using facility, with annual energy consumption of 12,500 Gigajoules and an annual electrical energy cost of close to $500,000. This equates to more than 1,000 tonnes of greenhouse gas emissions annually. Some steps have already been taken to reduce energy loads at the facility through biogas collection and energy efficiency efforts but this remains a high energy cost to the City of Charlottetown.

The Pollution Control Plant is in need of improvements to increase its treatment capacity in order to address wastewater flows from East Royalty in Charlottetown. Currently, wastewater in East Royalty is treated via the East Royalty Lagoon, but it is the City's intention to decommission the lagoon and to

divert wastewater flows to the Plant. In addition to requiring extra capacity for the needs of East Royalty, the City will also be looking to make improvements in order to take on the treatment of Stratford's wastewater flows. Capacity improvements at the plant will need to look at current flows in Charlottetown and Stratford as well as anticipated increases in flows as both communities grow and develop.

As provincial governments across Canada prepare to roll out carbon tax programs and federal infrastructure funding programs align with the mandate of the current government, it is anticipated that, going forward, infrastructure projects will need to demonstrate their long-term approach to sustainability. Projects will need to quantify not only financial costs but also environmental and social costs and benefits to the community as well.

There currently exists an opportunity to take a big-picture approach to improvements at the Plant that will not only address anticipated increases in wastewater flows but will identify ways to sustainably manage operating costs as well as provide additional environmental and social benefits, well into the future.

The City of Charlottetown is proposing an integrated sustainable design for its Pollution Control Plant that will address energy consumption and greenhouse gas emissions as well as treat waste outputs (wastewater and biosolids) as resources that can be used on-site for the benefit of the community rather than a waste by-product; thereby rebranding the Pollution Control Plant as the Charlottetown Resource Recovery Facility.

Project Objective:

To develop the Charlottetown Resource Recovery Facility, an integrated sustainable design showcase that will address energy needs and waste outputs and will have long-term financial, environmental and social benefits.

Project Components

Energy

Energy will be an important component of the Charlottetown Resource Recovery Facility. The City will look to make significant improvements in the ways power is used and produced. Upgrades to existing energy systems will help make the facility more efficient while possible renewable energy systems will assist in reaching the City's goal of offsetting the facility's energy use. By offsetting the facility's energy use, the City would be able to reduce its carbon footprint by 1,000 Tonnes CO2e (roughly 13 per cent). In turn, the facility's operational cost will be dramatically reduced.

We will look at energy production options such as solar, wind and tidal. We're also exploring opportunities to use biofuel to produce biomass materials that could be used in energy production. The City will work in partnership with the UPEI School of Sustainable Design Engineering and Holland College to identify energy opportunities and implement several key project components.

Solar

As one of the first steps in switching the facility over to renewable energy, existing assets such as roofs and land areas will be explored for solar photovoltaic energy generation potential.

These areas are the simplest to utilize as they are directly on site and owned by the city; however, these areas may not be able to provide the full power requirements.

Photo credit: Forrest

Therefore, other locations such as brownfield sites and neighbouring properties/facilities will be explored. The final system size and cost will depend greatly on the availability of land area.

Wind

Wind is an abundant resource in Prince Edward Island. The Hillsborough River may be a good location to install an off-shore or on-shore wind turbine. Wind development for this site could include a turbine with a capacity of up to two megawatts. This is comparable in size to the commercial grade turbine used at the Hermanville wind farm on PEI, which has a capacity of three megawatts. Alternatively, a number of smaller sized turbines may be installed to provide the same amount of energy.

Photo credit: Phil Hollman

Either way, two megawatts of capacity could provide all or most of the power requirements to operate the Charlottetown Resource Recovery Facility. If paired with solar and/or tidal power, the size of the turbine(s) could be further reduced.

There may be environmental implications of installing any wind turbine, off-shore or on-shore so a thorough environmental impact assessment would need to be conducted to ensure the environmental impacts are fully understood and mitigated where possible.

Tidal

The Hillsborough River presents an opportunity for tidal power generation. A single large turbine or a combination of smaller ones could potentially supply a significant amount of the power requirements at the treatment plant facility.

Photo credit: Andritz

Actual system cost and power production will depend on the tidal resource available and on the system design. Significant testing will need to be completed to quantify the resource available and determine the feasibility of tidal power at this location. As with wind power, a thorough environmental impact assessment will need to be conducted in order to fully understand and mitigate negative environmental impacts.

Biogas Fired Co-generation System

The City is exploring the possibility of a biogas fired co-generation system. The Plant has a primary and secondary digester system that currently produces approximately 750,000 cubic meters per year of digester gas. The gas is currently used to provide process heat and space heating. When the gas supply exceeds the heat demand the excess gas is flared. It is proposed that a 130 kilowatt (electrical) co-generation system could be installed providing more than 500,000 kilowatt-hours of electricity each year and hot water for process and space heating. The system is basically a biogas fired generator that includes a loop to make beneficial use of the excess heat produced and captured through the engine cooling system. The overall efficiency of the system is increased by finding beneficial uses for the heat that is produced in the process of generating electricity.

Effluent Water Heat Recovery System

The Pollution Control Plant treats approximately 20,000 cubic meters of water each day. The minimum monthly average temperature of this water is 10 degrees Celsius. This represents a potential heat energy source through the use of water to water heat pump. If the heat pump is able to extract five per cent of the available heat energy present, this would represent more than 1-million kilowatt-hours of heat energy each year. This process would save more than 100,000 litres of fuel oil annually.

The process is very similar to ground source heat pump systems used to heat homes. These systems take advantage of the heat in groundwater with an average temperature of approximately 8 degrees Celsius. The Plant's water stream has a higher average temperature and therefore a greater heating potential. The heat would be extracted through a refrigeration loop run in the reverse of that found in a domestic refrigerator. The process uses electricity to essentially move heat from the water to another location where heat is needed. It is possible to move approximately three times the amount of heat that is required to run the process. This makes the heating system three times more efficient that electrical resistance heating.

Biosolids

Charlottetown's Pollution Control Plant has received the highest classification in Canada as a Level 4 Wastewater Treatment Plant based on the complexity of the plant and the size of flow.

Photo credit: Parkson

A component of the resource recovery process is the production of an Exceptional Class A biosolid with a dry solid concentration at an average of 22 per cent.

According to the Canadian Water and Wastewater Association's website, biosolids "are nutrient-rich organic materials resulting from the treatment of domestic sewage in a treatment facility. When treated and processed, these residuals can be recycled and applied as fertilizer to improve and maintain productive soils and stimulate plant growth."

Each year approximately 4,000 wet tonnes of biosolids are removed by a contractor and used for agricultural purposes. To increase the potential uses of the biosolid, it is proposed to further dry the product to approximately 50 per cent dry material. The increased drying would be accomplished with an environmentally-friendly active solar sludge dryer system. The product would be easier to apply and increase the uses of the product.

Photo credit: Parkson

The biosolids will be placed in a drying facility similar to a greenhouse where it would be automatically turned and aerated to increase the drying performance. The main energy source for drying – the sun – will produce up to 95 per cent of the required energy. Auxiliary heating will be able to be provided from wastewater heat recovery and the heating cycle of the combined heat and power system.

Initial projections are to have approximately 25 per cent of current biosolid production handled through the solar drier. The drier could provide up to 400 tonnes of biosolids at 50 per cent solids. This could offset nearly 100 tonnes of fertilizer.

The City will also complete trials of mixing biosolids with soil to produce an enhanced soil for landscaping activities such as flower beds. There will also be investigations in cooperation with UPEI into further biosoilds processing options including pyrolysis capable of producing biochar, fuel oils, and liquid fertilizer equivalents.

Greenhouses

Production Greenhouse

Building a production greenhouse would afford the City the possible opportunity to offset costs that are incurred in the horticultural displays that make Charlottetown beautiful.

A production greenhouse would allow City staff to plant and grow the annual and perennials that are currently used throughout the City streets and parks.

Heat from the Charlottetown Resource Recovery Facility could be used to offset the heating costs of the greenhouse.

Photo credit: Vincent Dieras, Halifax Seed

Indoor Botanical Garden or Atrium

Indoor botanical gardens are often dedicated to the collection, cultivation and display of a wide range of plants.

They play a role in the conservation of plant diversity and can help save native or rare plant species that are at risk. They offer educational opportunities related to plant diversity and environmental issues.

But perhaps just as important are the social benefits of these indoor green spaces that provide a beautiful retreat from the often hectic pace of our urban environments.

These peaceful green spaces improve our physical and mental health, reduce our stress and create a sense of wellbeing.

It would certainly be a beautiful, warm, green retreat from the cold, snowy winter days of PEI.

We believe that either the production greenhouse or the indoor botanical garden/atrium could utilize biosolids, hydroponics or the Pollution Control Plant's heat recovery system.

Photo credit: (top) Emil Tiedemann; (bottom) Frank Jonkman, JGS Limited

Climate Adaptation and Coastal Protection

An important component of the Charlottetown Resource Recovery project will be to ensure the City is protecting its investment.

Currently, there is armoured stone installed along the shoreline of the property. Further study will be conducted on the site with support from the UPEI Climate Lab, Public Safety Canada, and PEI Emergency Measures Organization to gain a deeper understanding of the specific impacts of storm surges, sea level rise and erosion and to identify appropriate measures that could be put in place to mitigate risks to the property.

Funding opportunities will be sought for flood mapping and modeling, adaptation strategy design and implementation of adaptation strategies. The City will seek to partner with neighbouring properties to ensure an inclusive approach to mitigate the ongoing shore erosion challenges and enhance its flood protection strategy.

Next Steps

The City of Charlottetown has formed a partnership with the Carleton Centre of Community Innovation (Carleton University, Ottawa) on a Canadian Impact Infrastructure Exchange (CIIX) pilot project. The CIIX has selected three Canadian municipalities – Vancouver, Toronto and Charlottetown – to participate in this pilot project which will supply consulting support to develop a long-term feasibility study for this infrastructure project from an economic, social and environmental standpoint.

The analysis will identify the costs and benefits using a triple bottom line approach and quantify all benefits – financial, societal and environmental. The CIIX will also be working to create access to funding streams from a variety of potential funding partners that are looking for opportunities to invest in infrastructure projects that meet the criteria of a triple bottom line approach.

The City of Charlottetown is also reaching out to the local academic community to form an ongoing partnership with the UPEI School of Sustainable Design Engineering and Holland College. There are numerous components to the project that would directly align with the educational outcomes that UPEI and Holland College are looking for in their community partnerships.

With assistance from the CIIX, it is anticipated that the feasibility report for this project could be available before the end of 2017. In the interim, the City will continue to look to identify additional community partnerships and funding opportunities.