1. ROBERT O. PICKARD ENVIRONMENTAL CENTRE (ROPEC) ELECTRICAL RELIABILITY AND EFFICIENT USE OF DIGESTER GAS PROJECT

PROJET SUR LA FIABILITÉ DE L'ALIMENTATION ÉLECTRIQUE ET L'UTILISATION EFFICACE DES BIOGAZ AU CENTRE ENVIRONNEMENTAL ROBERT-O.-PICKARD (CEROP)

COMMITTEE RECOMMENDATIONS

That Council:

1. **Approve upgrades to the Robert O. Pickard Environmental Centre (ROPEC), as described in this report;**
2. **Approve an increase in capital expenditure authority for project 906648 Digester Gas Utilization of $41.8 million for a total of $57.2 million and that the increase be funded from the Wastewater Reserve; and,**
3. **Delegate the authority to the General Manager, Public Works and Environmental Services, in consultation with the City Solicitor, to negotiate, finalize and execute a contract with Envari Energy Solutions Inc., in accordance with this report.**

RECOMMANDATIONS DU COMITÉ

Que le Conseil :

1. **approuve les améliorations au Centre environnemental Robert-O.-Pickard (CEROP) décrites dans le présent rapport;**

2. approuve pour le projet no 906648 (utilisation des biogaz) une augmentation des dépenses d'immobilisations autorisées de 41,8 millions de dollars, ce qui porterait le total à 57,2 millions de dollars, une augmentation qui serait puisée dans le fonds de réserve pour les services d'eaux usées; et,

3. délègue au directeur général, Services des travaux publics et des services environnementaux, en consultation avec l'avocat général, les pouvoirs nécessaires pour négocier, conclure et exécuter un contrat avec Envari Energy Solutions inc., conformément au présent rapport.

DOCUMENTATION / DOCUMENTATION

1. Director's Report, Technology, Innovation, and Engineering Support Services, Public Works & Environmental Services, dated 4 October 2019 (ACS2019-PWE-TIE-0008).

   Rapport de la Directrice, Service d'appui technique, de l'innovation et du génie, Travaux publiques et services environnementaux, daté le 4 octobre 2019 (ACS2019-PWE-TIE-0008).

2. Extract of Draft Minute, 15 October 2019.

   Éxtrait de l'ébauche du procès-verbal, le 15 octobre 2019.

REPORT 6
23 OCTOBER 2019

RAPPORT 6
LE 23 OCTOBRE 2019

Report to
Rapport au:

Standing Committee on Environmental Protection, Water and Waste Management
Comité permanent de la protection de l'environnement, de l'eau et de la gestion des déchets
15 October 2019 / 15 octobre 2019

and Council
et au Conseil
23 October 2019 / 23 octobre 2019

Submitted on October 4, 2019
Soumis le 4 octobre 2019

Submitted by
Soumis par:
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Public Works & Environmental Services / Travaux publiques et services environnementaux

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Ward: CITY WIDE / À L'ÉCHELLE DE LA VILLE

File Number: ACS2019-PWE-TIE-0008

SUBJECT: **Robert O. Pickard Environmental Centre (ROPEC) Electrical Reliability and Efficient Use of Digester Gas Project**

OBJET: **Projet sur la fiabilité de l'alimentation électrique et l'utilisation efficace des biogaz au Centre environnemental Robert-O.-Pickard (CEROP)**

REPORT RECOMMENDATIONS

That the Standing Committee on Environmental Protection, Water, and Waste Management recommend Council:

1. **Approve upgrades to the Robert O. Pickard Environmental Centre (ROPEC), as described in this report;**
2. **Approve an increase in capital expenditure authority for project 906648 Digester Gas Utilization of $41.8 million for a total of $57.2 million and that the increase be funded from the Wastewater Reserve; and,**
3. **Delegate the authority to the General Manager, Public Works and Environmental Services, in consultation with the City Solicitor, to negotiate, finalize and execute a contract with Envari Energy Solutions Inc., in accordance with this report.**

RECOMMANDATIONS DU RAPPORT

Que le Comité permanent de la protection de l'environnement, de l'eau et de la gestion des déchets recommande au Conseil :

1. **d'approuver les améliorations au Centre environnemental Robert-O.-Pickard (CEROP) décrites dans le présent rapport;**
2. **d'approuver pour le projet no 906648 (utilisation des biogaz) une augmentation des dépenses d'immobilisations autorisées de 41,8 millions de dollars, ce qui porterait le total à 57,2 millions de dollars, une augmentation qui serait puisée dans le fonds de réserve pour les services d'eaux usées; et,**
3. **de déléguer au directeur général, Services des travaux publics et des services environnementaux, en consultation avec l'avocat général, les pouvoirs**

nécessaires pour négocier, conclure et exécuter un contrat avec Envari Energy Solutions inc., conformément au présent rapport.

EXECUTIVE SUMMARY

The City's wastewater is collected through a system comprised of 2,853 km of sanitary sewers and 102 km of combined sewers, where it is transported to the City's wastewater treatment plant - the Robert O. Pickard Environmental Centre (ROPEC) - in the city's east-end for treatment. On average, ROPEC – with an asset value of $1.7B - treats 415-million litres of wastewater every day, before it is safely discharged into the Ottawa River. During the treatment process, one of the by-products that must be managed by the City is biogas, predominantly – methane.

In 1996, staff identified a savings opportunity whereby the methane produced during the treatment process would be converted into electricity and heat using internal combustion engines that would partially power and heat the plant through a process called cogeneration (also commonly referred to as Combined Heat and Power, or CHP). It was estimated that the savings associated with this recommendation would be equal to 25 per cent of ROPEC's annual hydro budget, or roughly $685,000 per year. With Council's approval, the cogeneration plant – consisting of three 810 kW Caterpillar 16-cylinder reciprocating engines – was commissioned in 1997. An update on ROPEC's Energy Management Plan was presented to Council on December 20, 2006, which detailed how the plan was saving the City approximately $1.565M in electrical energy and natural gas costs per year.

Today, the cogeneration system at ROPEC provides utilities savings of approximately $1.4M annually. The success of this technology in producing environmental benefits and generating financial savings has been recognized as an industry best practice, with the United States Department of Energy and the United States Environmental Protection Agency establishing aggressive targets for the increasing utilization of cogeneration technology as a reliable renewable power source.

Business Need and Options Analysis

The existing three cogeneration units are currently at the end of their service life and need replacement. As a result, staff has worked with Envari (formerly Energy Ottawa) – the City's preferred partner in energy reduction and efficiency measures - and other industry experts to conduct a Preliminary Engineering Study (PES), Essential Power Study (EPS), Electrical Master Plan (EMP), and a Detailed Engineering Study (DES) between 2015 and 2018. Using information gathered from these various studies, staff developed a comprehensive business case in 2018/2019 to examine the efficient and effective utilization of ROPEC's digester gas.

As part of the business case, the project team identified the following five options that were carried forward for evaluation:

1) Status Quo (Maintain Existing Cogeneration Units)
2) Electrical Rehabilitation Only (Allow the Cogeneration Units to Fail)
3) Three New Cogeneration Units (810 kW or 1,000 kw)
4) Four New 1,000 kW Cogeneration Units
5) Five New 1,000 kW Cogeneration Units

To assist with evaluating these five options, it was important for the project team to establish a set of key project objectives that would be used to identify the preferred option. After extensive discussions with subject-matter experts, the following project objectives were adopted by the project team:

1) Climate and System Resiliency
2) Effective and Efficient Use of Digester Gas
3) Reduce Greenhouse Gas Emissions
4) Electrical Reliability
5) Operational Flexibility

Other options, such as using diesel generators only or converting digester gas into renewable natural gas (RNG), were also considered during the initial development of the business case, but ultimately not carried-forward for detailed evaluation due to notable limitations in achieving the key project objectives. However, it is worth noting that a Biogas Optimization Study is currently underway and will be completed by Q4 2020. Should this study recommend alternate uses moving-forward for ROPEC's digester gas, the City would be able to modify the operating approach for the cogeneration units to utilize only 10 per cent of the total available digester gas, while still achieving approximately 85 per cent of the anticipated financial savings. This approach would involve using the cogeneration engines to offset the Global Adjustment charges during peak periods, and in turn – would allow the City to use up to 90 per cent of the total available digester gas for alternate purposes, if desired by Council.

Based on the findings of the business case, which included an extensive analysis of operating and capital costs and utilities modelling for each option, staff recommends proceeding with four (4) new 1,000 kW Cogeneration Units. Concurrent to the addition of these new units, end-of-life electrical equipment would be replaced, and the Plant's electrical and heating loop distribution systems would be modified.

Financial and Environmental Benefits

The use of four cogeneration engines, along with modifications to the electrical distribution and heating loop systems, will save the City an additional $80M over the 25-year lifecycle of the engines, as well as reduce GHG emissions by an additional 1,565 tonnes of CO2e per year in comparison with the use of three existing cogeneration units (or up to 2,183 tonnes of CO2e per year in comparison with no cogeneration technology). These savings can be primarily attributed to the modifications to ROPEC's electrical and heating loop distribution systems, which will allow the electricity and heat generated by the cogeneration units to be more widely distributed throughout the Plant (reducing imported energy), as well as allow digester gas to be utilized by both on-site boiler systems (reducing imported natural gas).

Another significant benefit towards ensuring climate and system resiliency will be the ability to operate independently of the power grid (often referred to as "islanding") during a sustained power outage. Under the existing configuration, the cogeneration units are

unable to operate during a power outage, meaning the critical treatment processes at facility rely on backup diesel generators. Even with these backup generators, discharge from the plant would degrade after six hours, and all sewage being bypassed after 12 hours. The proposed modifications to the incoming electrical feed will ensure that full treatment is provided during an outage, serving as an important safeguard for the Ottawa River.

Project Implementation and Funding

Once approved by Council, staff will work to finalize and execute an agreement with Envari for the construction of the project. The current project schedule would see the upgrades completed and commissioned by the end of 2024.

The total project cost is estimated to be approximately $57.2M, including all design costs, capital costs, project management fees, and contingency costs. The project will be funded primarily from the City's Wastewater Reserve (approximately $41.8M), with the remainder of the funding coming from the existing capital project accounts (approximately $15.4M). When considering the total project cost and estimated savings, it is anticipated that the simple payback period for the project would be approximately 14 years.

In an effort to reduce the amount of funding being borrowed from the Wastewater Reserve, staff engaged an external agency specializing in the identification of grant and funding opportunities. This review confirmed that there are currently no viable funding opportunities, however - staff are committed to continuously reviewing new opportunities as they emerge.

RÉSUMÉ

Les eaux usées de la ville d'Ottawa sont collectées par un réseau d'égouts sanitaires (2 853 km) et d'égouts unitaires (102 km) qui les amènent à l'usine d'épuration de l'est de la ville, le Centre environnemental Robert-O.-Pickard (CEROP). Ce centre, un actif de 1,7 milliard de dollars, traite en moyenne 415 millions de litres d'eaux usées chaque jour avant de les déverser sans danger dans la rivière des Outaouais. Parmi les sous-

produits du processus de traitement que doit traiter la Ville se trouvent les biogaz, et principalement le méthane.

En 1996, on s'est rendu compte qu'on pouvait faire des économies en convertissant ce méthane en électricité et en chaleur à l'aide de moteurs à combustion interne qui alimenteraient et chaufferaient partiellement l'usine d'épuration grâce à un processus appelé « cogénération » (c'est-à-dire la production combinée de chaleur et d'électricité). On a estimé les économies à 25 % du budget annuel d'électricité du CEROP, soit environ 685 000 $ par année. Avec l'approbation du Conseil, la centrale de cogénération – composée de trois moteurs à 16 cylindres Caterpillar de 810 kW – a été mise en service en 1997. Le 20 décembre 2006, le Conseil a reçu un compte rendu sur le plan de gestion de l'énergie du CEROP expliquant que la Ville économisait chaque année environ 1 565 000 $ sur les coûts de l'électricité et du gaz naturel.

Aujourd'hui, le système de cogénération du CEROP permet d'économiser environ 1,4 million de dollars chaque année. Le succès de cette technologie dans la production d'avantages environnementaux et dans la réalisation d'économies financières a été reconnu comme une pratique exemplaire dans l'industrie, le Department of Energy des États-Unis et l'Environment Protection Agency des États-Unis établissant des objectifs ambitieux pour une utilisation croissante de la technologie de cogénération en tant qu'énergie renouvelable fiable.

Analyse des besoins et des options

Les trois unités de cogénération actuelles arrivent à la fin de leur cycle de vie et doivent être remplacées. Le personnel, en collaboration avec Envari (autrefois Énergie Ottawa) – principal partenaire de la Ville en matière d'efficacité énergétique et de réduction de la consommation d'énergie – et d'autres experts, a donc réalisé une étude d'ingénierie préliminaire, une étude des systèmes d'alimentation électrique essentiels, un plan directeur d'électricité et une étude technique détaillée de 2015 à 2018. En 2018-2019, à partir des données ainsi recueillies, le personnel a mené une analyse de rentabilité approfondie sur l'utilisation efficiente et efficace des biogaz du CEROP.

L'équipe de projet a établi dans le cadre de cette analyse de rentabilité cinq options à évaluer :

1) Statu quo (maintien des unités de cogénération actuelle)
2) Remise en état du système électrique uniquement (sans remplacement des unités de cogénération en fin de vie)
3) Trois nouvelles unités de cogénération (de 810 kW ou 1 000 kW)
4) Quatre nouvelles unités de cogénération de 1 000 kW
5) Cinq nouvelles unités de cogénération de 1 000 kW

Pour bien évaluer ces cinq options et trouver la meilleure, l'équipe de projet devait se donner un ensemble d'objectifs clés. Voici les objectifs adoptés après des discussions approfondies avec des experts :

1) Adaptation aux changements climatiques et résilience des systèmes
2) Utilisation efficace et efficiente des biogaz
3) Réduction des émissions de gaz à effet de serre
4) Fiabilité de l'alimentation électrique
5) Flexibilité opérationnelle

Au début de l'analyse de rentabilité, d'autres options ont aussi été envisagées, comme l'utilisation de génératrices diesel uniquement ou la conversion des biogaz en gaz naturel renouvelable; elles ont cependant été abandonnées avant l'évaluation détaillée, en raison de limites importantes quant à l'atteinte des principaux objectifs du projet. Il faut cependant souligner qu'une étude d'optimisation des biogaz est en cours et sera terminée d'ici le quatrième trimestre de 2020. Si cette étude recommande d'autres façons d'utiliser les biogaz du CEROP, la Ville pourrait modifier l'approche d'exploitation pour que les unités de cogénération n'utilisent que 10 % des biogaz disponibles, tout en atteignant environ 85 % des économies prévues. Il s'agirait d'utiliser les moteurs de cogénération pour compenser les coûts de rajustement global pendant les périodes de pointe, ce qui permettrait à la Ville d'utiliser jusqu'à 90 % des biogaz disponibles à d'autres fins, si le Conseil en décide ainsi.

En se basant sur l'analyse de rentabilité, qui comprend une analyse approfondie des coûts d'exploitation et d'immobilisation et une modélisation des services publics pour chaque option, l'équipe de projet recommande l'option des quatre (4) nouvelles unités de cogénération de 1 000 kW. Parallèlement à l'ajout de ces nouvelles unités, l'équipement électrique en fin de vie serait remplacé, et les systèmes de distribution en boucle d'électricité et de chauffage de l'usine de récupération seraient modifiés.

Retombées financières et environnementales

L'utilisation de quatre moteurs de cogénération, parallèlement aux modifications au réseau de distribution en boucle d'électricité et de chauffage, fera économiser à la Ville 80 millions de dollars de plus sur la durée de vie des moteurs (25 ans), et réduira les émissions annuelles de GES de 1 565 tonnes d'équivalent CO2 de plus qu'avec les trois unités de cogénération actuelles (jusqu'à 2 183 tonnes d'équivalent CO2 par année de plus qu'en l'absence de technologies de cogénération). Ces économies sont principalement attribuables aux modifications aux systèmes de distribution en boucle d'électricité et de chauffage du CEROP, qui permettront de distribuer plus largement l'électricité et la chaleur produites par les unités de cogénération dans toute l'usine (pour réduire l'importation d'énergie) et d'utiliser les biogaz dans les deux systèmes de chaudières (pour réduire l'importation de gaz naturel).

Un autre avantage important pour assurer l'adaptation aux changements climatiques et la résilience des systèmes sera la capacité de fonctionner indépendamment du réseau électrique (appelée « îlotage ») pendant une panne prolongée. Dans la configuration actuelle, les unités de cogénération ne peuvent fonctionner pendant une panne, ce qui signifie que les processus de traitement critiques des installations reposent sur les génératrices diesel. Même avec ces génératrices, les rejets de l'usine se dégraderaient après 6 heures, et toutes les eaux usées étant évacuées au bout de 12 heures. Les modifications proposées à l'alimentation électrique garantiront la poursuite du traitement pendant les pannes, protégeant ainsi la rivière des Outaouais.

Mise en œuvre et financement du projet

Une fois le projet approuvé par le Conseil, l'équipe de projet conclura une entente avec Envari pour les travaux. L'échéancier actuel prévoit la fin des réfections et la mise en service d'ici la fin 2024.

Le coût total du projet est estimé entre 46,4 millions et 54,5 millions de dollars, ce qui comprend tous les coûts de conception, les coûts d'immobilisation, les frais de gestion de projet et le fonds de prévoyance. Le projet sera financé principalement à partir du Fonds de réserve des services d'eaux usées de la Ville (entre 29 et 37,1 millions de dollars), le reste du financement provenant des fonds de projets d'immobilisations actuels (environ 17,4 millions de dollars). Si on tient compte du coût total du projet et des économies prévues, on s'attend à ce que la période de rentabilisation simple du projet soit d'environ 14 ans.

Pour tenter de réduire le montant emprunté dans le Fonds de réserve des services d'eaux usées de la Ville, l'équipe de projet a retenu les services d'une agence spécialisée dans la recherche de subventions et de fonds. Cette dernière a confirmé qu'il n'existait actuellement aucune possibilité de financement viable, mais l'équipe de projets s'engage à faire régulièrement l'inventaire des nouvelles occasions qui pourraient se présenter.

BACKGROUND

The City of Ottawa is committed to providing core services to residents and ratepayers in a manner that is both environmentally and financially sustainable. The Public Works and Environmental Services Department, as one of the departments responsible for delivering essential front-line services, implements a continuous improvement process whereby existing practices are constantly reviewed for efficiencies, and new opportunities to do work differently are evaluated. The effective and efficient use of taxpayer and ratepayer funds continues to be a top priority for the department as part of its service delivery model, and is a key consideration in all policy decisions that the department makes.

A critical service provided by the Public Works and Environmental Services Department is the collection and treatment of the City's wastewater. Ottawa's wastewater collection system covers 2,796 square kilometres between Stittsville, Orleans and Manotick. The system includes:

- 2,853 km of sanitary sewers;
- 102 km of combined sewers;
- 61 wastewater pumping stations; and
- Approximately 234,000 service connections.

Properties connected to City sewers discharge wastewater through a series of pipes and pumping stations to the Robert O. Pickard Environmental Centre (ROPEC) in the city's east-end for treatment. Originally built in 1962, ROPEC has undergone a number of upgrades and expansions, and is the city's only wastewater treatment facility with an asset value of $1.7 Billion. The treatment process at ROPEC is what is known as a secondary treatment system. After several stages to remove debris, the wastewater goes through two clarifications processes to remove solids, fats, and dissolved contaminates. During the final stages of treatment, chemicals such as iron and chlorine are added to remove phosphorus and kill most bacteria that has survived the treatment process. A final chemical is subsequently added to remove any excess chlorine prior to discharge to the Ottawa River. This robust treatment process ensures that the quality of the effluent meets or exceeds the standards established by the Ontario Ministry of Environment, Conservation and Parks and Environment Canada, and that chemicals from the treatment process do not adversely affect the natural water source.

As demonstrated through the various commitments made under the Ottawa River Action Plan (ORAP), the health of the Ottawa River is a top priority for the City of Ottawa. In line with the ORAP's goal of maintaining a heathy aquatic ecosystem, wastewater is thoroughly treated to ensure it is safe for the public's health and the environment before it is discharged to the Ottawa River. The treatment process at ROPEC is further safeguarded through monitoring, with the assistance of sensors throughout the plant that keep 24/7 staff informed of any issues or irregularities.

On average, the City treats 415-million litres of wastewater every day, which is the equivalent of more than 8,380 backyard swimming pools. Through the sewage treatment process, the removed solids, fats and grease need further treatment. These solids have an energy potential and nutrients are available for reuse. The processing of this material produces approximately 128 tonnes of biosolids daily, which is beneficially used to offset fertilizer use through agricultural land application. The other by-product of the treatment process, which is the subject of this report, is biogas (methane and carbon dioxide).

In 1996, staff identified a savings opportunity whereby the methane produced during the treatment process would be converted into electricity and heat using internal combustion engines that would partially power and heat the Plant through a process called cogeneration (also commonly referred to as Combined Heat and Power, or CHP). This process would not only provide significant savings by reducing the Plant's requirements for electricity, but it would also deliver environmental benefits by utilizing biogases as a fuel source for renewable energy.

The savings identified through the cogeneration project were estimated to be approximately 25 per cent of ROPEC's annual hydro budget (roughly $685K per year), with an anticipated capital investment payback period of five to six years. Details of the cogeneration project were presented to Council on May 21, 1996 in the Robert O. Pickard Environmental Centre Digester Gas Cogeneration Facility report (19-95-0007-V), and Council approved the transfer of $3.8M from the Sewer Capital Reserve Fund to undertake the project (later increased through two separate contract amendments to $4.5M). By moving forward with this project, the City became one of the early adopters of cogeneration technology in Canada.

The cogeneration facility was constructed and operational in 1997. Several years later, staff provided Council with the Robert O. Pickard Environmental Centre – Energy Management Plan report (ACS2007-PWS-UTL-0001) on December 20, 2006 to provide an overview of how the energy management plan at ROPEC was saving the City approximately $1.565M in electrical energy and natural gas costs per year. The report also confirmed that the capital investment payback of $4.5M was achieved by 2002 (five years after construction), and two additional digesters were being added by 2008 –

creating additional processing capacity that could present the opportunity for an additional cogeneration unit in the near future.

Existing Cogeneration System

The current cogeneration system at ROPEC consists of three Caterpillar 16-cylinder reciprocating engines burning digester gas to produce approximately 2.4MW of electricity - enough energy to power approximately 1,500 homes. Due to the original configuration of the electrical system, this electricity can only be utilized throughout 40 per cent of the Plant. Nonetheless, this renewable source of electricity represents annual utilities cost avoidance of approximately $1.4M.

The heat produced by these running engines is also captured through heat exchangers that are connected to the Plant's hot water heating system. Together with the on-site boilers, the heat from the cogeneration engines serve as a renewable heat source for the Plant – resulting in further utility savings. When the volume of available digester gas exceeds the requirements and/or processing capabilities of the cogeneration engines and the thermal requirements of the Plant, the excess gas is combusted in a waste gas burner ("flared"), which currently represents approximately 30 per cent of all digester gas produced at ROPEC. The existing system is instrumental in contributing to the overall cost effectiveness of ROPEC, which has one of the lowest unit costs of any secondary treatment plant in Canada.

The cogeneration units at ROPEC are now at the end of their service life and need to be replaced. The cogeneration units were initially estimated to have a lifespan similar to a backup diesel generator with significant capitalized maintenance (e.g. large engine overhauls and the replacement of many components), meaning full replacement was originally anticipated to be outside the Long-Range Financial Plan (LRFP) V window. Moreover, the scope of the 2013 ROPEC Development Plan that informed the LRFP contemplated like-for-like replacements, and did not consider potential challenges associated with future constructability requirements necessary to maintain the continuous operation of the plant during the upgrades.

If the cogeneration units were to fail, there would be significant environmental and financial implications for the City, including:

- the requirement to waste approximately 7,200,000 m^3 of digester gas annually produced at ROPEC that could alternatively be used as a renewable energy source; and

- the additional hydro cost at the Plant would be approximately $850 daily for each unit out of service.

Given the severity and magnitude of the risks associated with the failure of the cogeneration units, staff recognized the need to examine and evaluate options for the continuation of cogeneration at the Plant. Options for the cogeneration plant were evaluated as part of a business case prepared by staff, with subject-matter expertise and input provided by Envari Energy Solutions (formerly Energy Ottawa; herein referred to as Envari). Envari was selected to provide input as part of this review as the City's preferred partner in the pursuit of initiatives to reduce energy costs, as per the Council directive approved on June 14, 2006 (ACS2006-PGM-POL-0047).

Envari conducted a Preliminary Engineering Study (PES) in April 2015 to investigate options for the expansion of the cogeneration plant to utilize excess biogas. The PES revealed that there is excess biogas in sufficient quantity to justify the addition of a fourth co-generator for ROPEC. Recent estimates indicate that approximately 30 per cent of the digester gas produced at ROPEC is unused. The excess gas can primarily be attributed to the quantity of available digester gas exceeding the processing capabilities of the three existing cogeneration units, as well as the seasonal needs of the boiler plant. The PES concluded that increasing capacity by adding a fourth cogeneration unit, in conjunction with electrical distribution system upgrades, would allow ROPEC to be capable of utilizing all digester gas produced until 2027- 2033 (depending on the model of engine used) and result in additional cost savings by further reducing electricity usage from Hydro Ottawa's grid.

Following the PES, the City retained Stantec Consulting Ltd. in late January 2017 to undertake an Electrical Master Plan (EMP). One of the key desired state objectives of the EMP is to increase the reliability of the electrical system by facilitating the necessary maintenance of the facility's electrical distribution system and limit the effect of unplanned utility outages (e.g., due to large-scale natural disasters). The EMP will identify modifications required to ROPEC's existing electrical and heating systems to

interconnect the new cogeneration plant to provide power and heat to the entire ROPEC campus. These modifications will allow the Plant to operate independently of the hydro grid during a sustained power outage without impacting its ability to treat sewage. The EMP is expected to be complete by Q1 2020.

Preliminary discussions have been held with Envari, and pending Council's approval of this report - they are prepared to construct the new cogeneration plant, including the associated electrical distribution system and heating loop modifications.

DISCUSSION

In 2017, the Ontario Ministry of Energy (now known as the Ministry of Energy, Northern Development and Mines) released the latest Long-Term Energy Plan that outlines the estimated rate at which energy costs will increase in the province of Ontario. The Ministry has predicted that energy costs will increase roughly five per cent annually from 2021 through to 2027. Natural gas is also expected to see price increases in the near future, with the Federal Government estimating that rates will increase by approximately four per cent in response to its *Greenhouse Gas Pollution Pricing Act*, while Enbridge Gas recently received approval from the Ontario Energy Board for a rate increase of approximately 11 per cent. As such, balancing utility demands through investments in strategic infrastructure initiatives will be imperative to ensuring fiscal responsibility by the City.

The advantages of cogeneration, specifically in mitigating financial and environmental risks, are well-documented both nationally and internationally. In fact, the United States Department of Energy, as well as the United States Environmental Protection Agency, have established aggressive targets for the increasing utilization of cogeneration technology as a reliable renewable power source. The establishment of these targets, and the increasing rate of adoption of cogeneration systems by municipalities and utility companies across Ontario, can largely be attributed to the following key benefits of cogeneration:

- Decreased energy costs
- Enhanced energy resiliency

- Serves as a backup system for critical electrical requirements
- Reduced risk from uncertain energy prices

With the existing cogeneration units at ROPEC past the end of their service life and at risk of failure, staff prepared a comprehensive business case that examined five potential options for the utilization of biogas at ROPEC. Alongside each option, the following work would be completed concurrently due to operational requirements:

- The rehabilitation/replacement of the existing electrical system, including the replacement of end-of-life electrical equipment to ensure the reliability of the Plant's electrical distribution system; and,
- The installation of a fourth diesel generator and a new electrical building to support constructability, improve redundancy and ensure the City can provide essential power to critical areas of the Plant during a power outage, as required by the Ministry.

As referenced earlier in this report, the discussions and studies completed by Envari yielded the following five options for utilization of ROPEC's biogas which were carried-forward for detailed analysis and evaluation:

1) Status Quo**:** Continuing to maintain the existing cogeneration units through routine maintenance and ad-hoc repairs as engine components fail. Under this option, upgrades would take place for end-of-life equipment, however - the electrical distribution and heating systems would remain unaltered.

2) Electrical Rehabilitation Only: Under this option, upgrades would take place for end-of-life equipment, however – the City would cease all maintenance activities and allow the cogeneration engines to fail. Upon failure, the digester gas would be used in the boilers and flared (wasted) until an alternative use could be implemented.

3) Three Cogeneration Units: Replacing the three existing cogeneration units with three similar 810 kW units (Option 2a) or upgraded 1,000 kW units (Option 2b), for a total capacity of 2,430 kW and 3,000 kW, respectively. This option would also include modifications to the electrical distribution and heating systems, as well as the

replacement of end-of-life electrical equipment. Based on current biogas production volumes at ROPEC, the volume of gas would continue to exceed the capacity of the cogeneration units.

4) Four Cogeneration Units: Replacing the three existing cogeneration units with 1,000 kW units and adding a fourth 1,000 kW unit, for a total capacity of 4,000 kW. This option would also include modifications to the electrical distribution and heating systems, as well as the replacement of end-of-life electrical equipment. Based on current biogas production volumes at ROPEC, these engines would provide sufficient processing capacity until 2027 – 2033 (depending on the model of engine used).

5) Five Cogeneration Units: Replacing the three existing cogeneration units with 1,000 kW units, and adding two additional 1,000 kW units, for a total capacity of 5,000 kW. This option would also include modifications to the electrical distribution and heating systems, as well as the replacement of end-of-life electrical equipment. Based on current biogas production volumes at ROPEC, at least one engine would remain predominantly idle (i.e., used for redundancy) until 2027 – 2033, after which point its use would gradually increase with the increasing amount of biogas production.

With these options short-listed, staff – in consultation with industry subject-matter experts – established five project objectives to be used in identifying the preferred option. Each option above was evaluated against the five individual objectives to determine if it achieved the objective, partially achieved the objective, or did not achieve the objective. These project objectives were as follows:

- Climate and System Resiliency: Decreases the Plant's vulnerability to substation damage, decreases vulnerability to environmental spills and/or supports Plant operations independent of utility providers.

- Effective and Efficient Use of Digester Gas: Maximizes the utilization of digester gas, improves distribution of electricity and heat produced on-site, and/or decreases utility costs and reliance on utility providers.

- Reduce Greenhouse Gas Emissions: Decreases the need to flare (waste) digester gas, and/or decreases imported utility requirements, specifically – the use of Natural Gas which has higher GHG emissions.

- Electrical Reliability: Supports the on-going, effective operation of the Plant by eliminating single points of failure, simplifies maintenance and emergency repairs, and/or improves the safety of maintenance activities.

- Operational Flexibility: Supports the ability to manage utility costs, maintenance costs and peak energy use, supports potential future alternative digester gas uses (e.g. renewable natural gas), and/or supports the ability to adapt to changes in Provincial Programs.

Based on the findings of the business case, which included an extensive analysis of operating and capital costs and utilities modelling for each option, staff recommend proceeding with the replacement of the existing three cogeneration units, as well as the addition of a fourth cogeneration unit (Option 4). The business case also confirmed that this option was the only option that fully achieves each of the project objectives, including providing operational flexibility for potential future alternative uses for biogas. As stated earlier, alongside this recommended option - aging electrical equipment would be replaced and the electrical distribution and heating looping systems would be modified to distribute co-generator power throughout the Plant and permit operations independent of the utility grid. Additionally, a new cogeneration building would be constructed, as the existing co-generation facility space is no longer suitable and will be used for the installation of other treatment equipment.

Recommended Option

The recommended option, along with upgrades to the electrical and heating systems, presents immediate and tangible financial, operational and environmental benefits to the City through cost avoidance and improved system reliability. The effectiveness of cogeneration technology in delivering utility savings was clearly established when the technology was first introduced, and the proposed option recommends expanding the use of this technology to maximize the available savings by utilizing excess digester gas.

Construction of a new cogeneration plant at ROPEC consisting of four new 1,000 kW cogeneration units will increase the electrical production at ROPEC from 2,430 kW to 4,000 kW. This new processing capacity is also reflective of available digester gas volumes between now and 2027 to 2033, depending on which brand and model of engine staff select. When considering the estimated service life of these assets, Envari estimates that the utility savings would be approximately $79.8M over 25-years in comparison with Status Quo. When considering utility savings and incremental capital costs, the simple payback period for this option would be approximately 14 years. Extensive modelling completed by Envari has confirmed that the recommended option represents the best value of the options evaluated.

Upgrading and reconfiguring the electrical distribution and heating loop systems at ROPEC will not only reduce utility costs by expanding the power distribution to the entire plant, it will also improve the climate and system resiliency of ROPEC's electrical distribution system. Increasing resiliency at the Plant is a critical requirement for ensuring that wastewater treatment is maintained in the event of a sustained power outage or equipment failure. Currently, if the incoming power feed at ROPEC were to be interrupted, the entire plant would be impacted. While the facility does have three on-site diesel generators available to provide essential power to critical areas of the plant (as required by the Ministry of the Environment, Conservation, and Parks), these generators cannot provide sufficient power to operate all treatment processes during a sustained outage. Should a sustained power outage occur, it is estimated that discharge from the plant would degrade after six hours, with all sewage being bypassed after 12 hours. The upgraded and reconfigured electrical system, in conjunction with the new cogeneration units, will ensure that full wastewater treatment continues uninterrupted at ROPEC during a power outage, thereby protecting the Ottawa River from an untreated discharge.

The recommended option will also assist the City in working towards its corporate targets for GHG reduction and use of renewable energy. In 2015, the City included a short-term, community-wide target in its Air Quality and Climate Change Management Plan (AQCCMP) to reduce GHG emissions by 12 per cent below 2012 levels by 2024. In February 2018, a subsequent long-term target was set by Council to further reduce emissions by 80 per cent below 2012 levels by 2050. The addition of a fourth

cogeneration unit, in conjunction with the heat loop modifications, will make use of the excess digester gas that is currently being flared at the facility, further reducing GHG emissions by up to an additional 1,565 tonnes of CO2e per year in comparison with the use of three cogeneration units, or 2,183 tonnes of CO2e per year if the existing cogeneration units were to fail. This incremental reduction (using four units vs. existing three units) is the equivalent of removing approximately 328 vehicles from the roadway. This reduction can be primarily attributed to the operational flexibility of using biogas to offset imported natural gas when the cost of importing electricity is less than the cost of producing it on-site.

This recommended option is also consistent with the City's renewable energy strategy (Energy Evolution) which is designed to manage energy consumption and promote the use of renewable energy. It also serves to address many of the items outlined in Council's Declaration of a Climate Emergency Report (ACS2019-CCS-ENV-0005), specifically:

- Identify new concrete actions and resource implications (staff and financial) to achieve GHG emission reduction targets;
- Identify funding and savings options for the City when implementing emission reductions; and
- Complete a vulnerability assessment and develop a climate resiliency strategy.

Through the reconfiguration of the electrical and heating loop systems, power will now be available to the entire Plant, reducing imported hydro by up to 23 per cent and natural gas by up to 100 per cent.

Other Options Examined and Considered

As part of Phase 1 of Energy Evolution, a Biogas Optimization Study is planned which will identify combinations of technologies that effectively and efficiently optimize benefits of digester gas at ROPEC, and consider corporate financial, environmental and social objectives. In addition to a review of additional feedstocks to increase the production of biogas at ROPEC, the study will evaluate technologies including renewable natural gas generation, power to gas, waste heat recovery, vehicle/fleet fuels, and hydrogen gas

production fuel cells. This study is expected to begin in Q4 2019, with completion estimated for Q4 2020.

One of the options which will considered as part of the biogas study is the use of digester gas to produce renewable natural gas (RNG), which is a low-carbon upgraded form of biogas. Given that the Biogas Optimization Study has not yet been completed and the immediate need to replace the cogeneration engines and address an inability to island the plant, staff opted to remove RNG from the short-list of options to be evaluated as part of the business case. It is worth noting, however, that if RNG (or any other option stemming from this study) is deemed to be the preferred approach for managing biogas in future years, the cogeneration units would still be used to complement that alternate approach by operating during peak hours to offset Global Adjustment charges, which would provide 85 per cent of the savings while using less than 10 per cent of the gas and to provide the climate resiliency and continued operation of the Plant during a significant and/or prolonged power failure. While the simple payback period would be extended beyond 14 years in this case, the financial savings would still support the decision to invest in a new cogeneration plant.

Staff also believe that deferring a decision on RNG is the best course of action considering the cancellation of the Cap-and-Trade Program by the Provincial Government in July 2018, as it has created a state of uncertainty concerning the market and potential support for RNG in Ontario. As a result of this cancellation, while many municipalities are interested and studying the concept of RNG (including Peel, Durham, York, Simcoe, London, Brantford, and Ottawa), the City of Hamilton is the only municipality in Ontario currently operating a biogas facility using wastewater treatment gas.

As part of its analysis, staff also examined the option of a straight replacement of the existing units (i.e., a three-cogeneration unit system), as well as the option of replacing the existing units and adding two additional units (i.e., a five-cogeneration unit system). Staff are not recommending either of these options at this time, as the former option would result in available digester gas continuing to be flared into the environment producing GHG emissions, and the latter option would result in the fifth unit mostly remaining idle until at least 2027 due to insufficient digester gas availability (based on

recent projections). As well, even after 2027, a fifth unit would have limited usage during the early years since biogas volumes produced through wastewater treatment are likely to increase in a gradual and linear fashion. Nonetheless, given that a fifth unit could be required as early as 2027, the cogeneration building will be designed and configured to allow for the efficient and economical addition of a fifth unit, if/when warranted.

For the purpose of completing a comprehensive business case, staff also briefly considered an option of allowing the units to fail and no longer utilizing cogeneration; however, this option was quickly discounted as it had significant environmental and financial impacts to the City and was not in the best interest of residents. The option of abandoning cogeneration technology entirely and only utilizing diesel generators was also considered since it is technically viable; however, as with Option 1, this option was not carried forward based on the apparent and significant GHG implications.

Project Financing and Implementation Plan

To implement the recommended option, staff propose entering into an agreement with Envari to undertake the construction project and modification of the City's existing electrical distribution and heating loop system at ROPEC. Under this arrangement, Envari will act as the general contractor and constructor for this project, and will be responsible for coordinating and overseeing the work of all sub-consultants and/or sub-contractors.

The total project cost and funding is summarized in Table 1 below:

Table 1 - Project Financial Summary

Description	Estimated Cost
Cogeneration Units	$17.9M
Infrastructure / Electrical Rehabilitation	$39.2M
Project Total	**$57.2M**
Funding from Existing Capital Authority	$15.4M

Description	Estimated Cost
Funding from Wastewater Reserve	$41.8M

The project cost includes all capital, management fees, and contingencies. The projected year-end balance of the City's Wastewater Reserve is $71.2M. When considering the estimated annual savings and increasing cost of utilities (~2 per cent annually for inflation), staff anticipates the simple payback for the project to be achieved in 14 years.

Staff engaged an external agency specializing in the identification of grants and funding sources to examine potential opportunities to offset some of the project costs. This review unfortunately confirmed that there were currently no viable grant programs available for this specific project. As an example, while this project may have been eligible for funding under some of the Federation of Canadian Municipalities (FCM) programs, the grant would be contingent on borrowing money through FCM, resulting in interest costs offsetting a large portion of the grant amount. As a result, a decision was made not to proceed with these types of funding arrangements, however, staff will continue to review funding opportunities as they arise and make applications where appropriate.

In consultation with Envari, staff are proposing the following implementation plan, with the goal of bringing the system online by Q4 2024.

Table 2 - Estimated Project Timeline

Task	Completion
Conceptual Design Phase	Q4 2018 – Q3 2019
Value Engineering	May/June 2019
Design Phase	Q1-Q4 2020
Tender & Award	Q4 2020

Task	Completion
Construction	2021-2024
Start-up & Commissioning	2024

RURAL IMPLICATIONS

This is a city-wide report.

CONSULTATION

Staff consulted internal subject-matter experts, where required.

No public consultation was required for this report or its corresponding recommendations.

LEGAL IMPLICATIONS

There are no legal impediments to approving the recommendations in this report.

RISK MANAGEMENT IMPLICATIONS

All risks and associated mitigation measures have been outlined within the body of the report.

ASSET MANAGEMENT IMPLICATIONS

The recommendations of this report, Robert O. Pickard Environmental Centre (ROPEC) Electrical Reliability and Efficient Use of Digester Gas Project, is directly in keeping with the goals of the Comprehensive Asset Management Plan to ensure that we plan, renew and rehabilitate our assets so that they are able to provide for the necessary core services. The existing three cogeneration units that efficiently treat the 415-million litres of wastewater every day are currently at the end of their service life and need replacement and the planned approach for the upgrade will ensure continued service delivery to the City's residents. The additional feature of being able to island the facility in the event of a wide-spread power outage will also improve the climate and system

resiliency of ROPEC's electrical distribution system. Increasing resiliency at ROPEC is a critical requirement for ensuring that wastewater treatment is maintained in the event of a sustained power outage.

FINANCIAL IMPLICATIONS

With the approval of the recommendations of this report the Gas Digester Utilization Project (906648) will be increased by $41.8 million to $57.2 million and the Wastewater Reserve will be reduced by $41.8M to $29.4 million.

ACCESSIBILITY IMPACTS

There are no accessibility impacts associated with this report.

ENVIRONMENTAL IMPLICATIONS

Proceeding with the recommended option will provide several environmental benefits, including: reducing greenhouse gas emissions, reducing the need for utilities (hydro and natural gas), and mitigating the risk of system bypass in the event of a sustained power outage.

TERM OF COUNCIL PRIORITIES

ES1 – Support an environmentally sustainable Ottawa

ES2 – Reduce long-term costs through planned investment and staging of diversion and conservation strategies.

DISPOSITION

Upon Council's approval of the report recommendations, the General Manager of the Public Works and Environmental Services Department, in consultation with the City Solicitor, will negotiate, finalize and execute a contract with Envari.