Clause 5 in Report No. 4 of Committee of the Whole was adopted, without amendment, by the Council of The Regional Municipality of York at its meeting held on March 23, 2017.

5

Purchase of Six Electric Buses

Committee of the Whole recommends adoption of the following recommendations contained in the report dated February 17, 2017 from the Commissioner of Transportation Services:

1. Council authorize the purchase of six, forty-foot electric buses from two Canadian manufactures, New Flyer Industries and Nova Bus. Four buses would be purchased from New Flyer for a cost of $4.8 million and two from Nova Bus for a cost of $2.4 million (excluding HST).

2. The purchase of the six, forty-foot electric buses be conditional upon funding from the Ministry of Transportation in the amount of $750,000 per bus, for a total reimbursement amount to the Region of $4.5 million.

3. The Commissioner of Transportation Services be authorized to execute the associated agreements required to procure the buses in partnership with the Canadian Urban Transit Research and Innovation Consortium.

4. Staff report to Council in September 2018 with an update on the trial program.

Report dated February 17, 2017 from the Commissioner of Transportation Services now follows:

1. Recommendations

It is recommended that:

1. Council authorize the purchase of six, forty-foot electric buses from two Canadian manufactures, New Flyer Industries and Nova Bus. Four buses would be purchased from New Flyer for a cost of $4.8 million and two from Nova Bus for a cost of $2.4 million (excluding HST).

2. The purchase of the six, forty-foot electric buses be conditional upon funding from the Ministry of Transportation in the amount of $750,000 per bus, for a total reimbursement amount to the Region of $4.5 million.

3. The Commissioner of Transportation Services be authorized to execute the associated agreements required to procure the buses in partnership with the Canadian Urban Transit Research and Innovation Consortium.

4. Staff report to Council in September 2018 with an update on the trial program.

2. Purpose

This report is to seek Council authorization to purchase six electric buses without a competitive procurement, to support the Region's goal of having zero greenhouse gas emission by 2051. Section 3.3 of the Purchasing Bylaw provides that Council may authorize any purchase, or method of procurement, where doing so would be in the best interests of the Region.

3. Background

York Region Transit is participating in the Pan-Ontario Electric Bus Demonstration and Integration Trial

In 2017, York Region Transit (YRT/Viva) and other transit agencies, Brampton Transit and TransLink in Vancouver, plan to participate in an electric bus trial.

The purpose of the trial is to test and integrate Canadian-made electric bus systems with globally-standardized overhead charging systems. Charging systems would be provided by two leading engineering and electrical equipment manufacturing companies, Siemens and ABB. The pilot is supported by the Canadian Urban Transit Association (CUTA) and is administered by the Canadian Urban Transit Innovation and Research Consortium.

YRT/Viva has been a member of the Canadian Urban Transit Association since 2002 and in 2016, became a founding member of the Canadian Urban Transit Research and Innovation Consortium (CUTRIC).

The Canadian Urban Transit Association is a member-based organization that supports public transit across Canada. CUTA represents its members and is instrumental on all urban mobility issues, at all levels of government. Through CUTA, transit agencies have a national voice in developing and leading public transit initiatives.

The Canadian Urban Transit Research and Innovation Consortium is the research and development branch of the Canadian Urban Transit Association and was incorporated in August 2014

The Canadian Urban Transit Research and Innovation Consortium's objective is to help drive innovation in transportation across Canada, leading to job growth and economic development. CUTRIC conducts research, development and innovation, including work on electric bus technology and autonomous software.

The Canadian Urban Transit Research and Innovation Consortium has the ability to request funding from the Federal and Provincial governments, on behalf of members. In addition to transit agencies, funding partners of the electric bus trial include the Ministry of Transportation, the National Research Council of Canada, two Canadian bus and electric grid manufacturers, and Newmarket-Tay Power Distribution Ltd (Attachment 1).

The trial and evaluation of electric bus technology is being coordinated by The Canadian Urban Transit Research and Innovation Consortium

Through the demonstration of this trial, staff would better understand and validate electric vehicle and charging technology as a viable alternative fuel source.

Currently, there are two other Canadian transit agencies piloting electric bus and charging station technology; Winnipeg Transit and Société de transport de Montréal. Between these two agencies there are seven electric buses in service; four New Flyer buses and three Nova buses. These two trials are not part of the Canadian Urban Transit Research and Innovation Consortium pilot.

4. Analysis and Implications

Electric bus technology is currently the only propulsion system that does not generate greenhouse gas emissions

In 2016, YRT/Viva completed a comprehensive Alternative Fuel Study. The Alternative Fuel Study identified and analyzed available fuel types and technology applicable to the transit industry.

Other fuel types investigated included diesel fuel, diesel-electric hybrid, compressed natural gas, battery electric technology and hydrogen fuel cell.

Detailed phasing, financial and replacement programs for interim diesel-electric hybrid and electric vehicles have been developed through this study including Council-approved fleet asset lifecycles.

The two-year trial involves testing and evaluating electric buses manufactured by two Canadian bus manufacturers

The trial consists of testing and evaluating electric bus technology from two Canadian bus manufacturers, New Flyer Industries and Nova Bus. Currently, the majority of YRT/Viva's fleet consists of New Flyer and Nova buses, therefore; parts suppliers, warranty management and technical support are well established.

Funding made available through public and private investors would permit YRT/Viva to purchase the electric buses at a cost of $450,000 each, excluding HST; less than a conventional diesel bus at $580,000 each, excluding HST.

Through this controlled trial, YRT/Viva would be measuring benefits and risks associated with electric bus technology.

- Benefits
  - Gain experience in the electrification of heavy-duty transit vehicles
  - Work towards the elimination of noise pollution and idling buses
  - Demonstrate a reduction in operating and maintenance costs associated with the elimination of engine, transmission, exhaust and emission systems
  - Create research opportunities and employment growth potential
  - Create employment opportunities for skilled trade persons and developing new certification training programs for post-secondary institutions
- Risks
  - Electric bus technology requires significant research, data collection and skills training
  - Electric bus charging infrastructure should be standardized to support the electrification of the vehicles
  - At this time, heavy duty electric vehicles are not mass produced and customization is required

The Canadian Urban Transit Research and Innovation Consortium has future trials planned for other emerging technologies

YRT/Viva would have an opportunity to participate in future trials led by the Canadian Urban Transit Research and Innovation Consortium to support their vision associated with making Canada a global leader in zero- and low-emissions transportation and integrated mobility technologies. Some of the future trials include:

- Energy storage systems
- Hydrogen fuel cell electric vehicle
- Autonomous vehicle technology
- Rapid transit route electrification

The electric bus trial supports York Region's goal of zero greenhouse gas emissions across all services by 2051

York Region's corporate greenhouse gas emissions will continue to increase with current service delivery models if further action is not taken to reduce them. YRT/Viva's revenue-service fleet accounts for approximately 40 per cent of the Region's total corporate emissions.

The electric bus trial supports Council-approved strategic plans and documents, including Vision 2051, YRT/Viva 2016 to 2020 Strategic Plan, York Region Official Plan, Transportation Master Plan, and the Energy Conservation and Demand Management Plan (ECDM).

The Council endorsed ECDM Plan commits the Region to reduce its greenhouse gas emissions to 47 per cent below 2014 emission levels by 2051.

Almost half of the reductions committed by the ECDM Plan will come from converting YRT/Viva diesel buses to diesel-electric hybrid technology; then to a full electric transit system, starting in 2033. The path to achieve this corporate goal for Transit is detailed in the YRT/Viva Alternative Fuel Study, and outlined in the 2017 Annual Service Plan.

5. Financial Considerations

Funding for the electric bus trial would be provided by the Federal and Provincial government, York Region, Newmarket-Tay Power Distribution Ltd, Siemens, ABB, New Flyer Industries and Nova Bus. At the end of the trial period, YRT/Viva would retain ownership of the buses

Staff plans to purchase 15 replacement buses in 2017; six of these would be the electric buses for the trial. Funding to purchase and maintain the buses and other components of the trial has been included in the 2017 capital and operating budgets.

Table 1
Electric Bus Trial in York Region – Financial Contributions

Funding Source	Electric Bus	Electric Bus Charging Station
Federal Government	$0	$500,000
Provincial Government	$4,500,000	$250,000
York Region	$2,700,000	$0
Newmarket-Tay Power	$0	$250,000
New Flyer and Nova Bus*	$2,160,000	$0
Siemens and ABB*	$0	$320,000

*In-kind in the form of maintenance, support, and utility training on the system for the duration of the trial, in exchange for trial intellectual property.

Table 2
Estimated Operating, Maintenance and Lifecycle Costs
Electric vs Diesel Powered Bus

Operating and Maintenance Costs	Electric Bus Per Bus	Diesel Bus Per Bus	Total Savings Per Bus
Energy Costs	$35,800	$44,200	
Maintenance	$15,000	$36,715	
Capital Programs	$21,666	$15,555	
Total Costs	$72,466	$96,470	
Lifecycle (18 years)	$1,304,388	$1,736,460	25%

The Region will purchase the buses for $1.2 million each, for a total of $7.2 million. The bus purchase is conditional upon funding from the Ministry of Transportation in the amount of $750,000 per bus. With the funding this would make cost to the Region $450,000 per bus, for a total of $2.7 million (excluding HST). The six electric buses would be Region owned assets, and will remain in the YRT/Viva fleet for their useful life.

6. Local Municipal Impact

Local municipalities will benefit from the reduction of greenhouse gas emissions, vehicle idling and noise pollution. Through this process, York Region is moving towards a reliable, sustainable and emission free transit network that will support local municipal greening strategies.

7. Conclusion

Staff recommends that Council authorize the purchase of six, forty-foot electric buses from two Canadian manufacturers, New Flyer Industries and Nova Bus. Four buses would be purchased from New Flyer for a total cost of $4.8 million, and two from Nova Bus for a total cost of $2.4 million, excluding HST.

The purchase of the six, forty-foot electric buses be conditional upon funding from the Ministry of Transportation in the amount of $750,000 per bus for a total reimbursement amount to the Region of $4.5 million.

Staff will report to Council in September 2018 with an update on the trial program.

For more information on this report, please contact Ann-Marie Carroll, General Manager, York Region Transit at 1-877-464-9675 extension 75677.

The Senior Management Group has reviewed this report.

February 17, 2017

Attachments (1)

7345217

Accessible formats or communication supports are available upon request

Attachment 1

Pan-Ontario Electric Bus demonstration & integration trial (2017- 2020): Standardization of the J3105 Overhead Charging System for On Route, Distributed E-Bus Systems

Introduction Ontario's Climate Action Plan (CAP), Province of Ontario radical reductions in transportation-related GHGs such as CO2 and CO**,** noxious chemicals, diesel pollutants. There are no zero-emission buses in Ontario while some tried hybrid diesel-electric buses as well as compressed natural gas (CNG). Ontario is a perfect place to intergrade long-term strategy to reduce transportation-related GHG emissions. Transit agencies and local distribution companies do not have standardized charging systems, third party trial data, lifecycle of the bus, charger infrastructure, lack of expert personal and real road condition experience. CUTRIC in 2016 has work with transit and utilities to help manufactures to achieve the common goal.

Pan-Ontario Electric Bus Demonstration & Integration Trial

1. Lack of a commercialization-oriented demonstration & integration trials
2. New Flyer nor Nova Bus has had the opportunity to test their standardized bus designs in collaboration with both ABB and Siemens to demonstrate fully compatible charging solutions
3. Standardization and plug and play puts ON on the map

CUTRIC has consortium of public and private corporations integrate Canadian-made electric bus systems with globally standardized overhead charging systems: **1**. Brampton Transit (lead agency), **2.** York Region Transit (with New Market & Tay Power Distribution as a utility partner) **3.** Oakville Transit (with Oakville Hydro as a utility partner) **Bus:** New Flyer Industries (Manitoba) and Nova Bus (Quebec), **Chargers:** ABB and Siemens

Standardization process will allow transit agencies to buy from differing bus manufacturers while secure in the knowledge that their purchased vehicles will be able to plug in and charge up using differing makes and models and on route charging in the near-term and long-term futures. International standardization effort to ensure the development of the J3105 overhead charging standard.

Phase I (2017-2020): CUTRIC Project objectives

1. **Support the development** - internationally standardized overhead charging station hardware and software
2. **Displace** - 27 diesel buses for immediate GHG reductions next 5 to 20 years
3. **Maintain Canada's economic advantage** - Ensure e- bus manufacturing jobs in Manitoba and Quebec and create new e-charger optimization and maintenance jobs in Ontario.
4. **Support research** - integrate energy storage, renewable energy, high powered charging, and electric buses over the next 5 to 20 years to reduce GHGs and eliminate diesel air pollutants from transit.

Phase I (2017-2020): CUTRIC Project outcomes

1. **Improved, internationally standardized** – overhead charging system and on-bus charging receptacle/software.
2. **New knowledge** - development and publication of the charging system standard for overhead charging systems (SAE J3105).
3. **Increased involvement & collaboration** - 5 universities and colleges across Ontario and Quebec.
4. **Increased competitiveness** - vis-à-vis charging system optimization, supporting development of expert teams by creating the testbed for energy storage in future phases of the trial.
5. **Increased awareness and understanding** – technologies.
6. **Increased capability to develop** - new and improved energy systems and technologies that contribute to clean air objectives by developing the entire electric bus eco-system.

December 2016
Josipa Petrunic, PhD
Executive Director & CEO, CUTRIC | CRITUC

7. **Nationally:** manufacturers -> charging system suppliers -> utility capacity -> energy storage companies -> operational and maintenance staff.

Bus OEM investments into the Phase I Trial (2017-2019/2020)

1. **Electric buses** - standardized overhead charging systems at a reduced rate.
2. **Garage-based plug in charging stations** – Phase II or once international standards are published.
3. **Training and skills** - building for transit drivers.
4. **Technical training** - maintenance staff capacity building transit.
5. **Access to data** - from vehicle charging episodes.
6. **Access to data** - from powertrain efficiency monitoring.
7. Intellectual and engineering - transit agencies optimize at-garage charging system design and orientation.
8. **Development of a long-term maintenance support team** - oversee Phase I, II and III of the trial.
9. Commitment to absorb unexpected costs from component part replacement if vehicles fail to meet metrics of performance laid out in the trial agreements.
10. **Intellectual and engineering support** - Phase II & Phase III scaled up electric vehicle charging loads.
11. **Intellectual and engineering support** - Phase II & Phase III scaled up community energy storage integration for electric bus charging.

Investment Ratio (Cash): Phase I EBus Co-Investment Ratio [New Flyer, Nova Bus] ($1.2M/unit):MTO 63% and Transit 37%

Charging station investments into the Phase I Trial

1. **Standardized overhead charging station** hardware and software meeting international standards-in-development.
2. **Localized maintenance and technical** - utilities for duration of the trial.
3. **Training for utilities** - support personnel development and capacity- building among utilities for maintenance and upkeep.
4. **Access to data** - vehicle charging episodes.
5. **Access to data** - charging system failures.
6. **Intellectual and engineering** - utilities develop tools for demand management associated with electric buses.
7. **Intellectual and engineering** - Phase II & Phase III scaled up electric vehicle charging loads.
8. **Intellectual and engineering** - Phase II & Phase III scaled up community energy storage integration for electric bus charging.

Investment Ratio (Cash): Phase I (2017-2019) Overhead Charging Station [ABB, Siemens] ($1M/unit) in York Region- Local Distribution Company (LDC) 13%, NRCan 50%, MTO 37%.

Investment Ratio (Cash): Phase I (2017-2019) Overhead Charging Station [ABB, Siemens] ($1M/unit) in Oakville- Local Distribution Company (LDC) 25%, NRCan 50%, MTO 25%.

Investment Ratio (Cash): Phase I (2017-2019) Overhead Charging Station [ABB, Siemens] ($1M/unit) in Brampton – MTO 50% and NRCan 50%.

Pan-Ontario Electric Bus demonstration & integration trial (2017- 2020): Standardization of the J3105 Overhead Charging System for On Route, Distributed E-Bus Systems

Phase I (2017-2020): Short Term vs. Long-Term Deliverables

Short term	Mid term	Long term
"plug and play"	Optimization analysis of charging episodes	Business case viability of *utilities* as overhead charging station owners – *i.e. partners in long-term transit electrification*
Bus powertrains operate at OEM stated levels	Demonstration of full electricity "fuelling" costs, including commodity, demand charges, infrastructure depreciation	
	Publication of charging data	
	Publication of e-bus powertrain data	

NRC Data Collection, Analysis & Project Management (2016-2019) The National Research Council (NRC) has been selected as the only neutral, third will lead the professional development of data collection, data analytics and project management for the entire stakeholder set. **System integration** - modeling, simulation and optimization of charging station locations and route selection. **Project management** - development and execution of project management plan to ensure delivery of stated objectives. **Performance monitoring and reporting** - data collection, analysis and reporting to guide future phases of transit system electrification.

Phase II (2019-2021) *[Earlier start is possible]*

1. **Doubling E-buses** - (3-system) transit routes in existing (3-LDC) electricity jurisdictions.
2. **Doubling Transit Systems And Utilities** - minimum of 4 e-buses across at least 6 transit-utility jurisdictions in Ontario (e.g. by potentially adding Durham Region Transit/Veridian, Kingston Transit/Kingston Utilities, Thunderbay Transit/Thunderbay Hydro, etc.).
3. Integrating Translink/B.C. Hydro/UBC as a British Columbia satellite trial location using similar trial metrics with B.C. government support. *[May occur as part of Phase I]*
4. Integrating energy storage devices for local electric bus charging, peak shaving, and renewable or otherwise intermittent daytime energy consumption optimization.

Phase III (2021-2023) *[Earlier start is possible]*

1. **Doubling E-buses** - existing (6-system) transit routes in existing (6-LDC) electricity jurisdictions.
2. **Doubling Transit Systems And Utilities** - minimum of 4 e-buses across12 transit-utility systems Ontario.
3. Integrating Winnipeg Transit/Manitoba Hydro/University of Manitoba and STM/Hydro-Quebec as satellite trial locations using similar/same metrics with government support.
4. Integrating several grid-scale energy storage devices for local electric bus charging, peak shaving, and renewable/intermittent daytime energy consumption optimization.
5. Ameliorating "smart enabled" controls for vehicle-to-grid "state of charge" (SOC), vehicle-to-infrastructure "state of health" (SOH), and grid-to-vehicle GHG optimization communications.
6. Integrating automated vehicle controls to enable automated (driverless) e-bus charging episodes on routes.

Pan-Ontario Electric Bus demonstration & integration trial (2017- 2020): Standardization of the J3105 Overhead Charging System for On Route, Distributed E-Bus Systems

Summary Innovation Goals

1. 12 and 20 electric buses on Ontario roads over the next 2.5 years.
2. Integrate multiple transit systems across numerous electrical distribution jurisdictions.
3. Incorporate more than one electric bus manufacturer (i.e. Nova Bus and New Flyer).
4. Integrate vehicles that require on-route charging as well as end-point charging by integrating more than one charging station manufacturer (i.e. Siemens Canada and ABB Group).
5. Support the international standards processes (specifically, the J3105 standard)
6. Monitor, measure and report on e-powertrain efficiencies, overhead charging system efficiencies, energy and electrical costs to transit, and new business models for utilities that may be engaged in owning and operating high-powered overhead charging systems in the future (e.g. 300kW and 450kW charging systems).
7. Establish standard practices - Ontario and create “best practices” for electrification.
8. Predict and analyze the potential usage of Ontario’s Smart-Grid technology vis-à- vis on-route and end-point charging requirements for electric bus systems.

December 2016
Josipa Petrunic, PhD
Executive Director & CEO, CUTRIC | CRITUC