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# YORK REGION TRANSIT
# PILOT PROGRAMS TO REDUCE GREENHOUSE GAS EMISSIONS AND AIR POLLUTANTS

**The Transit Committee recommends the adoption of the recommendations contained in the following report, May 1, 2007, from the Commissioner of Transportation and Works:**

## 1. RECOMMENDATIONS

It is recommended that:

1. Regional Council endorse the use of bio-diesel fuel in the Viva bus fleet commencing in 2008, subject to York Region Transit staff reporting back on the results of ongoing tests on four buses in co-operation with Veolia Transportation and approval of the program as part of the 2008 Business Plan and Budget.

2. Regional Council approve the acquisition of five diesel-electric hybrid buses for testing purposes, subject to the approval of the 2008 Business Plan and Budget.

## 2. PURPOSE

York Region Transit (YRT) staff have conducted a review of alternative fuel programs and other technologies to reduce greenhouse gas exhaust emissions and air pollutants by the YRT bus fleet. As a result of this review, tests of the use of bio-diesel fuel and diesel-electric hybrid technology are recommended, subject to the conditions noted in this report.

## 3. BACKGROUND

Presently, diesel fuel is the fuel of choice of the majority of transit systems in North America, accounting for more than 95% of the transit buses operated. YRT's entire fleet of 352 conventional transit buses uses diesel fuel.

Transit authorities are pursuing alternative technologies that result in the reduction of unburned hydrocarbons, carbon monoxide and particulate matter associated with the use of conventional diesel fuel, or reduce the amount of diesel fuel consumed by their fleets. These initiatives include the use of ultra-low-sulphur diesel fuel (ULSD), compressed natural gas (CNG), bio-diesel fuel and hybrid technologies.

## 4. ANALYSIS AND OPTIONS

Staff have explored alternative fuel programs and other technologies and reviewed reports of trials completed by other transit services to reduce greenhouse gas emissions.

### 4.1 Ultra-Low-Sulphur Diesel Fuel

Ultra-low-sulphur diesel fuel (ULSD) was introduced during the fall of 2006 to reduce diesel tail pipe pollution and achieve cleaner air benefits. The new fuel, combined with new engine technology that is being introduced in 2007, is 97% cleaner than the No. 1 low sulphur diesel (LSD) fuel it replaces. Starting in October 2006, refiners and fuel importers were required to start producing ULSD, which contains 15 parts per million (ppm) sulphur rather than the 500 ppm contained in LSD. The resultant emission improvement using ULSD will be significant and rivals the removal of lead from gasoline a generation ago. Presently, all YRT contractors are using ULSD in the bus fleets assigned to them.

### 4.2 Compressed Natural Gas

Compressed Natural Gas (CNG) has been used in a limited number of transit bus fleets in Canada over the past twenty years. The use of CNG fuel was originally introduced to provide a much cleaner option to diesel fuel as it offered cleaner burning with lower emission levels. Since the original introduction of CNG and the subsequent introduction of ultra-low-sulphur diesel fuel (ULSD), coupled with more stringent emission standards that have necessitated improvements to diesel engine technology, the difference in emissions between CNG and state-of-the-art clean diesel engines has been significantly reduced.

The higher capital and operating costs associated with the operation of CNG are becoming increasingly difficult to justify in view of the introduction of ULSD and recent technological advancements to the diesel engine. Accordingly, many transit systems are either converting their existing CNG-powered engines to state-of-the-art diesel, or are replacing their CNG buses with diesel-powered or diesel-electric hybrid units. Considering these factors, YRT staff do not recommend the acquisition or testing of CNG buses.

### 4.3 Fuel Cell Technology

Fuel cell technology has been tested in transit buses since 1993 in an effort to develop a virtually pollution-free alternative to the internal combustion engines presently used in transit buses. Fuel cells operating with compressed gaseous hydrogen produce electricity without combustion and, unlike internal combustion engines, generate little, if any, noise, vibration, air pollution, or greenhouse gases.

The application of fuel cell technology in transit buses is felt by many to be the best means of reducing greenhouse gas emissions and air pollutants not only in these buses, but in the entire automotive sector. They are, however, still in the pre-commercial phase and are being manufactured in very low volumes with the resultant high cost of

production. Fuel cell manufacturers are concentrating their efforts on reducing fuel cell costs through volume production, system simplification and the use of lower cost components. They are also working on improving fuel cell durability and performance.

The manufacture of sustainable amounts of hydrogen for use in a wide range of automotive fuel cell applications such as transit buses still needs to be achieved. Safe storage of large quantities of hydrogen is also in the developmental stage. As a result, it is estimated that the wide use of fuel cell technology by the transit industry will not occur until the latter half of the next decade and therefore is not an option at this time.

### 4.4 Bio-Diesel Fuel

Bio-diesel is a clean-burning alternative fuel produced from vegetable oils and animal fats. Bio-diesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a bio-diesel blend. It can be used in diesel engines with no major modifications.

The use of bio-diesel in conventional diesel engines results in reductions of unburned hydrocarbons, carbon monoxide and particulate matter compared to emissions from diesel fuel. In addition, the exhaust emissions of sulphur oxides and sulphates (major components of acid rain) from bio-diesel are essentially eliminated compared to diesel. Although some increases in nitrogen oxide (NOX) emissions have been experienced with some types of bio-diesel, these can be mitigated by selecting bio-diesel with a high cetane number. Regardless, research has confirmed that bio-diesel exhaust has a less harmful impact on human health than petroleum diesel fuel. Bio-diesel emissions have decreased levels of polycyclic aromatic hydrocarbons (PAH) and nitrated PAH compounds that have been identified as potentially cancer-causing.

Bio-diesel blends of up to 20% bio fuel and 80% diesel (B20) have been used extensively by transit systems in the warmer latitudes of the United States. However, as a precaution, transit systems located in colder latitudes have used a blend of 5% bio fuel and 95% diesel (B5) in order to minimize possible damage to engines.

The Toronto Transit Commission (TTC) has concluded a test of bio-diesel at one of its garages. During the test, a bio-diesel blend of 5% (B5) was used during the winter months (November to March) and a blend of 20% (B20) during the warmer months (April to October). During this test, the TTC experienced very few fuel-related malfunctions and decided to expand the use of bio-diesel to all of its garages effective June 1, 2006. However, the manufacturers of the diesel engines in the TTC's bus fleet, (Cummins and Detroit Diesel Corp., the identical engine suppliers to the YRT bus fleet) expressed concerns regarding the use of a B20 bio-diesel blend because of the resultant damage to engines its continued use may cause. As a result of this situation, the TTC has discontinued the use of B20 bio-diesel and is now using a B5 blend at all of its garages.

When reviewing the higher costs associated with all alternative fuel systems, YRT Operations staff have come to the conclusion that the use of bio-diesel provides an

alternative that is worthy of exploration. The price difference between ultra-low-sulphur diesel and bio-diesel from the agencies contacted ranged from 0.1 cents per litre to 8 cents per litre.

YRT staff have partnered with Veolia Transportation and are commencing a test on four Viva buses using bio-diesel. As with all YRT service contractors, Veolia is responsible for supplying all the necessary fuel to operate the service. The test phase will involve the use of B5 bio-diesel fuel, before and after emission tests, review of fuel handling techniques, and an examination of maintenance and operational impacts. The use of a higher blend of bio-diesel is not recommended during the test phase due to concerns experienced by other transit systems. YRT will share the cost of this test with Veolia. Staff will report back to Transit Committee and Council with the test results and, if successful, will pursue bio-diesel for the 90-bus Viva fleet as part of the 2008 Business Plan and Budget process.

## 4.5 Diesel-Electric Hybrid Technology

Late in 2004, YRT staff received Council approval for the purchase of 4 diesel-electric hybrid demonstration buses from Overland Custom Coach. These buses were being developed by Overland Custom Coach and Battery Engineering and Test Services Inc., a company involved in developing state-of-the-art batteries that could be applied in hybrid vehicle technology. Regrettably, these companies were unable to obtain senior government funding commitments and the project is no longer being pursued.

The use of hybrid technology is maturing and is being used by some transit systems in Canada and the United States. In Canada, diesel-electric hybrid buses have been introduced in Kelowna by BC Transit, and in Saskatoon and Toronto. In Toronto, the TTC is presently accepting delivery of their initial order of 150 hybrid buses and has recently confirmed an order for an additional 360 units, which are to be delivered commencing in 2007. In the United States, New York City is operating a large fleet of hybrid buses which will grow to 416 units by the end of 2007. Other transit systems in the United States that are operating hybrid buses include Seattle, San Francisco and Philadelphia.

The trend to hybrid buses is being driven by the realization that this technology is an effective means of addressing climate change and local air quality. Diesel-electric hybrid buses use two power sources, a smaller than normal diesel engine and an energy storage unit (battery) to supply power to an electric motor. There are two propulsion systems presently used in hybrid buses. The ‘series’ system, which provides considerable benefits in a continuous stop-start operation with lower scheduled operating speeds, is being used by Toronto and New York City. The ‘parallel’ system, which is more suited to operations having higher scheduled operating speeds such as York Region, has been purchased in the hybrid buses acquired by BC Transit and Saskatoon. Both of these propulsion systems result in reduced fuel consumption, reduced emissions and lower operating costs.

Staff have contacted the aforementioned transit systems to determine their experience with hybrid buses. All are presently evaluating the operation of hybrid technology but because their introduction is relatively new, they are reluctant to share any performance information until they have conducted further analyses and have had an opportunity to report their findings to their respective boards, commissions or councils. Accordingly, staff require more time to investigate the feasibility of conducting a test of hybrid buses in York Region until the experience of other diesel hybrid bus users, and especially those using the 'parallel' propulsion system, becomes available.

Nevertheless, the trend toward the use of hybrid technology in transit operations should not be ignored. To confirm the environmental benefits of this technology in YRT operations, staff are requesting approval to conduct a test of five diesel-electric hybrid buses and include an option for the procurement of hybrid buses in 2008. The YRT contractors would be approached to determine the best option for participating in this review. Staff would also conduct a further review of the experience of other transit systems in Canada using the 'parallel' hybrid propulsion system as this information becomes available.

### 4.6 Relationship to Vision 2026

The implementation of these proposed initiatives will contribute to a reduction in greenhouse gas emissions and other air pollutants, and could lead to more widespread use of these alternatives by YRT to reduce air emissions. This complements the Vision 2026 goal of "Enhanced Environment, Heritage and Culture".

## 5. FINANCIAL IMPLICATIONS

### 5.1 Bio-diesel Test

YRT and Veolia staff have partnered to share the cost of a bio-diesel test phase on four Viva buses. The cost of the test phase is calculated to be approximately $1,000 per month which includes the testing program and added cost for the bio-diesel fuel. The financial implications associated with the introduction of bio-diesel fuel on a long term basis for the entire Viva fleet have not been finalized at this time as discussions with Veolia Transportation and the fuel supplier are ongoing. Provided a justifiable cost can be negotiated, this cost would be the subject of a further report and review as part of the 2008 Business Plan and Budget process.

### 5.2 Hybrid Bus Test

The capital cost of a diesel-electric hybrid bus is approximately $750,000. This unit price is approximately 50% higher than a conventional diesel bus which costs approximately $500,000. It is estimated that the higher capital cost will be fully offset by lower operating and estimated fuel savings during the 18-year life of the bus. The five trial buses and information from other transit systems will help quantify the savings under operating conditions in York Region.

The Province has established a new subsidy program known as the Ontario Bus Replacement Program (OBRP). Under the new program, transit systems are eligible to receive up to one-third subsidy for buses that are needed for replacement purposes. With this subsidy, the Region would be eligible to receive up to $1.25 million in funding from the Province to buy five diesel-electric hybrid buses. There has been no new funding program announced for expansion buses; however, they are eligible to be funded through the existing provincial gas tax program.

## 6. LOCAL MUNICIPAL IMPACT

The use of bio-diesel fuel by one YRT contractor for a one-year period would reduce greenhouse gas emissions and specific air pollutants that affect local air quality in the community while providing the opportunity to assess the merits of expanding its use to other YRT contractors. The introduction of five diesel-electric hybrid buses would also reduce emissions of greenhouse gases and specific air pollutants, and provide the opportunity to assess their effectiveness in the YRT operation.

## 7. CONCLUSION

Staff recommends the introduction of bio-diesel fuel for the Viva fleet in 2008 subject to successful test results and review and approval of the program as part of the 2008 Business Plan and Budget.

Also, it is recommended that five diesel-electric buses be purchased in 2008 subject to the 2008 Business Plan and Budget process.

For more information on this report, contact Rick Takagi, Manager, Operations (Ext. 5624) of the Transit Branch in the Transportation and Works Department.

The Senior Management Group has reviewed this report.