

**CITY OF HAMILTON**

**PUBLIC WORKS DEPARTMENT**  
*Transportation Division*

<b>TO:</b> Chair and Members Public Works Committee	<b>WARD(S) AFFECTED:</b> CITY WIDE
<b>COMMITTEE DATE:</b> January 16, 2013	
<b>SUBJECT/REPORT NO:</b> Transit Fleet - Business Case Analysis for Transit Fuel and 2013 Budget Mitigation (PW12017a) - (City Wide)	
<b>SUBMITTED BY:</b> Gerry Davis, CMA General Manager Public Works Department	<b>PREPARED BY:</b> Don Hull Director of Transportation (905) 546-2424, Extension 1860
<b>SIGNATURE:</b>	

**RECOMMENDATION**

- (a) That Council authorize staff to undertake a Request for Information (RFI) process to determine the viability of replacing the CNG fuelling station at the Mountain Transit Centre (MTC) to support a dual fuel policy, as follows:
- (i) The RFI process shall investigate replacing the CNG station with the City as the owner/operator or having a vendor constructing, owning and maintaining the CNG station under a contract with the City;
  - (ii) Staff be authorized to retain appropriate consulting services to manage the RFI process at an estimated cost not to exceed \$50,000 with funds to be provided from Transit Capital reserve ID #108025; the Director of Transportation be authorized to retain suitable consulting services to manage the RFI process through single source procurement Policy #11;
- (b) That staff report back to Council on the results of the RFI process prior to any future conventional transit fleet purchase;
- (c) That the following 2013 budget mitigation initiatives be approved and referred to the 2013 budget deliberations:
- (i) Cancel year three (2013) of the five year contribution of \$450,000 to the 110030 Transit Fleet Replacement Reserve;
  - (ii) Cancel the planned 2013 conventional transit (HSR) capital fleet purchase in the amount of \$9.1 million.

**EXECUTIVE SUMMARY**

A power point presentation will accompany this report.

The purpose of this report is twofold:

- To fulfil a staff commitment to report back to Council with a Business Case Analysis (BC) for Transit fleet purchase for 2013 and beyond, and;
- To present options for mitigation of the 2013 operating budget.

In the course of Council's consideration of the 2012 Transit budget, more specifically relating to mitigation opportunities, there was considerable discussion around the continually escalating cost of diesel fuel which was recognized as a major cost driver within the Transit budget.

For the past decade or more, it has been the City's policy to transition the Transit fleet mix from buses powered by compressed natural gas (CNG) to buses powered by diesel fuel as buses were retired and replaced with new buses. The reasons for this past practice are summarized as follows:

- The "all in" cost of CNG buses has been higher than the cost of diesel buses;
- CNG engines were more complex and costly to maintain;
- The CNG fuelling station is beyond its' expected life and maintenance costs have been rapidly escalating as many replacement parts were no longer available for the one-of-a-kind compressors, requiring parts to be individually manufactured and an increasing risk of catastrophic failure;
- Hamilton was the only municipality in Canada with a CNG transit fleet;
- Diesel engine reliability was higher compared to the first generation CNG engines.

However, in recent years, these conditions have been changing and staff has undertaken a detailed Business Case Analysis (BCA) of the optimum method of propulsion for the Transit fleet in the future including Diesel, CNG, Electric, and Hybrid buses prior to a staff recommendation for the annual fleet replacement purchase in 2013 and beyond. This investigation has included the implications of:

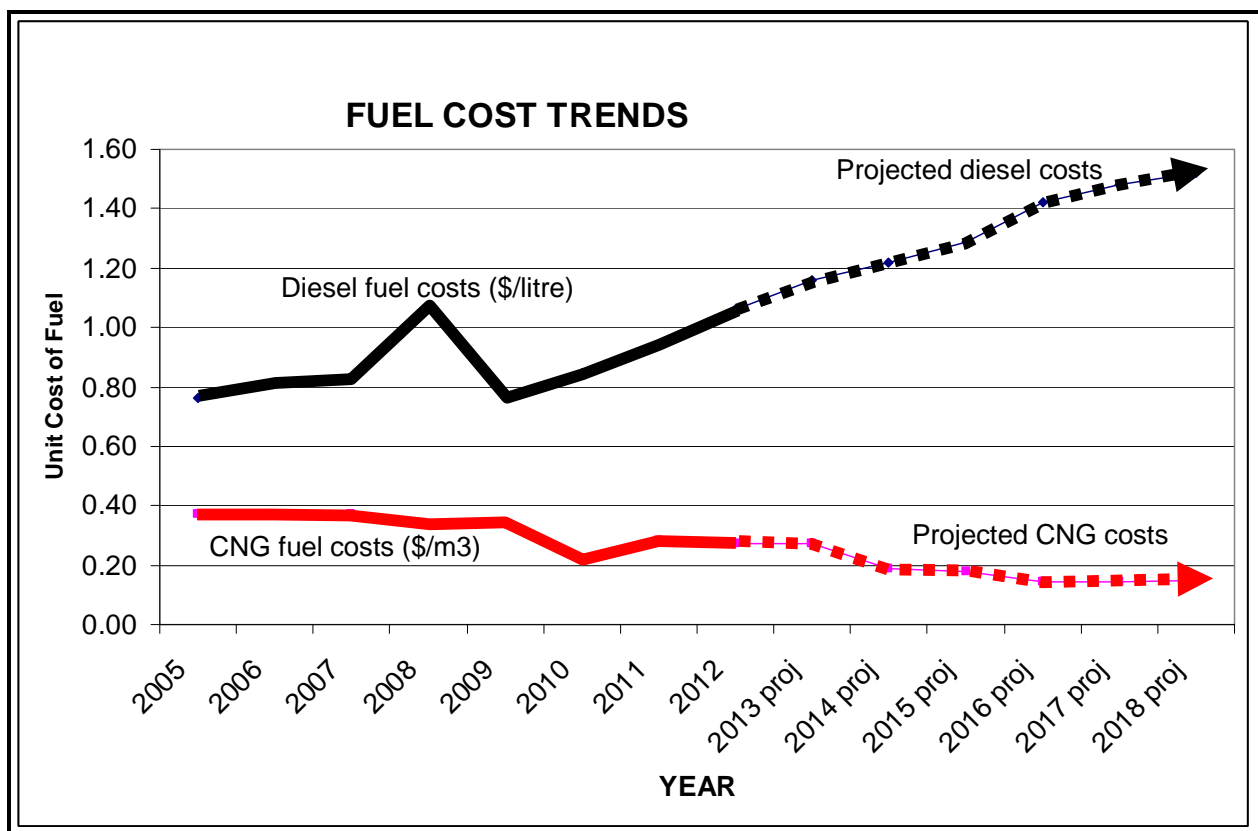
- A reversal in the "all-inclusive" cost of fuel that currently favours CNG due to the decoupling of Diesel and CNG prices;
- CNG engines are now less complex than Diesel as after treatment of engine emissions is not required;
- A one-time Capital investment, funded from existing Provincial Gas Tax Capital reserves for dedicated Transit capital projects, to replace the CNG fuelling station will mitigate operating budget pressures, specifically the cost of fuel and fleet maintenance;
- Another large Canadian municipality has made a commitment to construct a CNG fuelling station and to purchase CNG buses by 2014;

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- There has been significant recent growth in the number of CNG buses in operation by USA transit systems which has further supported improvements in CNG engine technology;
- New technology such as mini-hybrid engines (conversion of hydraulic systems to electric) can be applied to CNG buses to further mitigate fuel costs;

The graph below illustrates the de-coupling of CNG and Diesel fuel prices. Since 2009, the cost of diesel fuel has increased from about \$0.75 per litre in 2009 to a cost of \$1.06 per litre in 2012 and the Marathon Technical Services 2012 study of fuel costs predicts that diesel fuel prices will steadily increase for the foreseeable future, as shown in the graph. By comparison, the cost of CNG has been generally declining over the same period and is expected to further decline to about 2017 and then to inflate after that time, although at a lower rate of increase than diesel fuel.

These cost trends reflect the changing availability of fuel supplies in North America. With new extraction methods, large supplies of natural gas have become available within North America whereas the availability of diesel fuel is heavily dependant on off-shore oil supplies.



An overview of the historical CNG and Diesel bus fuel and maintenance costs over the 2005 to 2011 period at HSR is provided in the following graph. While the fuel costs of about \$0.20/km for CNG buses is lower than the fuel costs of about \$0.57/km for diesel buses, the historical maintenance costs of about \$0.67/km for older generation CNG

buses is higher than the maintenance costs of about \$0.30 for diesel buses. Overall, during this period the combined operating costs (fuel and maintenance) for diesel buses have been slightly less than for CNG buses. However, this cost comparison is expected to change significantly in future due to:

- The fuel cost trends noted above will shift the cost advantage towards CNG buses;
- Changes to CNG engine technology to utilize the same components as diesel engines and as well as increased after combustion treatment on diesel engines will reduce the difference in maintenance costs between CNG and diesel buses.

In accordance with Council's direction in staff report PW12017 to undertake a Business Case Analysis respecting Transit fuel policy, Marathon Technical Services consulting firm was engaged to conduct a detailed life cycle cost investigation of CNG, diesel and diesel hybrid bus technologies over the next 20 years. The final report was made available on July 3, 2012. An Executive Summary is provided as Appendix "A" to this report and the essential conclusions are as follows:

- It is recommended that the City of Hamilton change to CNG buses for the Transit fleet, as existing buses are retired. CNG provides a return of \$41 Million net present value (NPV) over a 20 year period with a payback of 7 years, as compared to the current diesel bus plan. All CNG scenarios provided a positive NPV and payback;
- In the CNG approach, it is possible to contract for long term delivery of natural gas thereby locking in savings and reducing overall project risk;
- The 12-year life for all buses tends to be a conservative assumption since a longer life would favour both CNG and Hybrid—since both have higher bus costs than clean diesel;
- It is estimated that this project will create a savings of 86 Kilo-tons of CO<sub>2</sub> over the 20 years--projecting a "green" image for Hamilton;
- The CNG project is economically and technically feasible and it has positive environmental and social impacts.

A new CNG fuelling station will be required in the short term to support the recommended conversion to CNG buses, at an estimated capital cost of \$5.7 Million. This cost was included in the Marathon life cycle cost investigation.

In addition to the cost and environmental advantages of CNG buses as compared to diesel buses, there are several other considerations that favour CNG as a transit fuel in the future:

- Natural gas is available in large quantities in North America whereas diesel fuel supplies are heavily dependant on off-shore suppliers. This would indicate that the pricing and supply of natural gas should be more reliable in the future;
- Hamilton Transit maintenance staff has considerable experience in working with CNG engines and the requirements of supporting an expanded CNG fleet are well understood;

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- The increasing utilization of CNG buses by USA transit systems will support the ongoing development of CNG bus technology into the future.

In summary, the business case for purchasing CNG buses in future is trending strong. It will require the replacement of the current CNG fuelling station at an estimated cost of \$5.7 Million by year 2014. The recommended RFI process will enable the different options to achieving this requirement to be fully investigated.

To pursue the recommended strategy supporting a future commitment to CNG buses, no new buses will be added to the HSR fleet in 2013 and the consumption of diesel fuel will increase in 2013 as 37 CNG buses have been retired from service and replaced with diesel buses during 2012. However, if Council adopts a policy of replacing buses with CNG buses, the addition of new buses in 2014 will result in reduced diesel fuel consumption. A preliminary estimate indicates that the costs of fuel in 2014 will be mitigated by about \$800,000, on an on-going basis, if new replacement buses are fuelled by CNG rather than diesel.

The 2013 budget outlook for fuel for the HSR fleet is provided in the Table below, based on no new services in 2013, no new buses being added to the fleet in 2013 and an expected increase in the price of diesel fuel from \$1.06 per litre to \$1.16 per litre. It should be noted that in 2013 the kilometres operated by CNG buses will be reduced with an expected savings in maintenance costs.

	<b>2013 Budget (Proposed)</b>	<b>2012 Estimated Actual</b>	<b>% Change in 2013</b>
Revenue Kms Operated	14,823,109	14,274,053	3.8%
Diesel fuel (litres)	8,745,000	7,924,000	10.4%
CNG fuel (m <sup>3</sup> )	1,170,000	1,785,000	-34.5%
Diesel fuel cost (\$)	\$10,145,000	\$8,400,000	20.8%
CNG fuel cost (\$)	\$310,000	\$473,000	-34.5%
Total fuel cost (\$)	\$10,455,000	\$8,873,000	17.8%

**FINANCIAL / STAFFING / LEGAL IMPLICATIONS**

**Financial:**

In 2011, Council approved a staff recommendation to contribute \$450,000 per year, each year for 5 years to help replace \$3M in Provincial Gas Tax funding of capital earmarked for bus replacement and reallocated to operating to fund Council's 2011 Transit Service Enhancement plan in the amount of \$3M. Approval of the staff recommendation will result in the cancellation of the planned 2013 contribution without impacting the sustainability of the transit fleet replacement reserve.

Cancellation of the 2013 HSR fleet replacement capital submission will result in a one-time Capital cost avoidance of \$9,138,000.

**Staffing:** N/A

**Legal:** N/A

## **HISTORICAL BACKGROUND**

Canadian transit service providers were early adoption leaders in regards to natural gas fueled transit buses. The world's first natural gas transit buses were developed in 1985 and involved the conversion of seven diesel buses to compressed natural gas (CNG) operation. Hamilton took the initiative to develop the technology with support from the federal and provincial governments, engine manufacturer Cummins, natural gas distribution company, Union Gas and ORTECH, a provincial government research organization. Municipal transit operations in Toronto, London, Mississauga, Burlington, Cornwall, and Kitchener-Waterloo soon followed Hamilton's lead and purchased first generation CNG buses and fuelling infrastructure. There were a number of challenges for the early adopters in terms of vehicle performance, securing support for technical issues, lack of funding to upgrade from early generation engine technologies, station issues, and withdrawal of support from the gas distribution industry following deregulation. Nonetheless, it is well understood that the early CNG adopters for transit fleet played an important role. Without their support, natural gas transit buses would likely not have advanced so quickly to the point where today natural gas is in use in more than a quarter of a million transit buses across North America with fourth generation engine technology that was the first to comply with 2010 emissions standards. Hamilton is currently the only remaining municipality in Canada operating CNG buses although many transit systems in USA currently use natural gas fuel.

The City commissioned construction of natural gas fuelling stations at the Mountain Transit Centre and Wentworth Street in 1990. Transit continued to purchase CNG buses until 2003. In 2004 the decision was made to purchase diesel buses as early generation CNG buses were found to be costly to repair and maintain and all in costing showed CNG buses were more expensive to run than diesel buses. Also the present CNG compressor station was considered too old and fragile (escalating annual maintenance costs) to support CNG fleet expansion. The HSR is the only full time user of CNG propulsion in Canada at this time. Coast Mountain Transit in British Columbia has a small fleet of CNG buses that see limited use.

HSR's fleet of 221 (Fall 2012) buses currently operates mainly on diesel fuel with 35 buses being powered by natural gas. In 2013, almost 9 million litres of diesel fuel will be consumed. With the introduction of federal regulations mandating emission after treatment components on diesel engines, diesel buses are experiencing lower reliability rates and higher maintenance costs than in pre-2007 model years. These after treatments include; Diesel Particulate Filters (DPF) for reduction of particulate matter, Diesel Oxidation Catalyst (DOC) mainly for the reduction of Carbon Monoxide, Selective Catalytic Reduction (SCR), in conjunction with Diesel Exhaust Fluid (DEF) which is injected into the exhaust system to reduce nitrogen oxide(NO<sub>x</sub>) output. The use of DEF adds approximately \$.03/litre to the cost of fuel for the buses that require it (41 HSR

buses at this time require DEF). There are no after treatments required for CNG engines other than the Catalytic Converter.

Diesel fuel cost represents the most volatile of high expenses within HSR's operating budget. Negotiating supply contracts has helped improve the predictability of this major expense; however, the City has limited ability to negotiate a long term favourable price. Natural gas has demonstrated better stability and is projected to continue that trend in the future.

The increasing gap between natural gas and diesel price now makes operating CNG buses economically attractive.

Concerns with the operating reliability of current generation diesel engines particularly due to extra emission treatment equipment required to meet federal regulations, increased North American reserves of low-cost natural gas and opportunities for reducing corporate greenhouse gas emissions are key considerations to consider when determining future transit bus procurements. While Clean Diesel is newer technology than CNG, the buses that will enter into Transit revenue service in 2012 are not expected to experience early developmental problems as these have been substantially resolved so that these newer technologies should match CNG in bus reliability.

Historically, previous generation CNG buses were not as reliable as diesel buses. However, with the introduction of ultra-low sulphur fuels, Diesel Particulate Filters, and other related emission control systems on 2007/2010 EPA-compliant engines, diesel buses are becoming less reliable than before. At the same time, the fourth generation CNG engines have shown substantial improvements in reliability. The engine manufacturer, Cummins Westport, reports that their current generation of natural gas engines, the ISL-G, is considerably below the current emission regulations in all categories, and substantially cleaner than even 2003 models.

The fuel economy of diesel buses has been relatively stable in recent years. Alternatively, industry reports of 10-20 per cent better fuel mileage, depending on duty cycle, with the ISL G Cummins engine compared to older generation CNG engine models, puts diesel and CNG engines' fuel economy at more comparable levels than before.

There have also been a number of improvements made in the currently available CNG engine technology, e.g., 80% parts commonality with its diesel equivalent, as well as the previously mentioned increase in fuel mileage compared to earlier CNG engines Transit is currently using. Ongoing maintenance of CNG engines is now equal to, or possibly less than that of an EPA 2010 diesel engine. Exhaust treatments on CNG engines are substantially less complicated than that of an EPA 2010 diesel engine.

CNG technology is becoming more widely accepted and approximately 25% of all bus orders in the United States are for CNG.

According to GHGenius, natural gas transit buses offer an 18% reduction in lifecycle carbon emissions compared with 2010-compliant diesel buses. The 18% carbon benefit equals a 19 tonne reduction for a transit bus that is driven 72,000 kilometers per year.

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It should be noted that in November 2011, the City of Calgary approved a report to proceed with the upgrading of one of their facilities to allow for CNG fuel dispensing, and the procurement of up to 200 CNG powered vehicles to be incorporated into their 1033 sized bus fleet.

**POLICY IMPLICATIONS**

N/A - for the feasibility studies.

**RELEVANT CONSULTATION**

Finance & Corporate Services (Finance and Purchasing)  
Public Works (Corporate Assets & Strategic Planning)

**ANALYSIS / RATIONALE FOR RECOMMENDATION**

Any decision to use CNG as the primary fuel for the Transit fleet going forward must identify all aspects and requirements of the Facility, compressor station, and bus specification(s). It is not anticipated that the garage facility will require major upgrading to meet any regulatory requirements for an entire fleet of CNG buses in an indoor, heated, parking/service area. The HSR has always, and continues to fuel CNG buses outside of the main building in a well ventilated Quonset hut style fuelling station.

The current CNG compressor station as a whole is over 20 years old and would require complete replacement. The increased annual maintenance cost to keep the station operational, the rarity of parts available to repair the station when a major failure occurs, and the lack of redundant capacity in the event of a compressor failure also contribute to the need to have the station replaced. In their report, Marathon Technical Services recommend "Given the long term commitment to CNG that the City is contemplating, Marathon has determined that: "the current station would be unreliable and very difficult to maintain over a 20 year period of heavy usage". Marathon is therefore recommending that if the City proceeds with a CNG bus program, that the CNG station be replaced with all new equipment." The cost estimated to replace the existing station in its entirety, with redundancy, is \$5.7M.

Staff is recommending that an RFI be issued to determine if there is an interest within the industry to have a Vendor become the owner, maintainer, and supplier of the fuel delivered to the City as opposed the current format whereby the City owns, operates, and incurs the maintenance costs related to the CNG fuelling station. Responses to the RFI would be analyzed in conjunction with both the Energy and Finance Departments to determine which course of action would be most beneficial to the City.

The procurement of CNG powered buses is being brought before the Metrolinx TPI (Transit Procurement Initiative) committee for consideration as part of their RFP to be issued for 2014 - 2016 consortium bus purchase. The past benefits of being part of the Metrolinx consortium have included; cost mitigation of hundreds of thousands of dollars



in bus procurements, extended warranties mitigating operational costs, reduction in staff resources to prepare, issue, evaluate, and award contracts.

In the event that Metrolinx does not feel that the inclusion of CNG propulsion systems in their next RFP would balance the additional staff time to include CNG vs. the number of Municipalities having an interest in procuring them, and a decision has been made to transition to CNG, HSR staff could issue their own RFP for the procurement of buses. It is expected that either of these procurement avenues would provide a contract for the delivery of CNG buses in 2014. The current Metrolinx contract expires in 2013 and there are no provisions to procure CNG buses within it.

### **ALTERNATIVES FOR CONSIDERATION**

Staff could be directed to continue purchasing diesel buses, and phase out all current CNG buses as new fleet are purchased. This would standardize the HSR fleet with diesel propulsion which is currently the Canadian industry norm.

If this direction were given, the 2013 \$1.5M increase in diesel fuel costs attributable to replacing 41 CNG buses with 41 Diesel buses would be repeated in 2015 as the last 35 CNG buses were phased out for a total increase over the 2012 budget of over \$2 Million.

### **CORPORATE STRATEGIC PLAN**

Focus Areas: 1. Skilled, Innovative and Respectful Organization, 2. Financial Sustainability, 3. Intergovernmental Relationships, 4. Growing Our Economy, 5. Social Development, 6. Environmental Stewardship, 7. Healthy Community

#### ***Financial Sustainability***

- ◆ Financially Sustainable City by 2020
- ◆ Effective and sustainable Growth Management
- ◆ Delivery of municipal services and management capital assets/liabilities in a sustainable, innovative and cost effective manner
- ◆ Address infrastructure deficiencies and unfunded liabilities
- ◆ Maintain effective relationships with other public agencies

#### ***Environmental Stewardship***

- ◆ Natural resources are protected and enhanced
- ◆ Reduced impact of City activities on the environment
- ◆ Aspiring to the highest environmental standards

### **APPENDICES / SCHEDULES**

Appendix A: Marathon Technical Services Report Executive Summary

## Executive Summary:

City of Hamilton, Public Works, Fleet & Facilities Division (FFD, HSR, or the City) contracted with Marathon Technical Services (Marathon or MTS), to study the financial viability of rebuilding the CNG station and replacing and expanding the fleet of CNG buses or purchasing a fleet of Diesel/Electric Hybrid buses at their Hamilton Street Railway (HSR) Mount Hope garage. Marathon did not address any enhancement to the existing Wentworth CNG station.

The Mount Hope CNG fueling facility was constructed in the 1990s in several phases by Union Gas. The CNG station currently fuels approximately 72 CNG buses out of a total fleet of 217 CNG plus diesel buses. HSR had been on a path to eliminate the CNG fleet as buses were retired, however, with the very low cost of natural gas for the foreseeable future, HSR is considering reviving the CNG bus procurement program and replacing or upgrading their existing CNG station.

Marathon's primary role in this analysis was to work with City staff to generate the pertinent performance and cost data required, to perform the analysis and interpret the results. City staff indicated that no further upgrades to the bus garage would be required as it is already operating with CNG buses—this savings helped to make the CNG option much more economical.

The CNG and Hybrid project costs were assembled including bus, station and capital costs, as well as new or differential operating costs such as CNG station maintenance and power cost. Given the age and condition of the current CNG station, it was assumed that a new CNG station would be required to meet the increased demand of a fleet of up to 217 CNG buses over a 20 year period.

A conservative mix of costs was used for analysis over a 20 year life cycle, but based on bus replacement at 12 year increments. The Net Present Value (NPV) and payback were used as evaluation metrics. The baseline (most likely), optimistic, moderately pessimistic and pessimistic scenarios were evaluated, and a sensitivity analysis of major risk variables was conducted for both the CNG and Hybrid options.

The baseline CNG scenario had an NPV of **\$41M** and all scenarios returned positive NPVs. Although still positive NPV, the pessimistic CNG scenario is considered very unlikely as it combines high inflation and status quo diesel costs.

The baseline Hybrid scenario had an NPV of **-\$18M** and all scenarios except the Optimistic scenario returned negative NPVs.

It is recommended that the City of Hamilton proceed with a project to replace approximately 18 buses per year with new CNG buses until the fleet is all CNG with a total size of approximately 217 buses and replace the CNG station. The first buses would arrive in 2013.