



TAC 2018 Environmental Achievement Award Submission

Compressed Natural Gas Snow Plows

Canada's first Alternative Fueled Snow Plows



Author:

Melissa Abercrombie, P.Eng.
Manager of Engineering Services
Oxford County

Nominee:

County of Oxford

Protecting and Enhancing the Environment

On June 24, 2015, County Council unanimously passed a motion to commit to 100% renewable energy by 2050. Oxford County was the first municipal government in Ontario to commit to a 100% renewable energy target at the time, and only the second in Canada after Vancouver, British Columbia.

Oxford's renewable energy commitment stems from the [Future Oxford Community Sustainability Plan](#) (2015), which includes specific targets and actions to reduce greenhouse gas emissions (GHG), promote green construction, and promote low-carbon transportation options. Efficiency and conservation measures are considered the first steps towards realizing a 100% renewable energy target.

With exhaust emissions from trucks, buses, and automobiles being major contributors to GHG, exploring what the County could do to lessen its impact was, and remains, a priority. Exhaust emissions are major contributors to health issues, including triggering lung diseases such as asthma, emphysema, and chronic bronchitis in vulnerable members of society.

Municipal fleet operators, in general, are increasingly aware of their fleet's impact on the environment. It is estimated that Ontario's municipal fleets, including transit, contribute approximately 43% of Canada's estimated 1.74 MT of municipal fleet emissions.

At Oxford County, we have chosen to take a leadership role in dealing with these concerns. Not only out of a sense of environmental responsibility, but also for financial considerations: fuel is the fleet's second largest operating expense for the County after salaries and wages.

To assist the County in understanding its current fleet and the potential opportunities, in 2015, Oxford County, in conjunction with Fleet Challenge, developed a "Green Fleet Plan." The Green Fleet Plan outlines opportunities to reduce engine and GHG with strategies based on technology and implementing or refreshing best practices.

The County's Green Fleet Plan focused on two overarching goals:

1. The optimizing of efficiency in its various areas (i.e., mode of travel, fuel, route planning, fleet operation, fleet/vehicle size, etc.); and,
2. Increasing the use of alternative fuels and sustainable technologies.

One of the areas highlighted in the Green Fleet Plan is alternative fuels. With both a dedicated electric vehicle and a co-fuel gasoline/electric vehicle already a part of the fleet, the decision was to shift towards compressed natural gas (CNG) as a fuel source for several factors. First, CNG vehicles offers environmental benefits over gasoline or diesel. The U.S. Department of Energy–Alternative Fuels Data Center states that when used as vehicle fuel, natural gas offers both life cycle GHG as well as tailpipe emissions

benefits. With the primary concern for emissions including hydrocarbons, nitrogen oxides, carbon monoxide and carbon dioxide, the exhaust emissions of a CNG vehicle are approximately 15% lower in GHG compared to gasoline fuel. In addition to the lower emissions, a private business was already in the final stages of constructing a CNG fueling station immediately south of Highway 401, only 10 kilometers from a County's works yard.

Once it was determined the County would explore integrating CNG vehicles into the fleet, analysis was then completed to determine what vehicles types should be considered for conversion to dual fuel CNG or dedicated CNG vehicles. It was determined that two vehicle types should be explored simultaneously for the greatest impact on fleet emissions:

- The County's snow plows, as the highest GHG emitter of the County's fleet; and
- Light duty pick-up trucks, which make up a majority of the County's fleet.

Degree of Innovation

Today's snow plows are outfitted with numerous technologies that allow the operators to control all aspects of the vehicle at their fingertips. However, historically, snow plows have been diesel fueled vehicles with no advancement in the non-diesel fuel market. In 2017, Oxford County announced the first successful implementation of alternative fueled snow plow vehicles in Canada. To accomplish this success, the County assembled a team that consisted of vehicle manufacturers, snow plow manufacturers, Engineers, Operators and maintenance staff. This multi-discipline team worked together to review each component of the snow plow to determine what changes would be needed to create a CNG snow plow.

The largest component to overcome was the mounting of the plowing equipment to the typical CNG truck chassis. Dedicated CNG vehicles place the fuel tanks directly behind the cab; however, this is the usual location for installation of plowing controls and connections. The solution resulted in the chassis being extended an additional 0.75m, and the CNG fuel tanks being mounted 0.75m behind the cab, to maintain the plowing controls and connections location directly behind the cab.

Through meticulous review of power requirements, equipment placement, load distribution, and vehicle sizing, a detailed specification was prepared. While the 0.75m displacement of the fuel tank on the surface appears simple, the additional length of the chassis, fuel lines and how the plowing equipment could be serviced in the area between the truck cab and fuel tanks caused numerous changes to the truck specification compared to a non-CNG truck. It was also important to ensure the CNG plows had a similar 550 kilometer range under optimal conditions. This range maintained by a CNG tank is equivalent to a 227 litre diesel tank.

Through procurement by tender, it was determined that Freightliner trucks with a Cummins engine would meet the minimum specifications. While this is a constraint in the current CNG market, it is one that is anticipated to be resolved as additional manufactures enter the alternative fuel markets.

Financial Implications

Being on the cutting edge of alternative fueled municipal snow removal in Canada, there was some uncertainty as to whether or not the reduced fuel consumption and environmental benefit would be cost effective. Table 1 illustrates the incremental capital cost per CNG snow plow.

Table 1: Incremental CNG Snow Plow Cost

Incremental Capital Cost	\$52,120
Green Commercial Vehicle Program*	\$20,848
Net Capital Cost	\$31,272

*Green Commercial Vehicle Program is an incentive based program by the Ontario Ministry of Transportation that provides up to \$30,000 rebate

The County was able to use they newly implemented incentive based program by the Government of Ontario, that provides up to a \$30,000 rebate for large dedicated CNG vehicles. The increased capital cost of each snow plow unit is off set by the reduced fueling cost.

For fuel comparison analysis, the same plow route and driver were used for both the diesel vehicle and the natural gas vehicle. Table 2 illustrates a cost comparison between diesel and CNG fuels for one of the County’s snow plow routes.

Table 2: Fuel Cost Comparison

	Diesel	Compressed Natural Gas
Annual Consumption	10,500 L	8,255 kg
Cost of Fuel	\$1.16/L	\$0.92/kg
Annual Fuel Cost	\$12,171	\$7,594
Additional Fueling Cost		\$626
Total Fuel Cost	\$12,171	\$8,842
Net Annual Savings		\$3,329

In our situation, fuel cost savings experienced with CNG are somewhat reduced due to the fueling station being located 10 km from the nearest County works yard. At this time there is only one CNG fueling station located within the County and two others to the north in a neighbouring County. The proximity of fueling stations and lack thereof will restrict the immediate expansion of the County's CNG snow plow fleet. However, this initiative has set the ground work for alternative fuel options for municipal fleets, and as other municipalities follow, the increase in demand will support and promote advancement of the CNG fueling sector.

Using a simple payback analysis, the payback period is projected to be 9.4 years for a CNG snow plow for which the County has a 10-year replacement life cycle. At the time of writing of this submission, the plow trucks has been in operation for 4 months, so this calculation has been made conservatively. Thus the increased capital cost per CNG snow plow due to the government incentive program is both a financially sound and environmentally responsible investment.

Ongoing analysis of the two snow plow units' performance and operating costs will be done to see if the CNG snow plows remain financially viable. The County's goal is to continue increasing the alternative fuel percentage of our fleet. By the end of 2018, the County is projecting to have 22% of the fleet utilizing alternative fuels.

It is anticipated that as there is greater demand for CNG fueled snow plows in Canada, the cost of procurement and outfitting of the vehicles will be reduced, thereby improving the payback period.

Overall Applicability to Transportation

With implementation of the first CNG snow plow vehicle in Canada, Oxford County is paving the way to expand alternative fueled vehicles beyond passenger vehicles applications. Canada's road networks play a vital road in connecting communities, industry, resources and tourism every day, and it is the responsibility of every municipality to ensure that they are well maintained especially during the winter season.

From the middle of November until early April, Oxford County relies on its snow plows up to 19 hours a day, 7 days a week for winter road maintenance. Reliability cannot be compromised when looking at alternative fueled vehicles. By working in close cooperation with its partners and driven by its sustainability commitments, Oxford County was able to deliver a fleet solution that balances its environmental, financial, and community priorities.

As Oxford County looks forward, there are still a number of challenges in greening the County's fleet. However, we are just at the initial stages, and are envisioning a cleaner, greener fleet future. The implementation of CNG snow plows is just one piece of the solution for municipalities, provincial agencies, federal agencies and private contractors to reduce GHG emissions while maintaining roadways across Canada. Together we can make a greener future for all Canadians.

Media clippings

[Oxford County news release: Oxford County's green fleet grows \(Oct 26, 2017\)](#)

[Municipal World: Plowing ahead with a green fleet in Oxford County \(Jan 2018\)](#)

[Heart FM: Oxford County is Leading the Way When it Comes to Going Green \(Oct 26, 2017\)](#)

[Woodstock Sentinel Review: County becomes home of first hybrid ambulances and natural gas snowplows \(Oct 27, 2017\)](#)

[NGV Global News: Oxford County Introduces CNG Snow Ploughs to Fleet \(Dec 10, 2017\)](#)

[Truck News: Oxford County adds CNG snow plows \(Dec 13, 2017\)](#)

[County greens its fleet \(Mar 9, 2017\)](#)

[NGT News: Oxford County in Ontario Shifts to CNG, Electric Fleet Options \(Mar 13, 2017\)](#)

Multi-media

[Future Oxford: Mobility story map](#)

[Video: Future Oxford Community Sustainability Plan \(2:37 min\)](#)

Photos

