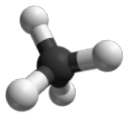
Business Case for Compressed Natural Gas in Chesapeake Virginia Municipal Fleet



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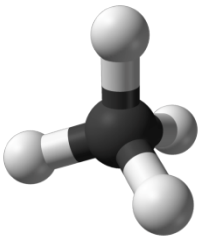

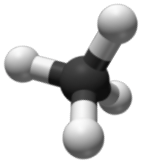

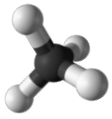

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Acknowledgements

This report builds on the NREL technical report titled "Business Case for Compressed Natural Gas in Municipal Fleets by C. Johnson, NREL/TP-7A2-47919. A full copy of that document is available at www.afdc.energy.gov/afdc/pdfs/47919.pdf. Funding for this supplemental report came from the EPA National Clean Diesel Campaign and the Clean Cities activity within the U.S. Department of Energy Vehicle Technologies Program.

Introduction

Chesapeake Virginia has a fleet of 54 vehicles and is considering converting them to use Compressed Natural Gas (CNG) and adding refueling infrastructure. This report discusses an economic assessment that was done of this potential project. In order to do an economic analysis of the implications of switching from diesel to natural gas, specific variables for the locality were considered such as purchasing schedule specific fleet costs, and vehicle miles traveled. This document establishes a feasibility scenario for CNG usage in the municipal fleet in Chesapeake by calculating the lifecycle cash flow of investing in the vehicles and infrastructure and paying it back through savings in fuel expenditures.

The profitability of CNG vehicle projects depends on several specific characteristics of the fleet and station. To assist fleets and businesses in evaluating the profitability of potential CNG projects, the National Renewable Energy Laboratory (NREL) built the CNG Vehicle and Infrastructure Cash-Flow Evaluation (VICE) model, which represents and evaluates these variables. The VICE model demonstrates the relationship between project profitability and fleet operating parameters. This report describes how NREL used the VICE model to provide guidance to assist with the decision to use CNG in the Chesapeake, Virginia municipal fleet.

This business case can be helpful for other municipal governments in Virginia and throughout the U.S. that operate fleets suited well for CNG vehicles. These fleets usually are transit buses, school buses, refuse trucks, and other vehicles that drive circular routes that enable refueling at the same station. CNG projects can benefit municipal governments and improve their residents' quality of life. These projects allow the government to utilize all the advantages of CNG, including long-term cost-effectiveness, more-consistent operational costs, increased energy security, reduced greenhouse gas emissions, reduced local air pollution, and reduced noise pollution.

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Project Parameters

This analysis uses multiple input variables and discounted cash flow analyses in the VICE model to simulate the actual financial circumstances faced by the Chesapeake fleet. The VICE model had to be used in an innovative way to account for the fleet's staggered purchasing schedule. Chesapeake has proposed a purchase schedule for six vehicles per year for a period of nine years. Furthermore, the station was built incrementally to accommodate the increasing CNG needs of the fleet.

The Chesapeake run of the VICE model assumed the parameters listed in Table 1 below. Of particular interest is the expected discount rate or rate of return (ROR). The ROR is the minimum expected return on investment. For this report, 6% is the targeted ROR or discount rate for Chesapeake. This is the baseline, and any value or profits are above and beyond this.

Parameter	Value
Number of Vehicles	54 Total Vehicles
Rate of Return discount rate	6% Required
Tax Incentive Value	80% Based on Current $32K Credit
CNG Maintenance Cost Comparison	$0.52 for CNG compared to Diesel
Excise Tax Credit	$0.55 / Diesel Gallon Equivalent (DGE)
Diesel Maintenance cost	$0.52 for Diesel Compared with CNG
Diesel Tax Exempt ion Value	$0.0089
CNG Station Salvage at End of Project	20%
Additional Garage Costs	Insignificant Change
Hossler Cost Per New Hire	$0 – No Additional Needed
Average. Vehicle Miles Traveled	15,000 Miles Per Vehicle
Fuel Efficiency Diesel	2.38 mpg
Vehicle Incremental Cost	$15,000 each (not including incentives)
Average Vehicle Life	9 years per vehicle
Hosslers or Attendants Needed	No additional

Table 1. Project Parameters

CNG Station Costs

As mentioned above, the Chesapeake project is unique in that it has a staggered schedule of vehicle purchases and station construction. Universal Air Products Corporation estimated the costs of station construction, maintenance, and operation. Their full estimate is in Appendix A and summary in Table 2. The $30,000 station tax credit was assumed to be applied to the initial year's investment of $511K and unavailable in subsequent year investments. The service contract (maintenance and operation) and miscellaneous parts expenditures were assumed to continue past the last year of the Universal quote. The station was assumed to last until the last set of purchased vehicles expired in 2028. At this point, the salvage value of the station will be $159,300 (20% of the total station expenditures).

Year	Vehicle Purchases	Diesel Price (before tax deduct.)	NG Price	Vehicles Operating	Fuel Savings	Station Expenditures (with installation)	Service Contract	Miscellaneous Parts ($50K)
2011	6	$3.501	$1.505	6	$77,669	$511,000	$3,750	$2,500
2012	6	$3.708	$1.556	12	$166,778	-	$3,750	$2,500
2013	6	$3.916	$1.606	18	$267,326	$69,000	$5,000	$2,500
2014	6	$4.124	$1.657	24	$379,313	$95,000	$7,900	$2,500
2015	6	$4.332	$1.708	30	$502,739	$13,000	$7,900	$2,500
2016	6	$4.540	$1.759	36	$637,604	$71,000	$6,000	$2,500
2017	6	$4.748	$1.809	42	$783,909		$13,500	$2,500
2018	6	$4.956	$1.860	48	$941,653	$95,000	$13,500	$2,500
2019	6	$5.164	$1.911	54	$1,110,836		$13,500	$2,500
2020	0	$5.372	$1.961	48	$1,033,166		$13,500	$2,500
2021	0	$5.580	$2.012	42	$944,058		$13,500	$2,500
2022	0	$5.787	$2.063	36	$843,510		$13,500	$2,500
2023	0	$5.995	$2.113	30	$731,523		$13,500	$2,500
2024	0	$6.203	$2.164	24	$608,097		$13,500	$2,500
2025	0	$6.411	$2.215	18	$473,232		$13,500	$2,500
2026	0	$6.619	$2.266	12	$326,927		$13,500	$2,500
2027	0	$6.827	$2.316	6	$169,183		$13,500	$2,500
2028	0	$7.035	$2.367	0	$-	$(159,300)	$ -	$ -

Table 2. Fuel costs and station expenditures by year (pre-discounted).
Green costs are beyond the realm of the quoted expenditures

Fuel Price and Rate of Increase

The VICE model's diesel fuel price reflects a review of Energy Information Administration's (EIA) ten year period from 2000 through 2010 extrapolated by the authors out to 2030. The natural gas price reveals the same trends, but is converted from cubic feet to diesel gallon equivalents (DGEs) using the EIA conversion factor of 1,028 Btu per cubic foot. This extrapolation represents historically based estimate of fuel costs over the long term as shown in Figure 1 below. Nationwide fuel prices were used instead of specific Chesapeake prices because the nationwide averages have lower volatility and therefore are a more sound basis for extrapolations.

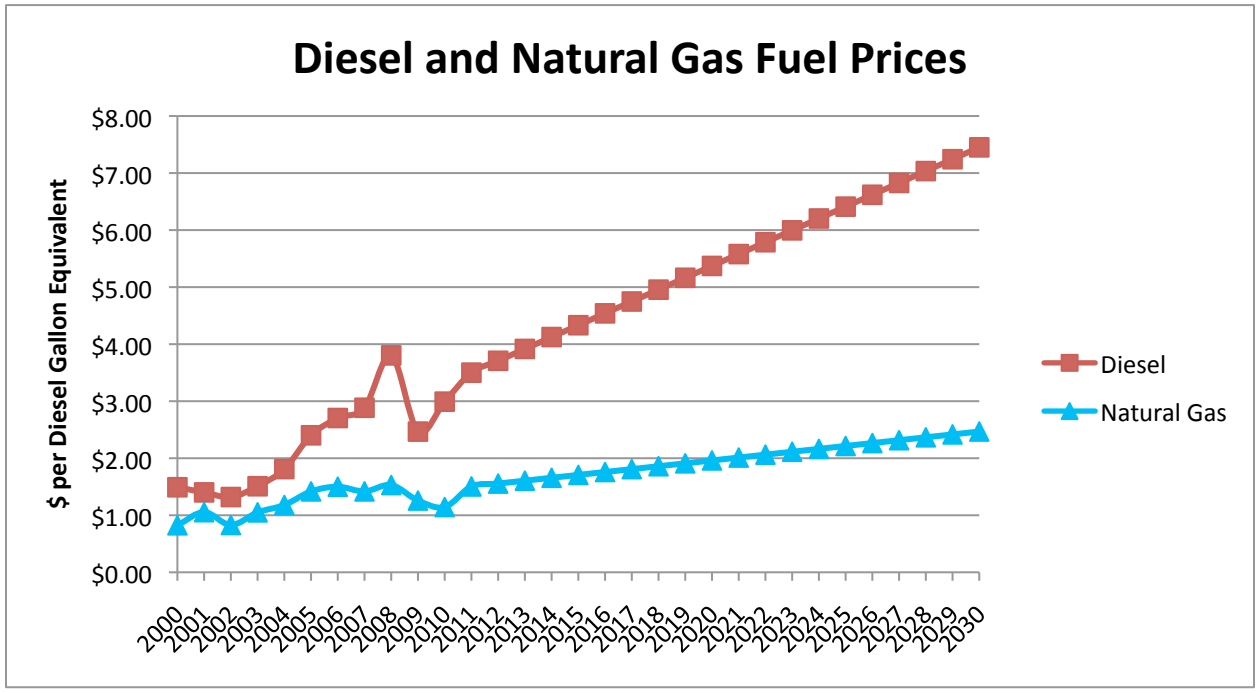

Figure 1. EIA Fuel Price Data (2000-2010) and Author's Extrapolations

Taxes and Incentives

The Chesapeake fleet is tax exempt, so excise taxes were removed from the retail fuel prices before modeling. The federal government provides incentives for CNG use through tax credits. These credits are intended to reduce the overall cost of installing the CNG refueling station, and to purchase CNG. The incentives have been crafted so tax-exempt entities such as municipal governments can benefit by passing the credits to suppliers.

Refueling Station

The Alternative Fuel Infrastructure Tax Credit is available to reimburse 30% of the cost of installing a CNG station, up to $30,000. Tax-exempt entities are allowed to pass this credit onto the company that is building the station. The VICE model assumes that the builder reduces the

purchase price by an amount equal to this tax credit. As a result of the tax credit partially expiring on December 31, 2010, this represents a change from Johnson 2010.

Garage Cost

The facility upgrade costs associated with upgrading a fleet from diesel to CNG are considered zero. This is in agreement with the fact that the incremental cost of making a new garage and maintenance facility compatible with CNG is minimal (Marathon 2006). This is confirmed with conversations and considerations from the locality.

Project Life and Salvage Value

The project life, or investment period, is from the first vehicle purchase until the end of the last vehicle's useful life. The station is assumed to be in use throughout the entire project period (18 years) and then salvaged at the end of that period. The salvage value of the station is assumed to be 20% regardless of how many years it has been in service. This number is static throughout time because the value is more a function of demand for components than it is the age of the components.

The difference between diesel and CNG salvage values of all three vehicle types is considered zero (Linder 2009 and Lemmons 2009). This means that at the end of the vehicle's life, a CNG vehicle is worth no more than a diesel vehicle.

Financial Calculations

Investments are assessed by looking at their discounted cash flow. The cash flow is the annual sum of money going into a project or money being saved by a project. The “discount rate” places greater value on current money than future money under the assumption that you would be able to invest and increase your current money but not if you don’t receive it until some point in the future. The two main indicators of financial viability are as follows:

1. Net Present Value (NPV). This is the total present value of a CNG project, including the cost of CNG equipment purchased now along with future costs and cost savings from fuel and operations throughout the lifetime of the project. These costs and cost savings are called "cash flow," with costs being a negative cash flow and savings being a positive cash flow. If the NPV of the project is positive or zero at the desired discount rate, the project makes financial sense.

   The estimated NPV for the Chesapeake Project is $4.7 million

2. Discounted Payback Period. This lets an investor know when the investment has broken even and is starting to turn profits. At this point, an investment no longer carries the risk of losing money. When assessing the payback period, the investor uses the same discount rate as used when looking at the NPV.

   The estimated payback period for the Chesapeake Project is 4.1 years. Most municipal governments consider this to be a good payback period due to their limited investment opportunities.

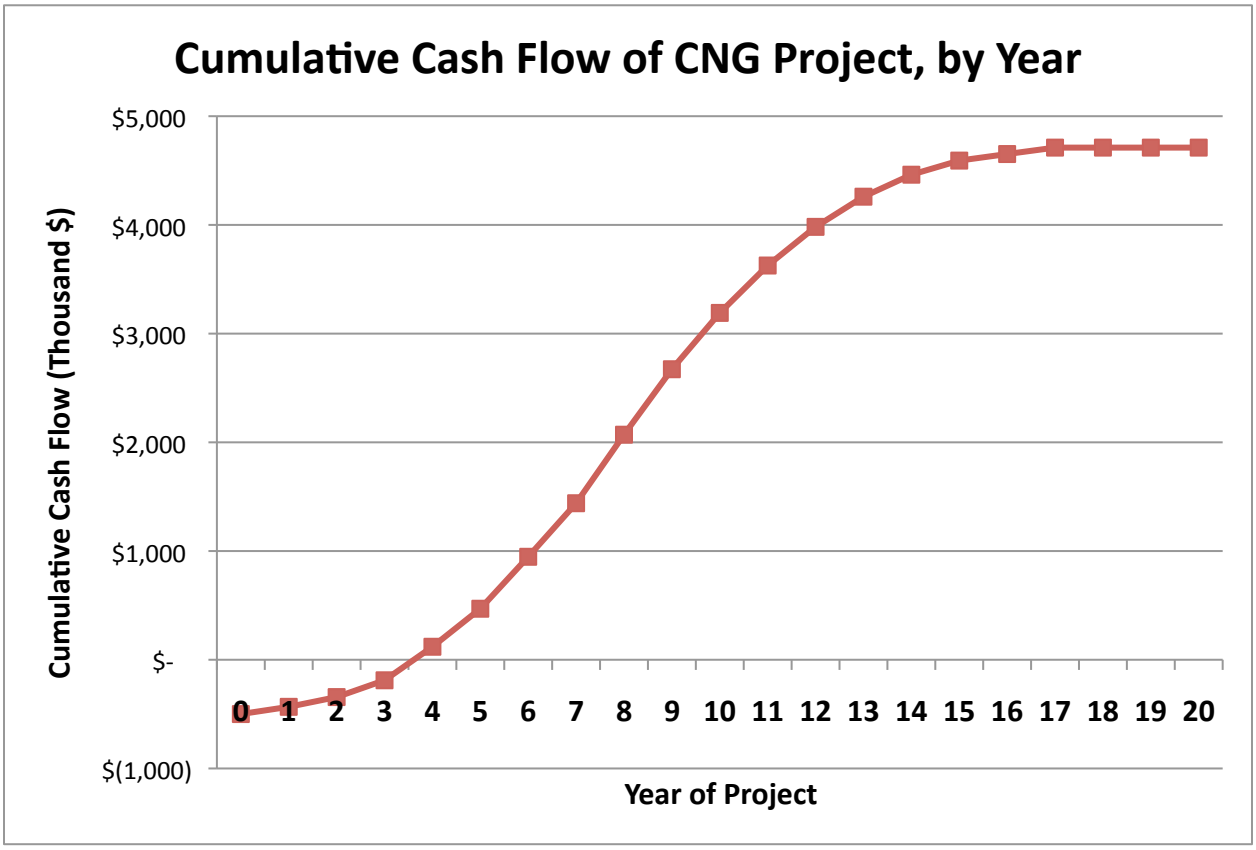

Figure 2. Cumulative cash flow of Chesapeake's CNG project.

Conclusions

As with all fleet projects, predicting whether a project is financially sound is challenging but critically important. Decisions made on equipment purchases, capital upgrades, and fuel contracts have long-term impacts on the operational success of the fleet. NREL has modeled the impact of these decisions and other fleet parameters with its VICE model and analyzed fleet projects.

With the Chesapeake fleet, this final NPV was $4.7 million when the discount rate was set to 6%. The payback period for this project was 4.1 years. Most municipal governments consider this to be a good payback period. This decision makes financial sense even before one places a value on the other advantages of a CNG project such as more consistent fuel expenditures and emissions reductions.

References

Johnson, Caley. (2010). National Renewable Energy Laboratory Technical Report: Business Case for Compressed Natural Gas in Municipal Feets. NREL/TP-7A2-47919. June 2010. http://www.afdc.energy.gov/afdc/pdfs/47919.pdf Accessed March 2011.

Hrichak, George; Fleet Manager, City of Chesapeake. Personal communication. March 2011.

Lemmons, J. Director, Equipment & Performance. Waste Management. Personal communication. August 2009.

Linder, P. Director of Transportation Services. Kern County Superintendent of Schools. Personal communication. July 2009.

Marathon Technical Services. (2006). Designing New Transit Bus Garages to be Fuel Flexible. White paper. www.afdc.energy.gov/afdc/pdfs/bus_garage_design.pdf.

Glossary and Acronyms

Compressed natural gas (CNG)—A gas, consisting primarily of methane, that is compressed to allow more energy to fit into a smaller fuel tank.

Diesel-gallon equivalents (DGE)—The amount of energy that is in 1 gallon of diesel fuel. This is larger than a GGE.

Federal Transit Administration (FTA)—An agency within the United States Department of Transportation (DOT) that provides financial and technical assistance to local public transit systems.

Gasoline-gallon equivalents (GGE)—The amount of energy that is in 1 gallon of gasoline. CNG is typically measured in this unit.

Hostler—A person who refuels, cleans, and performs regular maintenance for a fleet of buses or trucks at the end of the day.

Net present value (NPV)— The difference between the present value of cash inflows and the present value of cash outflows. All present-value cash flows have been discounted so that recent flows are worth more than future flows.

National Renewable Energy Laboratory (NREL)—One of the U.S. Department of Energy's 16 national laboratories, NREL is the primary laboratory for renewable energy and energy efficiency research and development.

Rate of return (ROR)—The gain or loss on an investment over a specified period expressed as a percentage increase over the initial investment cost (investopedia.com).

Vehicle-miles traveled (VMT)—The number of miles traveled by 1 vehicle in 1 year.

Vehicle and Infrastructure Cash-Flow Evaluation (VICE) model—An NREL-built model that assesses the profitability of investing in alternative fuel infrastructure under for various fleets. NREL plans to expand the VICE model to assess more fuels than CNG.