

Conversion to a Greener Fleet

A Cost-Benefit Analysis of a Conversion to Compressed Natural Gas for a Municipal Bus Fleet

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Received: October 5, 2014 Accepted: December 12, 2014 Online Published: December 25, 2014

Abstract: Concerns about global warming and energy security, associated with rising oil derivative fuel prices, are spurring interest in exploring alternative sources of energy supply to road transportation means, especially motor vehicles that constitute a major source of air pollution in the world. Natural gas is an important source of energy that is lately being considered as an alternative to fossil fuel and other oil derivatives as a fuel to states' fleets and pacts. In addition to being a domestically abundant and a secured source of energy, it helps reducing pollution and maintaining a clean and healthy environment. In its attempt to find an economically viable solution to overcome the problem of the rising costs of fuel, CityBus Corporation of Lafayette/ West Lafayette, IN considers improving the energy efficiency of its vehicle fleet whose operation and greenhouse gas emissions are part of the factors affecting local air quality. Thus, the following cost-benefit study compares the total costs of two potential options for municipal bus replacement: standard diesel fueled buses and Compressed Natural Gas (CNG) fueled buses.

Since the results shows that the implementation of the CNG alternative has a lower Net Present Value (NPV) cost, moreover, it would potentially reduce greenhouse gases and particulate emissions in comparison to the standard diesel option; the study concludes that the CNG alternative is more viable from both the economic and the environmental perspectives. Thus, the study recommends the conversion of the states' bus fleet to the use of CNG as a source of fuel to municipal bus fleets.

Key Words: Compressed Natural Gas, Pollution, Environmental Sustainability

Introduction

Concerns about the global climate change and energy security, associated with rising oil prices, are spurring considerations on alternative sources of energy supply to road transportation means, especially motor vehicles that constitute a major source of air pollution in the world. The degradation of the quality of air and environmental resources, coupled with fears about the depletion of the non-renewable resources, jeopardizes the future of coming generations and the sustainability of the environmental resources. Moreover, the excessive use of oil derivatives as a source of energy raises concerns about the economic dependency of the industrial countries, which do not produce oil, on oil producing and exporting economies and increases their vulnerability to oil price shocks and to the political instability in oil producing countries. Thus, the continuous search for sustainable and more environmentally friendly sources of energy is recently preoccupying policymakers.

Natural gas is an important source of energy that is lately being considered as an alternative to fossil fuel and other oil derivatives as a fuel to states' fleets and pacts. In addition to being a domestically abundant and a secured source of energy, it helps reducing pollution and maintaining a clean and healthy environment. Classified as the cleanest of all the fossil fuels by the Environmental Protection Agency (Natural Gas Issues and Trends:1998, 1999), the main products of the combustion of natural gas are carbon dioxide and water vapor if compared to other fuel source. Coal and oil are composed of much more complex molecules, and oil release higher carbon ratio and higher nitrogen and sulfur contents, so when combusted, coal and oil release higher level of harmful emissions. In addition to higher ratio of carbon emissions, nitrogen oxides NO_x , and sulfur dioxide SO_2 emissions, coal and fuel oil release major pollutant substances that do not burn like ash particles. Meanwhile, the combustion of natural gas releases lower level of reactive hydrocarbons like carbon dioxide CO_2 , carbon monoxide CO_1 , very small amounts of both NO_x and SO_2 , and no ash or particulate matter. (Natural Gas Issues and Trends:1998, 1999).

The levels of greenhouse gases have been increasing due to the widespread burning of fossil fuels by growing human population. The transportation sector is the greatest contributor to air pollution in the United States. According to the Department of Energy (DOE), about half of the all air pollution and greenhouse gases and more than 80 percent of air pollution in cities are produced by cars, trucks, and buses in the United States.

Carbon dioxide is one of the principle greenhouse gases. It makes up a high proportion of the United States greenhouse emissions. The reduction of greenhouse gas emissions in general and carbon dioxide emissions in particular, plays an important role in combating the negative environmental effects of the global warming. As the combustion of natural gas emits almost 30 percent less carbon dioxide than oil, and 45 percent less than coal, natural gas can be used in the transportation sector to cut down on the high levels of pollution generated by gasoline and diesel fueled cars, trucks, and buses. According to the U.S. Environmental Protection Agency (EPA), carbon monoxide emissions of vehicles operating Compressed Natural Gas (CNG) are 90 to 97 percent less than traditional gasoline and diesel fueled vehicles, carbon dioxide emissions are 25 percent less. Other non-methane hydrocarbon emissions can be reduced by as much as 50 to 75 percent using CNG-fueled vehicles, and NO_x emissions can be reduced by 35 to 60 percent.

Domestic natural gas production has increase remarkably in the United States during the recent years. The extraction of many natural gas unconventional sources like coal-bed methane and shale gas has positively impacted the total domestic production (Yang, Tyner, & Sarica, 2013). The Energy Information Administration (EIA) 2013 Annual Energy Outlook (Annual Energy Outlook 2013 with projections to 2040, 2013) reported that natural gas production in the United States was States was 21.6 trillion cubic feet in 2010 and is expected to increase significantly until 2035. The increased production of natural gas in the United States lowered the prices making the U.S. exports of natural gas more attractive. In 2011, the U.S. net imports of natural gas were almost 2 trillion cubic feet as the United States consumed more natural gas than it produced. However, the expected increase of U.S. natural gas production by about 1 percent per year from 2011 to 2040 will enable meeting the domestic demand while also allow for more exports (Yang, Tyner, & Sarica, 2013). Hence, compressed natural gas has the potential to become a less expensive energy source than diesel fuel for use in public transportation

sector, especially the city bus fleets. However, the conversion of public fleet and buses to CNG fueled vehicles incurs enormous additional capital costs of constructing natural gas fueling stations. Unless such additional capital costs are fully compensated by savings of fuel costs over vehicle lifetimes, public fleet companies will not take the initiative to switch to CNG fueled vehicles.

Faced by the rising costs of fuel and the increasing concern over emissions caused by fleet operations, CityBus Corporation of Lafayette/ West Lafayette, IN considers improving the energy efficiency of its vehicle fleet whose operation and greenhouse gas emissions are part of the factors affecting local air quality. CityBus is the operating name of the Greater Lafayette Public Transportation Corporation (GLPTC). GLPTC is a nonprofit corporation serving the adjacent cities of Lafayette and West Lafayette in Indiana State. However, the main goal of CityBus Corporation is to reduce the total cost of maintaining its fleet and expects to find a long-term solution to maintain the current level of services. One of the biggest parts of the total cost is fuel cost. Most of the transit buses in the United States use diesel for fuel. As CNG fueled vehicles are being explored as means of decreasing fuel costs, CityBus Corporation considers the replacement of its retired vehicles of its fleets with more environmentally friendly vehicles, thus using the cleanest technology that could result in significant monetary savings.

This study compares the total costs of two potential options for municipal bus replacement: standard diesel fueled buses and CNG fueled buses. In the next section, relevant literature is reviewed to inspect how the option of converting to CNG fueled vehicles is approached from different perspectives. The following section shows how the total costs of both of the two options are estimated over a 15-year project's lifespan. A detailed explanation of how all of the capital, fuel, and environmental costs of the two options are estimated is provided in this particular section. The results suggest that the CNG option has a lower Net Present Value (NPV) cost, and that cost savings would be larger if the corporation could obtain a grant to cover the costs, or even part of the cost of constructing new CNG fueling stations. Then the study concludes that, from both economic and environmental perspectives, the CNG option would generate remarkable fuel costs savings and would reduce greenhouse gases and particulate emissions in comparison to the standard diesel option and. Then, a sensitivity analysis is conducted to the breakeven value of the annual growth rate of CNG fuel price that would make total costs of both options equal.

Literature Review

Throughout the economic literature, the interest in gasoline alternatives was mainly approached via addressing concerns about greenhouse gas emissions and the generated adverse impacts that would impede the applications of sustainability measures.

The degradation in the air quality that is attributed to the motor vehicles gas emission in Dhaka, the capital of Bangladesh, urged for some governmental initiatives that were addressed to alleviate the air pollution (Wadud & Khan, 2011). Wadud and Khan conducted a study that quantified the ex-post social benefits of a government policy which resulted in a widespread conversion of petroleum based vehicles to CNG vehicles. To determine the effects of the policy intervention, a model that links the change in gas emissions due to the implementation of the policy to the changes in the quality of ambient air and the number of avoided premature deaths was developed via multiple steps. In the first step they quantified the gas emission that was determined through a vehicle emissions inventory model for the

current policy case. The changes in the modeled emissions were then fed into an air quality model that was developed to determine the changes in the quality of the ambient air. In the final step, the resulted improvements in air quality were coupled with population distribution and functions of health impacts. The cost savings that are associated with these specific health impacts were used to evaluate the willingness to pay to avoid an adverse health cases and to determine the avoided costs due to the policy intervention. Wadud and Khan strongly recommended the policy intervention, the study concluded that the conversion policy resulted in around 6,000 avoided premature deaths in 2009, in an amount of saving of US\$ 1.15 billion that makes around 1.3% of the country's GDP, and in around US\$ 0.6 million benefits of pollution reduction.

In addition to the concerns of air pollution in Beijing city in China, Jha *et al.* addressed more concerns of the heavy dependence of China upon foreign oil imports from the Middle East to support its growing economy. The vulnerability China's economy to the volatile prices and the unstable political environment of the Middle East puts China in a politically compromising position (Jha, Ngo, Patel, Trusova, & Kutcher, 2011). As China has large coal deposits, thus coal bed methane is also a highly available resource from which compressed natural gas vehicles can gain advantages and improve national, political, and environmental position. They stressed the double advantages of increasing the use of CNG vehicles that defuse fewer pollutants than gasoline based vehicles and lower the demand for foreign energy resource. They chose Beijing as a case study, wherein pollution levels are 23 times those of New York City, because it has an established infrastructure favoring CNG vehicles as it has four pipelines that carry natural gas to the city. Their paper examines the positive aspects related to the mass introduction of CNG vehicles in China through running a social and consumer cost-benefit analysis.

They constructed their analysis on a number of assumption related to the adopted discount rate, inflation rate, exchange rate, oil prices, and transportation costs to calculate the life cycle for mid-sized passenger "Volkswagen Jetta" car with few listed characteristics. They concluded that the implementation of CNG project will result a societal benefits as it decreases the pollution levels and generates great savings regarding the amount of vehicles used in Beijing.

As the Department of Public Works in the city of Milwaukee considered using alternative source of energy for its vehicles fleet, a detailed cost-benefit analysis was conducted to evaluate the net benefits of the replacement of a portion of the city's fleet of diesel-fueled garbage trucks with trucks fueled by compressed natural gas (Cheng, Grigg, Jones, & Smith, 2011). The analysts compare the marginal cost of replacing the retired garbage trucks with CNG-fueled trucks with the currently adopted practice of replacing them with diesel-fueled trucks. They constructed a model with four specifications upon assumptions about renewed tax incentives and non-fiscal costs associated with gas emissions. They also conducted a sensitivity analysis to account for the inherent uncertainty in the predictions of few factors, such as fuel costs. The study resulted in positive net benefits for the purchase and use of 10 CNG-fueled garbage trucks over a 12-year truck life time.

Though the analysts recommended the purchase of the trucks, they emphasized that the relevance of the study estimates will be influenced by further parameters in the future, like the costs of vehicle purchase, fuel, and fuel economy. Thus, they strongly recommended a continuous monitoring for the vehicles' performance and other external circumstances to achieve an economically and environmentally sustainable fleet.

A similar study was conducted to evaluate the transition of the State's vehicular fleet to natural gas in West Virginia (Mason, 2013). This transition was spurred by the fact that for more than a century West Virginia has been a leader in the exploration and production of abundant natural gas resources in the United States. The study addressed the main obstacle to the introduction of the natural gas as a vehicular fuel, which is the supporting of natural gas-fueling infrastructure. To overcome this obstacle, the natural gas fuel stations should be located in heavily populated areas that contain the largest concentration of federal, state, and municipal fleet vehicles. The study also stressed the conversion of state fleet vehicles will overcome the problem of the inadequate demand for these stations in these areas, the thing that will result in an immense costs savings to the state.

Upon referring to the above analysis that shows how the conversion of petroleum based vehicles to the use of a more environmentally efficient fuel alternative was approached from different perspectives, the following analysis will attempt to compare the impact of CityBus decision to replace their current standard diesel fueled bus fleets with the alternative of CNG fueled buses.

To keep the number of buses in their fleet the same, each year some of the existing buses of the CityBus Corporations fleet need to be retired and replaced by the same number of new buses. This study will compare the costs of two alternatives. The first one is replacing the retired buses with the same type of standard diesel fueled buses which are currently used. This option is considered as the status quo in this study. The second option is to convert to a CNG fueled buses which are presumably more economically and environmentally viable, in terms of generating cost savings due to lower fuel costs, and causing less greenhouse gas emissions.

Data Source & Description

The data analyzed in this study are a secondary dataset taken from a study that was conducted by Yang *et al.* (Yang, Tyner, & Sarica, 2013) who used actual primary dataset provided by CityBus Corporation to evaluate the economics generated by the conversion of the municipal bus fleet to hybrid diesel-electric buses and CNG fueled vehicles. The nominal discount rate in this study is assumed to be 0.05.

In following is a detailed explanation of how the total costs, including environmental costs, of the two potentially considered options are estimated within the 15 years lifespan of the project.

Cost Estimates

Capital Cost

When considering the status quo's option, the capital cost will be the cost of purchasing new standard diesel fueled buses. Meanwhile, the capital cost of the second option will include both the cost of purchasing CNG fueled buses and the cost of building new CNG fueling stations. The price CityBus would pay for the purchase of a new standard diesel bus is \$400,000, and for the purchase of CNG bus is \$450,000 calculated in 2012 dollars. The actual CityBus vehicle replacement schedule was used to estimate the costs during the lifespan of the project. CityBus estimated that the total of 65 of the existing buses in the fleet of 75 buses need to be replaced and predicted the annual price increase rate of bus prices to be 5%. Table 1 shows the number of buses purchased each year during the project lifespan. The costs of buses purchased are estimated in Appendix 1 for the project's 15 years accordingly.

The other component of the capital cost is cost of building new CNG fueling stations that are required for the second option to be implemented. This cost is estimated by CityBus to be \$2 million and would happen at the beginning of the first year. This cost needs to be amortized under a certain amortization rate to evaluate the annualized cost. The amortization of this cost was found to have no impact on the net present value cost calculation of the second option by Yang *et al.* because the discount rate and the amortization rate used in the study are the same at 5% (Yang, Tyner, & Sarica, 2013).

The calculations of the capital costs estimates for the both types of fleet buses during the project lifespan are shown in Appendix 1(Project's Total Costs Estimates).

Table 1. Number of Buses Purchased Each Year

| | Year | Number of Buses Purchased |
|-------|------|---------------------------|
| 1 | 2013 | 7 |
| 2 | 2014 | 3 |
| 3 | 2015 | 3 |
| 4 | 2016 | 4 |
| 5 | 2017 | 4 |
| 6 | 2018 | 4 |
| 7 | 2019 | 4 |
| 8 | 2020 | 4 |
| 9 | 2021 | 4 |
| 10 | 2022 | 4 |
| 11 | 2023 | 4 |
| 12 | 2024 | 5 |
| 13 | 2025 | 5 |
| 14 | 2026 | 5 |
| 15 | 2027 | 5 |
| Total | | 65 |

Fuel Cost

It is assumed in the study of Yang *et al.* that both of the two types of transit buses in the fleet, the diesel-fueled and the CNG fueled, traveled the same distance. CityBus fixed the annual total mileage of the

fleet at 1.8 million since the distance of the route from the fuel station is usually not so long, so each kind of bus can finish the route without coming back to the fuel station. Fuel cost of each type of the buses is calculated via multiplying the price of the fuel by the amount of fuel used for the type of bus. The initial diesel fuel price in 2012 was reported by CityBus as \$3.11 per gallon and CNG price \$1.5 per Diesel Gallon Equivalent (DGE). The annual cost of each fleet option is calculated as the summation of each kind of bus's fuel cost in that year. Accordingly, the annual fuel costs of the project's CNG vehicles are roughly estimated as \$1,200,000, and \$1,800,000 for the standard diesel vehicles. The increase in the annual fuel costs for the subsequent years are estimated according to the growth rates in the prices of the two types of fuel. The US Department of Energy (DOE) projections of crude oil price from 2010 to 2035 states that crude oil price and diesel price have the same price growth rate of 4.9%.

The CNG price is mainly comprised of two parts: natural gas wellhead price and transmission distribution cost. DOE projections show that the growth rate of transmission/distribution cost is highly correlated with the general inflation rate. Using information from the Henry Hub spot natural gas price projection from U.S. Energy Information Administration (EIA) Annual Energy Outlook 2012, the wellhead price of CNG is 0.52 per DGE and the transmission/distribution cost of CNG is 0.98 per DGE. So the average annual growth rate of CNG price is 3.9%, while the price growth rate of diesel is 4.9%.

Appendix 1 shows the calculations of the fuel costs estimates. It also shows the summation of the capital costs and fuel costs for each type of buses.

Environmental Cost

The environmental cost is estimated in this study to account for the environmental effect of using each of the two fleet options, whether standard diesel fueled buses or CNG fueled buses. This study follows the same approach that was followed in Yang *et al.* evaluation of the environmental costs of using different types of municipal fleets.

Since it makes up a high proportion of the United States greenhouse emissions, Carbon dioxide (CO_2) is considered by the Environmental Protection Agency (EPA) as one of the principle greenhouse gases. The reduction of (CO_2) emissions plays an important role in sustaining better environmental measures. Another important component of greenhouse emissions caused by transit buses is Particulate Matter with a diameter of 10 μm or less (PM10). Passenger and bus drivers are among the most vulnerable groups of people with immediate and long lasting exposure to these small particles. (Cheng, Grigg, Jones, & Smith, 2011). The two kinds of emissions accounted for in this study are the Carbon Dioxide Equivalent (CO_2e) and PM10. CO_2e is used to describe the environmental cost of the two types of fleet options.

In addition to CO_2 emissions, the other two types of greenhouse gases emissions considered in this study are the Methane gas emissions (CH_4) and the Nitrous Oxide gas emissions (N_2O). Both are typically calculated in the units of Carbon Dioxide Equivalent (CO_2e). The Gas's Global Warming Potential (GWP) factor developed by EPA is used in order to convert them to CO_2e (Emission Factors for Greenhouse Gas Inventories, 2011). According to U.S. EPA Annual Energy Outlook of 2011, if the GWP of CO_2 is set at 1, the GWP of CH_4 and N_2O are 21 and 310 respectively. Thus, CNG transit buses

release 1.966 g of CH_4 per mile and 0.175 g N_2O per mile. For the standard diesel bus, the emission factor is 0.0051 g per mile for CH_4 and 0.0048 g per mile for N_2O . With these emission factors, the amount of greenhouse gas and PM10 emissions for each fleet option could be estimated upon incorporating data of CityBus fleet emissions. Emission of CH_4 and N_2O are converted into CO_2e equivalent emissions when multiplied by the corresponding GWP of CH_4 and N_2O . Hence, the total CO_2e emissions for CH_4 over the 15-year project's lifespan are 61,432 tons, and 66,560 tons for N_2O . In the same study (Yang, Tyner, & Sarica, 2013), in order to calculate the environmental costs of the two options of fleet buses, Yang *et al.* used the shadow price of avoiding these two pollutants.

A carbon tax levied on CO_2 emissions could be applied as a shadow price for estimating the related CO_2 environmental costs. The carbon tax design suggest by Metcalf (Metcalf, 2009) at a range from \$55 to \$110 per ton of carbon is used, which is equivalent to \$15 to \$30 per ton of CO_2 when divided by GWP factor of 3.67.

The PM10 estimates developed by Wayne (Wayne, Sandoval, & Clark, 2009) are used in this study to proxy the PM10 emissions level. This particular study measures the average PM10 emissions for each type of the buses during the period between 2007 and 2009. These averages are reported as 0.013 g/mile for CNG buses and 0.022 g/mile for standard diesel buses.

For PM10 emission, the 2007 report of the Federal Transit Administration in the U.S. Department of Transportation (FTO), The transit bus life cycle and cost and emissions estimation reported estimated that the shadow price of PM10 emission is \$6,367 per ton in 2006 dollars. After adjustment by the historical inflation from 2006 to 2011, the social cost of PM10 is estimated as \$7,384 in 2012 dollars (Clark, Feng, Wayne, & Lyons, 2007). The Net Present Value (NPV) of environmental cost of the two fleet options, when considered at the upper bound of Metcalf's range which is \$30 per ton of CO_2e , are \$1,552,102 for the CNG fueled bus option and \$1,672,650 for the standard diesel fueled buses. Thus, the NPV of the environmental cost for CNG is \$120,548 less than the standard diesel option.

Results

Appendix 1 reports the results of discounting the total costs of the two alternatives using 5% discount rate.

When comparing the present values the total costs of each option, where total costs refer to the summation of the capital cost and the fuel cost for each of the options upon excluding both of the environmental costs and the cost of building new CNG fueling stations, the CNG option total costs are \$6,507,293 less than the standard diesel option.

When comparing the fuel costs of each option during the project's lifespan, the fuel cost differences between the CNG bus option and the standard diesel bus option will equal \$14,699,820 by the end of the project's 15-year lifespan. Thus, the fuel cost savings of CNG bus should be accounted for as an advantage that tilts the balance to the CNG option as alternative to the fleet buses.

As for the environmental costs, the results show how much greenhouse gas and PM emissions are reduced when the fleet converts to the use of CNG buses alternative in the next 15 years. The CNG option would produce 6,300 tons of CO_2 , 24.5 tons of CH_4 and 2.1 tons of N_2O less when compared

with the diesel option. The standard diesel option has a higher emission rates in terms of both CO_2e and PM emissions, and the emission amount is expected to increase after 2020.

Even upon adding both of the environmental costs and the cost of building new CNG fueling stations, the present value of the CNG option total costs, including capital, fuel, and environmental cost, is \$19,327,661 less than the present value of the standard diesel option's total costs.

Sensitivity Analysis

The trajectory of prices of both the diesel fuel and the natural gas constitutes a key source of future uncertainties in this analysis. As mentioned above, the strong correlation between the price of crude oil and the price of diesel fuel indicates that the fluctuation of the crude oil is the key driver of diesel price. Meanwhile, the growth rate of CNG prices is influenced by multiple factors like the technological progress in the development of shale gas extracting techniques, the natural gas transportation and storage cost, as well as the speed of U.S. economic recovery. Thus, a sensitivity analysis is conducted on the breakeven value of the annual growth rate of CNG prices. The annual growth rate of the diesel fuel price is assumed to be constant at the same rate of 4.9%, and a sensitivity analysis is solved for the breakeven of annual growth rate of CNG price that can make the NPV of the total costs for both alternatives the same. The calculations that are shown in Appendix 2 (Sensitivity Analysis – Changing CNG Price Growth Rate) indicates that when CNG price has an average annual growth rate of 9.3%, the total costs of the two alternatives would be the same. Consequently, the CNG prices would have to go up by almost as double as the standard diesel fuel growth rate of 4.9% for the two alternatives to have the same NPV of total costs.

Conclusion

In its attempt to find an economically viable solution to overcome the problem of the rising costs of fuel, CityBus Corporation has the option to choose between two alternatives of bus types in order to replace the retired vehicles of its bus fleets. When comparing the two alternatives of buses, the CNG fueled buses and the standard diesel fueled buses (the status quo), the CNG alternative is recommended. From an economic perspective, the CNG alternative has a lower NPV of the total costs over the project's lifespan of 15 years than the standard diesel alternative. Even in the case of not receiving a grant to cover the costs of constructing a new CNG fueling station, and despite the higher cost of purchasing new CNG fueled buses than standard diesel fueled buses, the generated savings in fuel costs will compensate for the CNG alternative higher capital costs, whether the higher costs of purchasing new buses or the cost of building CNG fueling stations. Moreover, since the demand of CNG buses in total is steadily increasing, the total fuel cost of the CNG alternative will fall. Thus, beyond the 15 years of the project's lifetime, the fuel cost differences between the CNG alternative and diesel alternative will become larger. Thus, the fuel cost savings that would occur upon implementing the CNG bus alternative is considered the most important advantage for choosing it.

From an environmental perspective, the CNG buses would produce lower levels of greenhouse gases

and PM emissions, thus, reducing the environmental social costs of the project which are true costs to society though they are not paid by CityBus Corporation under the current policy, they are a true cost to society. Moreover, the potential environmental benefits of using CNG buses may allow for CityBus

Corporation to get either a state grant from Indiana State Government or a federal government grant to cover part of the cost of building the CNG fueling station.

Thus, converting to “Greener” municipal fleets is likely to allow for social, environmental, in addition to economic benefits to all the interested parties who have standing in similar projects. From national standing, the conversion will potentially lower air pollution levels, the thing that will be reflected in better health measures and a higher sustainability of environmental resources. Moreover, since natural gas resources are domestically abundant, similar conversion to CNG fuel fleet will allow for less economic vulnerability to oil price shock and the political instability of energy global markets.

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