Alternative Fuels
Technical Assistance Program

CAPITAL REGION
WATER

Capital Region Water

ALTERNATIVE FUELS, VEHICLES & TECHNOLOGIES FEASIBILITY REPORT

Prepared by Eastern Pennsylvania Alliance for Clean Transportation (EP-ACT)
With Technical Support provided by: Clean Fuels Ohio (CFO); & Pittsburgh Region Clean Cities (PRCC)

Table of Contents

Analysis Background

Capital Region Water (CRW) is a special-purpose unit of local government that improves, maintains, and operates the greater Harrisburg area's water system and infrastructure — from raindrop to river. Capital Region Water is the steward for drinking water, wastewater and stormwater services for the City of Harrisburg and portions of surrounding municipalities including Penbrook, Paxtang and Steelton Boroughs and Susquehanna, Swatara and Lower Paxton Townships.

Capital Region Water took over operation of Harrisburg's water systems in late 2013 with a renewed commitment to operating openly and transparently, in a fiscally responsible, proactive, and sustainable manner, and with a community focus. During this time CRW, has set forth new standards for serving the customers in an environmentally friendly, and sustainable way that will help promote CRW's vision of community relations and interaction.

CRW's plan includes examining their entire fleet and conducting an analysis of their fleet of vehicles it currently has and evaluating the way the vehicles are utilized. The goal is to align their fleet with their overall sustainability goals. This includes an in-depth analysis of the vehicles' current usage and the possibility of converting all, or a portion of their fleet to alternatives to gasoline and diesel fuel.

Capital Region Water has applied to The Commonwealth of Pennsylvania's newly developed Alternative Fuels Technical Assistance Program (AFTA) run by the Department of Environmental Protection seeking recommendations for their fleet. This report is a culmination of meetings, information gathering and analysis specific to CRW's, vehicles and fleet usage of those vehicles and best reflects recommended practices and technologies that will best help CRW achieve their desired objectives.

1.0: Introduction - Fleet Feasibility Analysis:

This Alternative Fuel Vehicle (AFV) Fleet Performance Feasibility Study is designed to examine the feasibility and cost-savings potentials of deploying a range of commercially available alternative fuel, advanced vehicle, and efficiency solutions in the Capital Region Water District fleet. As with many public agencies, the Capital Region Water District fleet performs a range of essential public services for their citizens, including water delivery, water infrastructure maintenance and improvements, and more. Providing these services account for large and ever-growing expenses for agency budgets, and the majority of these expenses come in the form of vehicle acquisition prices, fuel purchases, and equipment maintenance costs. However, a range of advanced vehicles, alternative fuels, and efficiency technologies are currently available and have the potential to significantly reduce both annual and lifecycle fleet operational costs as well as have environmental benefits when deployed in the right applications.

2.0: Fleet Management Goals – Scope of Work & Criteria for Analysis:

Eastern Pennsylvania Alliance for Clean Transportation (EP-ACT), Clean Fuels Ohio (CFO) and Pittsburgh Region Clean Cities (PRCC) are pleased to present the following detailed AFV Options and Feasibility report. This report is designed to provide the following core deliverables: 1) Detail the priority criteria and goals for the fleet in evaluating technologies; 2) Provide a baseline analysis of current fleet operations with Key Performance Indicators (KPIs) on the fleets vehicles and operations; 3) Outline alternative fuel vehicle and efficiency technology options relevant to fleet operations; 4) Assess the operating costs and other investments needed to implement the various technology options; and 5) Provide Return on Investment (ROI) scenarios and recommendations based on the analyses above. We would like to thank the Capital Region Water District Staff for their assistance in gathering data and providing feedback for this report.

Our team has met with key Capital Region Water District stakeholders who have outlined a set of broad goals and criteria for evaluating new technologies for fleet operations. These criteria are outlined in the table below and used throughout this report to evaluate various technology options for the fleet.

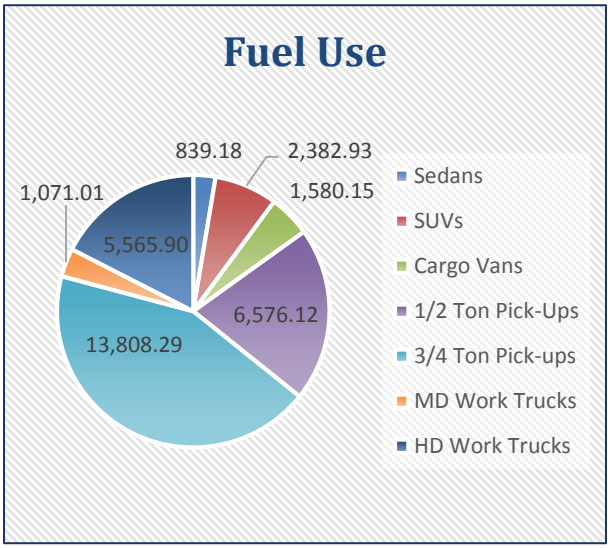
Priority Review Criteria for Analysis:
1. *Use life cycle cost effectiveness and return on investment projections as the primary tool for evaluating each potential fuel, vehicle technology, and station option.*
2. *Include data on environmental performance; factor into decision matrix as a secondary evaluation tool.*

We have used these criteria to evaluate alternative fuel and efficiency technologies that are most relevant and effective for the fleet's operations. In addition to these criteria, our staff have used the real-world fleet data provided by the Capital Region Water District to create key current vehicle performance profiles. Our staff utilizes these profiles to create alternative fuel vehicle replacement scenarios, charting out similar models of alternative fuel vehicles (including cost differences, mpg differences, maintenance cost differences, etc.). The core work in this report focuses on comparing the operational costs and return on investment between the current fleet's vehicle performance and usage profiles and various alternative fuel replacement vehicle scenarios. Finally, we have looked at the Total Cost of Ownership (TCO) and Return on Investment (ROI) based on three fuel price models (a low oil model, status quo or "median" oil model, and a high oil price model). These models come from the U.S. Energy Information Administration (EIA), which collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy's interaction with the economy and environment. A summary of the current performance of the fleet is detailed on the following page.

3.0: Key Performance Indicators – Existing Fleet Analysis

We generally recommend replacing vehicles at appropriate intervals to minimize fleet repair costs and maximize performance and efficiency. Therefore, our staff collected data including fleet vehicle inventory data, refueling practices data, and replacement plan data. Based on this data, we have performed a baseline analysis and identified six key indicators that provide a summary of the fleet's current operating parameters. These Key Performance Indicators (KPIs) are designed to provide a baseline overview of current make up and operations of the fleet, as well as provide a high-level context for the recommendations outlined in the report that follows.

KPIs - Capital Region Water- Fuel				
Fuel Type	**Gallons**	**Total Cost**	**Avg. $/MI**	**$/Gal**
Gasoline	25,161.00	$37,070.17	$0.15	$1.47
Diesel	6,662.58	$12,356.10	$0.69	$1.85
Total	**31,823.58**	**$49,426.27**	**$0.42**	**$1.66**
Idle Time & Fuel				
Fuel Type	**Hours**	**Cost**	**% of Fuel**	**% of Costs**
Gasoline	5,550.00	$8,158.50	30%	36%
Diesel	4,050.00	$7,492.50		
Total Cost	**9,600.00**	**$15,651.00**		



The on-road fleet vehicles can be divided into seven broad categories of units and are analyzed as follows.

KPI – Capital Region Water- Fleet Detailed Breakdown									
Vehicles	**# of Units**	**Fuel Use**	**%Fuel**	**~Fuel $ /Group**	**Miles**	**%Miles**	**$/MI**	**MPG**	**Idle Time**
Sedans	3	839.18	3%	$1,233.59	17,872.49	7%	$0.07	21.30	-
SUVs	6	2,382.93	7%	$4,408.42	43,816.00	17%	$0.10	18.39	-
Cargo Vans	2	1,580.15	5%	$2,623.05	11,995.00	5%	$0.22	7.59	650.00
1/2 Ton Pick-Ups	8	6,576.12	21%	$9,666.90	54,636.00	21%	$0.18	8.31	2,450.00
3/4 Ton Pick-ups	19	13,808.29	43%	$25,545.34	115,688.88	44%	$0.22	8.38	1,800.00
MD Work Trucks	5	1,071.01	3%	$1,981.37	8,537.94	3%	$0.23	7.97	700.00
HD Work Trucks	11	5,565.90	17%	$10,296.92	10,458.00	4%	$0.98	1.88	4,000.00
Total	**54**	**31,823.58**	**100%**	**$55,755.58**	**263,004.31**	**100%**	**$0.29**	**10.54**	**9,600.00**

As the previous table details, three groups of vehicles do the bulk of the work and account for most fleet operational costs, mileage, and idle hours. These fleet segments are the "3/4 Ton Pick-Ups" (43% of fuel use), "1/2 Ton Pick-Ups" (21% of fuel use), and "Heavy Duty (HD) Work Trucks" (17% of fuel use). Focusing

on these fleet segments and vehicles in this priority order will offer the largest economic and environmental benefits moving forward. With this in mind, the recommendations in the report below have been specifically designed to help minimize the costs associated with the fleet's operations.

4.0: Alternative Fuel Options – Summary Comparisons & Conclusions:

This report is designed to provide a full range alternative fuel and vehicle options analysis for your fleet operations. This section is designed to provide basic foundation information for high level comparison of five commercially available alternative fuel types: Biodiesel (B20), Ethanol (E85), Compressed Natural Gas (CNG), Propane (LPG), and Electric vehicles (EV). As described in section 2.0 above, our team has created current vehicle performance profiles, alternative fuel vehicle replacement scenarios, and used US EIA fuel prices scenarios to perform total cost of ownership and return on investment analysis of the various fuel options for your fleet. The following table is designed to provide a high-level summary of each fuel option for CRW to understand what alternative fuel choices are currently available for comparison purposes.

Summary Alternative Fuel Comparisons & Conclusions					
	Biodiesel (B20)	**Ethanol (E85)**	**CNG**	**Propane**	**EV**
Basics	Biodiesel is a renewable fuel that can be manufactured from organic oils, fats, or recycled grease for use in diesel vehicles.	Ethanol is a widely used renewable fuel made from corn and other plant materials. It is blended with gasoline.	Natural gas is a domestically abundant gaseous fuel that can have significant fuel cost savings over gasoline and diesel fuel.	Propane is a readily available gaseous fuel that has been widely used in vehicles throughout the world for decades.	Electricity can be used to power plug-in electric vehicles, which are increasingly available. Hybrids use electricity to boost efficiency.
Retail Availability	Widely available	Widely available	Purchased through utility pipeline.	Regional / Local distributors.	Widely available but charger required
Retail Cost	Moderate	Moderate	Low	Moderate to low.	Low if charger is available
Pollution-Tailpipe	Low, except for CO2	Low, except for CO2	Low—25 percent lower CO2 than diesel and gas.	Moderate	None
Major Pros	Universal availability and moderate cost. Emissions benefit	Universal availability and moderate cost savings.	Low fuel cost. Low Emissions & Noise. Extensive distribution.	Simpler station than CNG. Fuel savings vs. gasoline likely in fleets.	Limited range and not well suited to heavy vehicles because of range and battery weight.
Major Cons	No major cost savings. Cold flow issues if not properly treated	Lower energy per gallon. Limited environmental benefit	High cost / complexity of stations.	Seasonal price spikes if not under contract. No heavy vehicle options.	A charge can take hours and applications are limited based on vehicle drive cycle.
Conclusion	Use **biodiesel** only when fuel cost is same or lower than diesel fuel.	Do not use **ethanol** until it's 20-27% lower $ than gasoline.	**CNG** vehicles are cost-effective but station costs too high for your fleet.	***Propane*** *vehicles & station most cost-effective* for your fleet type.	**EVs** cost-effective but no models for priority fleet segments above.

The previous conclusions are based on detailed analysis of current vehicle operational profiles, alternative fuel replacement scenarios (including vehicle cost and performance data vs. conventional), refueling infrastructure investments needed, and any other required costs (i.e. maintenance facilities

modifications). This does not include an analysis of environmental advantages for using any type of alternative fuels. If environmental benefits are to be prioritized by CRW, a separate analysis can be conducted and weighted towards environmental benefits. The cost associated with other technologies currently might not make financial sense, but the benefits can be measured in Green House Gas (GHG) emission reduction numbers with the current fleet of vehicles and future vehicle purchases as well as the future cost of fuel to show the advantages of converting to those other alternative fuels. Other unnoticed or unmeasurable benefits to switch to the other non-recommended fuel types can be used for: good will to the public; environmental stewardship and sustainability goals.

Liquid Propane Gas (LPG) sometimes referred as Propane or even Propane Autogas, when used as a vehicle fuel, is the most cost-effective option for the fleet's key high use vehicle segments, a full summary of the propane vehicle analysis is provided below.

4.1: Detailed Propane Autogas Options Analysis:

Propane is produced as a by-product of natural gas processing and crude oil refining. It accounts for about 2% of the energy used in the United States. The interest in propane as an alternative transportation fuel stems mainly from its domestic availability, high energy density, and clean-burning qualities. ***Propane is the world's third most common engine fuel*** and is considered an alternative fuel under the Energy Policy Act of 1992. Older propane vehicle models injected the fuel as gas vapor for combustion. However, modern propane vehicles now almost entirely operate with Liquid Propane Injection engine systems and offer higher fuel efficiency, performance, and reliability compared to older propane vehicles. Additional information about propane also can be found here:
https://www.afdc.energy.gov/uploads/publication/propane_basics.pdf

Propane Overview: Properties, Characteristics, and Considerations	
	Propane Autogas (LPG)
Basic Properties	Gas (C3H8), stored at low pressure (~120 psi) as color and odorless liquid.
Source/Production	Domestic: By-product of conventional oil & gas exploration; non-renewable.
Distribution	Rail and Truck trailer distribution
Availability	Delivered to station storage tanks
Retail Unit	Gasoline or Diesel gallon energy (BTU) equivalent
Fuel Retail Cost	**Regional Avg: ~$1.47 - $1.80 gge** *(*Higher volume contracts result in lower prices)*
Vehicle Cost	Lower cost; ~$5,000-$10,000 per vehicle
Station/Fueling Considerations	Low cost, similar set up to gasoline except with above ground tanks, limited permitting, and environmental concerns.
Facility Modifications	No major facilities modifications; heavier than air fuel similar properties to gasoline and diesel
Engine Noise Level	Low noise level, ~1/10 decible level
Environmental Factors	No threat to soil, surface water, or groundwater, dissipates in air
Tailpipe Emission	Lower than conventional gas and diesel vehicles

Propane also offers significant emissions benefits as detailed below.

Propane Emissions vs. Typical Diesel Baseline Emissions*					
	PM	**NO_x**	**CO**	**HC**	**$C0_2E$/ GHG**
Propane (new heavy-duty vehicle)	100%	> 60%	>90%	>80%	19%
Propane (conversion)	80%	0%	20-40%	- 10%	21-24%
** These figures, and new studies on which the figures are based, are posted at the U.S. Department of Energy's Alternative Fuels Data Center at http://www.afdc.energy.gov/afdc.*					

Capital Region Water currently operates a number of vehicles that have immediate opportunities to be converted to or replaced with propane powered technologies – particularly the fleet's pick-up trucks (F-150, F-250, F-350). Propane engine systems exist for most light and medium duty equipment options (particularly for model years 2005 and newer) and a growing number of heavy duty engine technologies are beginning to enter the market, including school buses, shuttles, and class 6-7 truck chassis. Many manufacturers are having different models and makes EPA certified every year. There will be more available choices as these vehicles come to market. The table below is designed to detail broad guidelines for propane vehicle applications for the major market niches. You can view all available OEM propane vehicles here: https://www.afdc.energy.gov/uploads/publication/vehicle_buyers_guide.pdf.

Propane Overview: Vehicle Market/Application Relevance	
	Propane Autogas (LPG)
Light Duty: Sedans / Police Patrol	LPG is well suited to this light duty market, if these vehicles drive higher miles and return to base. Police patrol options viable, but fuel tanks limit trunk storage space.
Light Duty: Vans / Service Pick-ups	LPG is well suited to this light duty market, and many vehicle options exist at relatively low cost, including service trucks and vans, and shuttle chassis.
Med-Heavy Duty: Dump Trucks / Utility Vehicles	Class 5-7 Propane engines available through heavier duty make and model selection limited. Currently no Class 8 propane vehicles available.

With the incremental cost of light-medium duty propane vehicles ranging from $5,000-$12,000, propane vehicles deployed in many fleet operations, will easily result in a net lifetime savings if fuel usage meets basic minimum thresholds. Though propane fueling stations are an additional required investment, the total capital costs for a propane station is relatively low ($30,000-$60,000), and these costs can be amortized into the per gallon fuel price while continuing to maintain low fuel costs. Additional there are many propane suppliers who have different types of ownership models***including providing the equipment in exchange for a guaranteed gallons of fuel contract. ***

The following table provides real world cost details for a small volume capacity (~20,000 gallons per year) propane station as an average price throughout Central and Eastern Pennsylvania. The information in the table includes three cost categories (design, equipment, and construction). Though final costs for individual entities will vary, this information is relevant to the size and capacity of a station for your fleet operations. Since propane is delivered by truck, the station capacity is scalable and can be increased at no cost by scheduling more frequent fuel drops as needed or as the number of vehicles increase.

Propane Station Estimate (Station Capacity: 20,000+ GGE/Year)	
Total Design Costs	$500
Total Equipment Costs (1000 gal tank + 1 dispenser)	$25,900
Total Construction Costs	$6,600
Total Propane Station Costs:	**$33,000**

Again, costs for an equivalent station located at your specific location will vary. Cost will vary based on factors such as how much site preparations are needed, i.e. permits, concrete padding, electrical, etc. as well as specific design and construction costs. It is also important to note that the costs in the table above include $9,795 in FuelMaster® fuel use tracking equipment, which your fleet may not require.

Though these costs can be directly incurred by the fleet, some propane fuel suppliers sometimes are willing to enter into agreements to front the capital investment for such infrastructure in exchange for a long-term fuel contract with a fleet. In these cases, fuel suppliers amortize the cost of the station into the long-term contract price for the fuel (i.e. $1.80/gallon fuel price with amortized contract and no fleet station investment versus $1.75/gallon fuel price with fleet paying for all capital investments). The tables below detail the lifetime cost savings for propane vehicles vs. conventional fuels, using US EIA price data.

Select Propane Vehicle Comparisons			
Gasoline F-250/350		**Propane F-250/350**	
Engine Type	6.2L V8	**Engine Type**	6.2L V8
Base Cost	$30,060	**Base Cost**	$41,825
Avg. Fuel/Year	767	**Avg. Fuel/Year**	767
Annual Mileage	6,089	**Annual Mileage**	6,089
Maintenance Costs/Mile	$0.03	**Maintenance Costs/Mile**	$0.015

Gas vs. Propane Operating Costs: F-250/350 (Avg. Annual Use)						
	Low Oil Price		**Median Oil Price**		**High Oil Price**	
	Gas	**Propane**	**Gas**	**Propane**	**Gas**	**Propane**
O&M	$1,827	$913	$1,827	$913	$1,827	$913
Ten Year Total	$15,860	$11,049	$23,688	$13,135	$39,657	$17,972
Total Savings	**$4,810**		**$10,554**		**$21,685**	
Net Savings	**-$6,955**		**-$1,211**		**$9,920**	

As shown in the table above, based on current fleet fuel use averages, only in the high oil price scenario do propane vehicles have a positive ROI ($9,919) over the 10-year timeframe. However, as the tables below detail, if the fleet were to focus on deploying propane in the top five highest utilized vehicles in this fleet segment, as well as the "1/2 Ton Pick-Up" segment, the ROI payback changes significantly.

Gas vs. Propane Operating Costs: F-250/350 (Top 5 Most Utilized)						
	Low Oil Price		**Median Oil Price**		**High Oil Price**	
	Gas	**Propane**	**Gas**	**Propane**	**Gas**	**Propane**
O&M	$1,827	$913	$1,827	$913	$1,827	$913
Ten Year Total	$21,989	$15,476	$33,237	$18,473	$56,180	$25,423
Total Savings	**$6,513**		**$14,765**		**$30,757**	
Net Savings	**-$5,252**		**$2,999**		**$18,992**	

Select Propane Vehicle Comparisons			
Gasoline F-150		**Propane F-150**	
Engine Type	8cyl 5.0L	**Engine Type**	8cyl 5.0L
Base Cost	$30,060	**Base Cost**	$40,500
Avg. Fuel/Year	939.45	**Avg. Fuel/Year**	939.45
Annual Mileage	6,829.50	**Annual Mileage**	6,829.50
Maintenance Costs/Mile	$0.03	**Maintenance Costs/Mile**	$0.015

Gas vs. Propane Operating Costs: F-150 (Average Annual Use)						
	Low Oil Price		**Median Oil Price**		**High Oil Price**	
	Gas	**Propane**	**Gas**	**Propane**	**Gas**	**Propane**
O&M	$2,049	$1,024	$2,049	$1,024	$2,049	$1,024
Ten Year Total	$19,237	$13,439	$28,826	$15,994	$48,385	$21,919
Total Savings	**$5,798**		**$12,832**		**$26,466**	
Net Savings	**-$4,642**		**$2,392**		**$16,026**	

Beyond the vehicles examined above, the fleet would also have opportunities to replace the following additional vehicles with propane powered options:

Additional Propane Vehicle Scenarios – Ten Year ROIs					
Vehicle	**MY**	**Incremental $**	**Low Oil Price**	**Median Oil Price**	**High Oil Price**
Taurus Sedan	**2002**	**$5,000**	**-$978**	**$2,894**	**$10,397**
Chevy Blazer	**2004**	**$7,500**	**-$2,654**	**$146**	**$5,574**
Escape Hybrid	**2009**	**$7,500**	**-$1,351**	**$2,265**	**$9,275**

As described in the tables above, this analysis has examined four "1/2 Ton Pick-ups," five "3/4 Ton Pick-ups," one Sedan, and two SUVs – 12 total vehicles subject to near term replacement with propane powered options. While propane does not require maintenance facility modifications or costly training for mechanics, it would require the fleet to install a propane/autogas refueling station at relevant location. As described above, the highest the fleet would reasonably expect to pay for such a station is $33,000 – but likely could realize a station for significantly lower costs. The table below is designed to detail the total investment in propane vehicles, vehicle 10 year operational costs (including maintenance), and investments in station infrastructure to fuel vehicles.

10 Year Total Investment ROI Scenarios (w/No Incentives)			
	Low Oil Price	**Median Oil Price**	**High Oil Price**
(4) F-150s	**-$18,569**	**$9,569**	**$64,104**
(5) F-250/350s	**-$26,262**	**$14,996**	**$94,960**
(1) Sedan (2) SUV	**-$4,983**	**$5,306**	**$25,246**
Station Cost	**$33,000**	**$33,000**	**$33,000**
Ten Year ROI	**-$82,814**	**-$3,129**	**$151,310**

The table above details the most conservative scenarios (in terms of erring on the high-cost side) of vehicle incremental price, fuel price projections, and infrastructure costs. We believe that a combination of competitive local vehicle dealers, station packagers, and State of Pennsylvania incentive programs could cut ROI time likely to half – making propane yield relatively high savings for select fleet vehicles. Based on this, we offer the following recommendations:

Key Recommended Action: *Use Propane Vehicles and Equipment with ROI*

1. ***Acquire alternative fuel vehicles whenever the lifecycle costs (including all available subsidies) are less than the lifecycle cost of conventional vehicles.***
   a. *Deploy propane vehicles for light-medium duty applications whenever feasible.*
   b. *Convert vehicles that are less than 4 years old, this will bring down your infrastructure ROI*

4.2: Maximize Incentives – Pursue Federal, State, and Local Grants:

Securing funding is often critical to the success of efforts to reduce petroleum use and vehicle emissions in fleet operations. The Pennsylvania Department of Environmental Protection (DEP) has and will continue to offer grant funding for clean, alternative fuel projects in Pennsylvania and investment in Pennsylvania's energy sector through the **A**lternative **F**uels **I**ncentive **G**rant Program (AFIG). The past AFIG programs were designed to reimburse the 50% of the incremental cost to purchase alternative fuel fleet vehicles or convert vehicles to utilize alternative fuels up to a maximum of $20,000 for each vehicle and $200,000 per application. Station Cost can be applied for in a separate application provided you have 10 or more vehicles in your fleet that are less than 26,000lbs. Gross Vehicle Weight (GVW). Currently, The Pennsylvania DEP has announced a 2017 round of AFIG funding. The details for the application can be found at: http://www.dep.pa.gov/citizens/grantsloansrebates/alternative-fuels-incentive-grant/pages/default.aspx; If Capital Region Water District applied for and received AFIG funding for the vehicle replacements outlined above, it would dramatically improve the fleet ROI scenarios as detailed in the table below:

10 Year Total Investment ROI Scenarios (w/AFIG Incentives)

Vehicle Types	AFIG $/Vehicle	Low Oil Price	Median Oil Price	High Oil Price
(4) F-150s	$5,220	$2,311	$30,449	$84,984
(5) F-250/350s	$5,882	$3,151	$44,408	$124,373
(1) Sedan (2) SUV	$2,500/$3,750	$5,017	$15,306	$35,246
Station Cost (>10 units)	$16,500	$33,000	$33,000	$33,000
Ten Year ROI		-$22,521	$57,162	$211,602

Based on recent successes with fleet grant awards and the availability of future state grant programs, we recommend your fleet actively pursue AFIG Funding for propane vehicle replacements.

Key Recommended Action: *Pursue All Available Subsidies and Incentives*

2. ***Pursue AFIG incentives to reduce the implementation costs of propane technologies outlined above.***

5.0: Key Recommended Actions – Conclusion:

The following recommendations for further action are based on our review and assessment of data supplied and current fleet Key Performance Indicators. These summary recommended actions are designed to provide a framework for achieving fleet goals. The Table below summarizes each of the overall recommendations in this report, based on a detailed analysis leading to the specific recommended action. Although this recommendation is best suited for current conditions with Capital Region Water's fleet, many alternative fuel vehicles and technologies combinations could be beneficial to attaining higher sustainability goals. The use of electric vehicles in other categories of Capital Region Water's fleet profile, would dramatically lessen the effect of Green House Gas emissions. Our recommendation would be to use this combination for higher environmental benefits.

Key Recommended Actions:
Fuel Options Assessment:
1. Acquire alternative fuel vehicles whenever the lifecycle costs (including all available subsidies) are less than the lifecycle cost of conventional vehicles. Specifically, the fleet should: **a. Deploy 8-12 propane vehicles for select light-medium duty applications as described above.** *b. Use **biodiesel** as long as the incremental cost is in line with or lower than diesel fuel.* *c. Do not use **ethanol**, wait until it's cost effective for operations (i.e. 20-27% lower than gasoline costs).* *d. Wait to use **CNG** vehicles at this time based on limited ROI potential for fleet applications.* *e. Incorporate **Electric vehicles** in your fleet whenever you are replacing sedans within your fleet*
2. Pursue state and federal incentives, subsidies, grant programs, and other incentives to help reduce the implementation costs of strategies and technologies outlined in this report.

More information describing the methodology and full analysis results for each of the alternative fuel options scenarios is available upon request. This report has researched many possible scenarios based on the current fleet profile, as Capital Region Water shifts its fleet structure to utilizing different types of vehicles and other scenarios not examined here, the recommendations made herein might change as well.

We have attached some informational links that we feel would be of interest to CRW in pursuing some other alternative ideas that are feasible because of CRW unique business. There are many water treatment facilities that utilize waste water to natural gas. This process is called **Anaerobic Digestion** which produces Biogas® and is carbon neutral or has a negative carbon footprint, the process can be expensive, but might be feasible, when adding partners, subsidies or when sustainability goals and a continuous fuel supply are desired.

- https://www.epa.gov/sites/production/files/2015-07/documents/opportunities_for_combined_heat_and_power_at_wastewater_treatment_facilities_market_analysis_and_lessons_from_the_field.pdf
- http://www.americanbiogascouncil.org/pdf/briefing15may12_nacwa.pdf
- https://cleancities.energy.gov/files/u/news_events/document/document_url/73/1_-_Mintz_RNG_062915_final_posting.pdf
- http://task37.ieabioenergy.com/files/daten-redaktion/download/Technical%20Brochures/Wastewater_biogas_grey_web-1.pdf
  (Note that we cannot verify the information in this resource)