

CITY OF GARLAND

ALTERNATIVE FUELS & VEHICLES PLAN

Fuel & Emission Strategy Team

Mission: *Develop organizational strategies for reduction of fuel expense and emissions associated with operation of the City's vehicle and equipment fleet.*

OBSERVATION: STATE OF THE INDUSTRY

Manufacturers continue to introduce battery only as well as plug-in hybrid vehicles into the marketplace. Only one manufacturer at the time of the development of this plan continues to produce a dedicated compressed natural gas (CNG) passenger vehicle, Honda Civic. In addition, only one manufacturer produces a hydrogen powered vehicle in limited numbers. CNG and Propane are options for medium and heavy duty trucks yet automobile manufacturers have limited production of CNG vehicles and while propane infrastructure is a moderate investment, CNG infrastructure remains costly.

PLAN BACKGROUND

The introduction of alternative fuels and vehicles is an informed choice undertaken by the City to demonstrate its mission to become a leader in regional air quality by affirmatively impacting vehicular emissions. Consequently, the City of Garland seeks to continue its active participation in the emerging alternative fuels (AF) and alternative fuel vehicles (AFV) market. The City's goal is (1) to maintain current alternative fuel usage while increasing the transition into AFVs and (2) systematically monitoring new technological advancement toward meeting departmental needs. The capital costs for alternative fuels and vehicles are sometimes greater than conventional fossil fuels and vehicles. But a single unit by unit cost comparison is only one approach. A more comprehensive lifetime vehicle and fuel cost comparison factoring in emissions and air quality considerations should also be considered to provide for better big picture best value analysis. As the City actively pursues AFV options, alternative fuel infrastructure must also follow either as city-owned facilities or in partnership with other agencies. The introduction of alternative fuels and vehicles is an informed choice undertaken by the City to demonstrate its mission to become a leader in regional air quality by affirmatively impacting vehicular emissions. The City offers these strategies toward reaching its stated mission.

- **Strategy 1: Petroleum Reduction**
- **Strategy 2: GHG Reduction**
- **Strategy 3: Improve Air Quality**

PLAN STRATEGIES

Strategy 1: PETROLEUM REDUCTION

Since crude oil is a global commodity, the world market dictates its price. Skyrocketing demand in China and other developing countries, coupled with political and social upheaval in key oil supply nations, is further taxing the international supply/demand equation, further degrading the nation's energy security, and driving up prices at the pump.

Propane remains the fuel of choice for off-road type vehicles like forklifts, mainly used mainly in warehouse applications. Liquid Natural Gas (LNG) has been evaluated and seems to be the best application for trucking and transit operations and many consider as prohibitive due to fueling options and costs of the infrastructure requirements. Flexible Fuel Vehicle (FFV) is an alternative fuel vehicle with a multi-fuel engine that can typically use Ethanol/E85 or Unleaded but gets fewer miles to a tank.

Natural gas, a fossil fuel comprised mostly of ethane, is one of the cleanest burning alternative fuels. It can be used in the form of compressed natural gas (CNG) or liquefied natural gas (LNG) to fuel cars and trucks. Dedicated natural gas vehicles are designed to run on natural gas only, while dual-fuel or bi-fuel vehicles can also run on gasoline or diesel. Dual-fuel vehicles allow users to take advantage of the wide-spread availability of gasoline or diesel but use a cleaner, more economical alternative when natural gas is available. Since natural gas is stored in high-pressure fuel tanks, dual-fuel vehicles require two separate fueling systems, which take up passenger/cargo space. Natural gas vehicles are not produced commercially in large numbers—the Honda GX CNG is the only new vehicle available in the U.S. However, conventional gasoline and diesel vehicles can be retrofitted for CNG. In addition, dual-fuel vehicles have the additional challenge of changing driver habits to using an alternative fuel which may be more time consuming and inconvenient.

Advantages & disadvantages of natural gas

Advantages	Disadvantages
Nearly 87% of U.S. natural gas used is domestically produced	Limited vehicle availability
60-90% less smog-producing pollutants	Less readily available than gasoline & diesel
30-40% less greenhouse gas emissions	Fewer miles on a tank of fuel
Less expensive than gasoline	Refueling time

Advantages & disadvantages of E85

Ethanol or E85 is an alternative fuel as defined by the U.S. Department of Energy. E85 is the term for motor fuel blends of 85 percent ethanol and 15 percent gasoline. E85 is designed for use in flexible fuel vehicles (FFVs). Ethanol has 66% of the BTU value of gasoline, lowering the miles per gallon when blended with gasoline. In turn, it takes 1.4 gallons of E85 to do the same work as a gallon of gasoline. Again, changing driver habits may lead to less convenient refueling locations and could prove to be an initial challenge.

Advantages	Disadvantages
Domestically produced, reducing use of imported petroleum	Can only be used in flex-fuel vehicles
Lower emissions of air pollutants	Lower energy content, resulting in fewer miles per gallon
More resistant to engine knock	Limited availability
Added vehicle cost is very small	Currently expensive to produce

E10 is a blend of 10 percent ethanol and 90 percent gasoline. It is approved for use in any make or model of gasoline powered vehicle sold in the U.S. Many automakers recommend its use because of its high performance and clean burning characteristics. A recent survey documents these findings considering E10. From a positive standpoint, fuel cost may decrease depending on daily market value of unleaded; Fuel octane rating increases; Harmful gasoline emissions decrease; No long-term engine damage. From a negative standpoint, easily absorbs water from storage tanks; Has a shelf life of less than 90 days; Acts as a solvent with fuel tanks, lines, pumps and other fuel related equipment; Deteriorates aluminum, plastic, rubber, and some fiberglass due to ethanol's corrosive properties; E10 consistently reduces miles per gallon by 2% to 3%.

Hybrid and plug-in hybrid vehicles are considered by the City to be an appropriate interim solution until a more viable AFV is developed. The hybrid vehicle generally obtains an increase in vehicle miles per gallon (MPGs) while reducing emission at low speeds. The City has several hybrid vehicles in its inventory and has had positive feedback with these units.

Conversion kits for Plug-in hybrid vehicles (PHEV) are now available for Toyota Prius and Ford Escape SUV models and are reported to lower emissions while doubling MPG equivalents. Original battery packs are replaced with improved and longer lasting ones that remove driver concerns due to miles driven between charges.

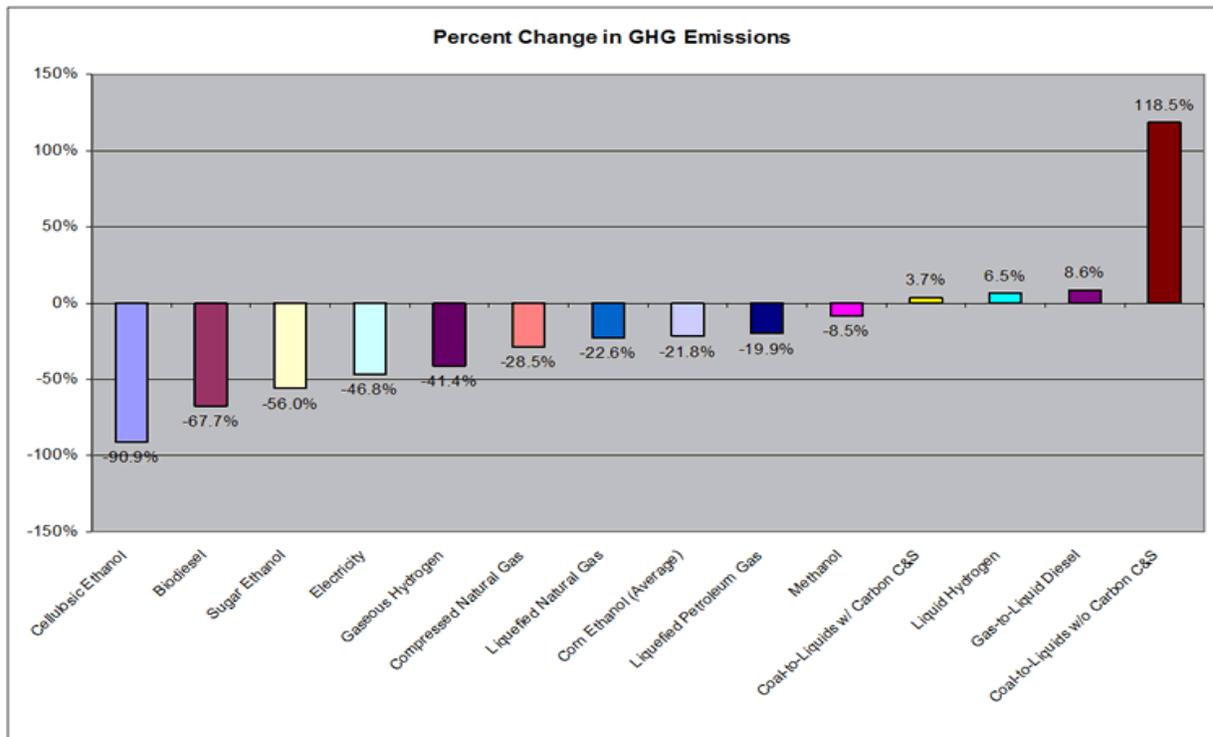
Hydrogen vehicles are touted as producing no emissions, but will require an expensive fueling infrastructure. A limited number of hydrogen vehicles are being produced in 2009; this AFV is several years away from being a viable option for City vehicles.

Biodiesel is a domestic, renewable fuel that can be made from vegetable oils, animal fats, or recycled restaurant greases. Pure biodiesel is known as B-100 and is considered an alternative fuel. It is not the same as raw vegetable oil. It contains no petroleum, but can be blended with any level of petroleum to create a biodiesel blend. The most common blend is B-20, (20% biodiesel and 80% diesel). B-20 can be used in nearly all diesel equipment and is compatible with most storage and distribution equipment without impacting engine warranty. B-20 works as a cleaning agent in diesel systems and may initially cause minor fuel issues such as increased fuel filter replacement needs and cause fuel injectors and pumps to fail, causing more downtime to vehicles. B-20 and lower-level blends generally do not require engine modifications. While B-20 comes with an increased cost, it does reduce the dependency of foreign oil and supports green efforts. An example of concerns with B-100 include recent testimony from the City of Thousand Oaks, California who stated that they used B-100 biodiesel at their Hill Canyon Treatment Plant, and experienced issues with low-temperature gelling in the storage tank, which created problems with engine components such as injector pumps, hoses and gaskets in most of the equipment. As a result of the problems experienced with B-100 biodiesel they discontinued its use. Serious analysis must be undertaken prior to considering this fuel as a viable option, and of particular concern are manufacturer warranty issues when switching to this fuel.

Biodiesel compared to petroleum diesel

Advantages	Disadvantages
Domestically produced from non-petroleum, renewable resources depending on fuel blend, i.e., B-20, etc.	Use of blends above B5 not yet warranted by auto makers
Can be used in most diesel engines, especially newer ones	Lower fuel economy and power (10% lower for B100, 2% for B20)
Less air pollutants (other than nitrogen oxides) and greenhouse gases	Currently more expensive
Biodegradable - depending on blend	More nitrogen oxide emissions
Non-toxic - depending on blend	B100 generally not suitable for use in low temperatures

Strategy 2: GHG REDUCTION



The chart presents an estimate for the percent change in lifecycle greenhouse gas emissions, relative to the petroleum fuel that is displaced, of a range of alternative and renewable fuels. The fuels are compared on an energy equivalent or BTU basis. Thus, for instance, for every BTU of gasoline which is replaced by corn ethanol, the total lifecycle greenhouse gas emissions that would have been produced from that BTU of gasoline would be reduced by 21.8 percent. These emissions account not only for CO₂, but also methane and nitrous oxide. This chart represents best available information about current or projected production practices and the impact of those practices on lifecycle greenhouse gas emissions. EPA along with other Federal agencies and stakeholders are committed to continuing to improve lifecycle analysis techniques.

Strategy 3: IMPROVE AIR QUALITY

The Clean Air Act and Amendments of 1990 define a "nonattainment area" as a locality where air pollution levels persistently exceed National Ambient Air quality standards or that contributes to ambient air quality in a nearby area that fails to meet standards. Designating an area as nonattainment is a formal rulemaking process, and EPA normally takes this action only after air quality standards have been exceeded for several consecutive years. Nonattainment areas are given a classification based on the severity of the violation and the type of air quality standard they exceed. EPA designations of nonattainment areas are only based on violations of national air quality standards for carbon monoxide, lead, ozone (1-hour), particulate matter (PM-10), and sulfur dioxide. EPA is working toward making designations based on the newer 8-hour ozone or PM 2.5 standards. The City of Garland resides within a nonattainment zone and therefore is interested in doing its part by lowering vehicular emissions within its operating fleet. As a result, the City has opted to work toward electrification of its fleet where appropriate and feasible. Additionally, the City is home to Garland Power and Light, a municipally-owned electric utility and as a result there is a financial incentive and interest on the part of the municipality to utilize low cost electricity as an alternative fuel.

In April of 2006, the City of Garland passed Resolution No. 9453 establishing a Clean Fleet Program in cooperation with the Regional Transportation Council. This resolution addresses goals in acquisition, operations, maintenance and compliance verification in conjunction with the Clean Fleet Vehicle Policy.

FUTURE CONSIDERATION: EMERGING FUELS

Staying apprised of the future of the fuel industry is very important. There are many emerging fuels including Bioutanol, Biogas, and Biomass to liquids, and gas to liquids, these fuels will be evaluated as they become more practical. By following the industry and being active in trade organizations, staff will continue to stay informed and keep the City of Garland on the forefront of implementation, recommending those fuels that have low environmental impact and are economically and operationally feasible.

Hydrogen

Hydrogen (H₂) is being aggressively explored as a fuel for passenger vehicles. It can be used in fuel cells to power electric motors or burned in internal combustion engines (ICEs).

It is an environmentally friendly fuel that has the potential to dramatically reduce our dependence on foreign oil, but several significant challenges must be overcome before it can be widely used.



Benefits

Produced domestically. Hydrogen can be produced domestically from several sources, reducing our dependence on petroleum imports.

Environment friendly. Hydrogen produces no air pollutants or greenhouse gases when used in fuel cells; it produces only NOx when burned in ICEs.

Challenges

Fuel cost & availability. Hydrogen is currently expensive to produce and is only available at a handful of locations, mostly in California.

Vehicle cost & availability. Fuel cell vehicles are currently far too expensive for most consumers to afford, and they are only available to a few demonstration fleets.

Onboard fuel storage. Hydrogen contains much less energy than gasoline or diesel on a per-volume basis, so it is difficult to store enough hydrogen onboard a vehicle to travel more than 200 miles.

Other challenges include fuel cell performance, customer acceptance, and hydrogen transport and bulk storage.

Fuel cell

Although they are not expected to reach the mass market any time soon, fuel cell vehicles (FCVs) may someday revolutionize on-road transportation.

This emerging technology has the potential to significantly reduce energy use and harmful emissions, as well as our dependence on foreign oil. FCVs will have other benefits as well.

A radical departure

FCVs represents a radical departure from vehicles with conventional internal combustion engines. Like battery-electric vehicles, FCVs are propelled by electric motors. But while battery electric vehicles use electricity from an external source (and store it in a battery), FCVs create their own electricity. Fuel cells onboard the vehicle generates electricity through a chemical process using hydrogen fuel and oxygen from the air.



FCVs can be fueled with pure hydrogen gas stored onboard in high-pressure tanks. They also can be fueled with hydrogen-rich fuels; such as methanol, natural gas, or even gasoline; but these fuels must first be converted into hydrogen gas by an onboard device called a "reformer."

FCVs fueled with pure hydrogen emit no pollutants; only water and heat; while those using hydrogen-rich fuels and a reformer produce only small amounts of air pollutants.

In addition, FCVs can be twice as efficient as similarly sized conventional vehicles and may also incorporate other advanced technologies to increase efficiency.

Meeting challenges together

Before FCVs make it to your local auto dealer, significant research and development is required to reduce cost and improve performance. We must also find effective and efficient ways to produce and store hydrogen and other fuels.

Automakers, fuel cell developers, component suppliers, government agencies, and others are working hard to accelerate the introduction of FCVs. Partnerships such as the DOE-led FreedomCAR initiative and the California Fuel Cell Partnership have been formed to encourage private companies and government agencies to work together to move these vehicles toward commercialization.

FreedomCAR

FreedomCAR is a new cooperative research effort between the DOE and the U.S. Council for Automotive Research (Ford, General Motors, and DaimlerChrysler) formed to promote research into advanced automotive technologies, such as FCVs, that may dramatically reduce oil consumption and environmental impacts. FreedomCAR's goal is the development of cars and trucks that are:

- Cheaper to operate
- Pollution-free
- Competitively priced

FLEET STATISTICS: BRIEF HISTORY

The City of Garland was an active compressed natural gas (CNG) user prior to 2000 owning and operating several CNG powered vehicles and utilized an alternatives fuels filling site in East Garland at Newman Power Plant. Since 2000, the City has eliminated CNG as an alternative fuel due in part to its comprehensive analysis of CNG but has continued to actively study the feasibility of other technologies and fuel blends toward evaluating the appropriate mixture of alternative and fossil fuel powered vehicles for its fleet.

In Fiscal Year 2005/06, the City developed a Fuel and Emissions Strategy Team composed of city departments like Garland Power and Light, Water Utilities, Environmental Waste Services, Organizational Development Team, Transportation and Environmental Health Services. A Clean Fleet Resolution was created from this committee and approved by the City Council in 2006. The resolution provides guidelines covering the acquisition of future fleet vehicles through the city's replacement program and set goals for future emission reductions in the city fleet. A hybrid

technology initiative is one successful strategy recommended by the committee to reduce Nitrogen Oxide (NOx) and Particulate Matter (PM) concentrations in the city and region during fiscal year 2005/2006.

In 2010, the City Manager created a new sustainability and green governance department under his office titled the Office of Environmental Quality (OEQ). One priority of the office is to be an active resource and work closely with Fleet Services to facilitate ongoing emission reduction strategies and to provide options in how initiatives are funded. In 2010, the Fuel and Emissions Strategy Team was renamed the Alternative Fuels and Vehicles Committee and reorganized seating slightly different committee members like Purchasing, GPL, Water Utilities, OEQ and Fleet Services with an expanded mission to build on existing emission reduction activities, aftermarket technologies, conversions and replacement guidelines established in the 2006 resolution. In 2010/2011 timeframe, the Alternative Fuels and Vehicle Committee has approved actions that have resulted in the development and submission of five (5) state and federal grants to acquire funding toward continued emission reductions activities as well as introducing electric and propane vehicles and infrastructure projects into the city. And the total value of grant submissions exceeds \$620,000.00.

CURRENT FUEL INVENTORY

TYPE 1: Unleaded

TYPE 2: Diesel (on road)

TYPE 3: Diesel (off road)

TYPE 4: Propane

CURRENT VEHICLE INVENTORY

As of 02/2011

Total All Types: 1734

Total motorized on-road fleet: 1430

ON-ROAD (FUEL)

Fuel/Hybrid	45
*Flex Fuel	300
Unleaded (Various grades)	567
Diesel	518
TOTAL	1430

Percent on-road vehicles powered using alternative fuel: 3%
Percent on-road fleet capable of accepting alternative fuels: 24%

*Flex Fuel Discussion

A gallon of E85 contains 23%-28% less energy than a gallon of conventional gasoline. Because ethanol contains less energy than gasoline, fuel economy is reduced for most earlier American FFVs (flexible-fuel vehicles) by about 30% (most after 2003 lose only 15-17%, or less) when operated on pure E85 (summer blend).

OFF-ROAD (FUEL/NON-FUEL)

Non-Fuel	234
LPN / Propane	9
Diesel (Red Dye)	44
Electric	17
TOTAL	304

FUTURE DEPLOYMENTS ONROAD/OFF-ROAD

ONROAD

The following list details new AFVs that are implemented or being considered as the result of annual vehicle replacement in FY 2011.

- 10 Propane vehicles (under consideration in 2011)
- 1 Other – Hydraulic Hybrid Electric (implemented in 2011)
- 4 Plug-in Hybrid electric vehicles (PHEV) (implemented 2011)

Although the City of Garland is not mandated by federal or state regulations to purchase alternative fuel vehicles (AFVs) or use alternative fuels, annual evaluations have been undertaken toward analyzing available alternative fuel vehicle options for future use. More recently, the City has taken the initiative to form a Fuel & Emissions Strategy Team with a representation of various user departments. The team has rolled out new tools such as the “Vehicle & Equipment Questionnaire” which is now a normal part of the new equipment acquisition process. This survey provides the Fleet Department with a tool to assist in placing more fuel and emissions efficient units throughout the City. These purchasing decisions are not only based upon operational issues and fiscal concerns but promote responsible environmental stewardship.

When selecting AFVs, great consideration is given to the end user application and their operational functions since the size and location of fuel tanks impact the storage, functionality and useful bed space of vehicles. Other issues include availability of fuel supply, ability to refuel without long delays, driving range between fuel stops, vehicle usage by on-call staff including responding to emergency or disaster situations and the availability of original equipment manufacturer (OEM) vehicles.

PROPANE POWERED VEHICLES

In 2011, a propane vehicle program will be evaluated for potential roll out within the city government. The city has submitted a grant proposal to North Central Texas Council of Governments and was approved but placed on a waiting list for possible funding in 2012. As a result, the city has contacted and continues ongoing discussions with the Texas Railroad Commission (TRC) for possible agency funding within 2011. The city has received grant approval from TRC for the acquisition of propane vehicles. A total of ten (10) propane powered vehicles along with refueling infrastructure are being considered for purchase in 2011.

ELECTRIC VEHICLE DEPLOYMENTS

In 2011, an electric vehicle program will be rolled out within the city government. The program is partial grant funded through North Central Texas Council of Governments. A total of four (4) plug-in hybrid electric vehicles (PHEV) has been acquired initially and made available for city employees to drive and evaluate before permanently locating the vehicles to four home departments. A total of six (6) Level 2 and one (1) Level 3 (DC fast charger) charging infrastructure stations will be deployed in 2011 as part of the electric vehicle deployment project. City staff will evaluate indicators like utilization, maintenance, road worthiness, cost of service and work activity feasibility toward considering future deployments in city departments.

OFF-ROAD

Ongoing efforts will be made to locate funding sources for off-road projects. As opportunities become available key considerations will included but not be limited to dependence on feasibility of the effort, meeting plan goals for emission reductions and capacity of grant oversight/management functions to effectively performed needed administrative activities.

FUEL SAVING DEVICES AND ADDITIVES

Some vendors are promoting various devices and additives. The Federal Trade Commission (FTC) offers a fact sheet regarding these devices, which indicate savings

as minimal. The U.S. Environmental Protection Agency (EPA) has tested more than 100 devices and additives and has not found any that significantly increase fuel economy. Several were found to offer small improvement in fuel economy but also resulted in increased exhaust emissions. Also, installation of these devices may cause engine damage and may be considered illegal tampering (or void vehicle warranty) as cited in the FTC fact sheet mentioned above. Overall, the City's position is to be cautious with these types of devices.

ESTIMATED SAVINGS SINCE INTRODUCTION OF HYBRID VEHICLE PROGRAM

Using an Internet online calculator from "Project Get Ready", the following emission offsets were derived since 2006. Figures are based on the difference of deploying hybrid vehicles over the period versus comparative conventional fossil fuel vehicles and the result of the comparative analysis includes the following emission reductions, fuel cost and oil offsets:

- Reduction of 315 metric tons of emissions;
- Saving an estimated \$74,970.00 in lifetime cost of fuel;
- Eliminating an estimated 765 barrels of oil.

AFV PLAN ACTION STATEMENTS:

The plan supports the following action statements in the planning, implementation, and monitoring activities undertaken in the plan as well as to continue to follow objectives established in the 2006 Clean Fleet Vehicle Resolution.

- Lead by Example.
- From the 2006 Clean Fleet Vehicle Resolution [1] brings forward the minimum Nitrogen Oxide (NOx) reduction goal of 25% reductions. In 2010 this goal is redefined for the purposes of this plan to cover only medium and heavy duty diesel vehicles being replaced, repowered or retrofitted with emission reduction devices. Waivers are possible when new technologies or achievements of the required emission reduction are not possible. And further in this plan set a Particulate Matter (PM) reduction goal by seeking best available control technology when using emission reduction retrofits on existing fleet vehicles. Cost effectiveness is also an important consideration in seeking emission reduction objectives.
- Create a funding model that provides the framework toward the acquisition of funding and resources to further AFV efforts.
- When feasible and prudent convert selected current fleet vehicles to AFV to improve environmental benefits within the city.

- When feasible and prudent purchase or lease additional electric vehicles (EV) to further reduce the City's carbon footprint and improve surrounding air quality.
- When feasible and prudent invest in electric recharging infrastructure to provide adequate charging stations for city use. When feasible and prudent consider joint use of recharging infrastructure by the municipal government and general public.
- When feasible and prudent consider propane as an alternative fuel for deployment in the city fleet.
- Continue to seek incentives and rebates toward offsetting alternative fuel costs.
- "No net increase" in criteria and toxic air pollutants caused by purchasing, leasing and/or retrofits to the fleet vehicle class containing medium up and including large diesel vehicles is a plan goal. This action item will be verified using greenhouse gas inventory observations.
- Ensure vehicles operating on alternative fuels comply with motor vehicle emission standards.
- Utilize grant funding as well as other public/private financial alternatives and partnerships as sources to fund the City's alternative fuels and vehicles program. Efforts serve to reduce petroleum dependence, lower GHG emissions and improve air quality.

[1] 2006 Clean Fleet Vehicle Resolution, Section 1, 1.1 – 1.3. This resolution was developed in coordination with the North Central Texas Council of Governments to support regional air pollution initiatives.

PLAN UPDATES

Follow annual updates to this plan in years beyond 2011 on the city's website.