

NORTH FLORIDA ALTERNATIVE FUELS, VEHICLES & INFRASTRUCTURE MASTER PLAN





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CONTENTS

1. EXECUTIVE SUMMARY.....	5
2. INTRODUCTION.....	7
2.1. PURPOSE.....	7
2.2. BENEFITS.....	7
2.3. STUDY AREA.....	8
2.4. CLEAN CITIES PROGRAM AND THE CLEAN FUELS COALITION.....	8
3. CONTEXT.....	11
3.1. DEFINITIONS.....	11
3.2. BASELINE.....	13
3.3. FORECAST.....	16
4. FUELS.....	21
4.1. SOURCES.....	21
4.2. ENERGY CONTENT.....	24
4.3. PRICES.....	25
4.4. EMISSIONS.....	27
5. VEHICLES.....	31
5.1. FUEL ECONOMY.....	31
5.2. RANGE.....	32
5.3. COST.....	33
5.4. AVAILABILITY.....	34
6. INFRASTRUCTURE.....	39
6.1. SCOPE.....	39
6.2. LOCATIONS.....	41
6.3. PERMITTING.....	42
7. REGULATION.....	45
7.1. FEDERAL.....	45
7.2. STATE.....	47
7.3. LOCAL.....	48
8. GOALS.....	51
9. STRATEGIES.....	53
9.1. BIODIESEL.....	53
9.2. ELECTRICITY.....	55
9.3. ETHANOL.....	58
9.4. HYDROGEN.....	59
9.5. NATURAL GAS.....	59
9.6. PROPANE.....	62
APPENDIX.....	63
DEFINITIONS.....	63
ACRONYMS.....	66

TABLES

TABLE 1: POPULATION OF NORTH FLORIDA, 2012.....	8
TABLE 2: ENERGY CONTENT COMPARISON OF TRANSPORTATION FUELS	25
TABLE 3: CURRENT AVERAGE PRICES OF FUELS (OCTOBER 2013), LOWER ATLANTIC REGION.....	25
TABLE 4: ESTIMATED AIR QUALITY EMISSIONS OF ALTERNATIVE FUELS RELATIVE TO CONVENTIONAL FUELS.....	28
TABLE 5: ESTIMATED GHG EMISSIONS OF ALTERNATIVE FUELS RELATIVE TO CONVENTIONAL FUELS.....	29
TABLE 6: ENERGY EFFICIENCY OF HEAVY DUTY VEHICLES.....	32
TABLE 7: RELATIVE PRICE PREMIUM FOR AFVS	34
TABLE 8: ELECTRIC VEHICLE AVAILABILITY FOR MODEL YEAR 2014.....	35
TABLE 9: RELATIVE COST OF ALTERNATIVE FUEL INFRASTRUCTURE.....	39
TABLE 10: SELECTED CODES & STANDARDS APPLICABLE TO ALTERNATIVE FUEL INFRASTRUCTURE	43
TABLE 11: SELECT FEDERAL ALTERNATIVE FUEL INCENTIVES.....	46
TABLE 12: SELECT FLORIDA ALTERNATIVE FUELS INCENTIVES	48
TABLE 13: ON-GOING AND PLANNED ALTERNATIVE FUEL PROJECTS.....	51

FIGURES

FIGURE 1: ESTIMATED CONSUMPTION OF VEHICLE FUELS (1000 GGES), 2011	14
FIGURE 2: ESTIMATED CONSUMPTION OF ALT. FUELS (1000 GGE), 2007 - 2011	14
FIGURE 3: AFV AND HYBRID VEHICLE SUPPLY, 2004 - 2011	15
FIGURE 4: FORECASTED TRANSPORTATION ENERGY CONSUMPTION (QUADRILLION BTUS).....	16
FIGURE 5: FORECASTED LDV ALT. FUEL USE (TRILLION BTU).....	17
FIGURE 6: FORECASTED NATURAL GAS USE (QUADRILLION BTU)	17
FIGURE 7: PROJECTED BIOFUELS PRODUCTION (BILLION EISA2007 RFS CREDITS EARNED)	18
FIGURE 8: FORECASTED LIGHT-DUTY AFV SALES (THOUSANDS OF VEHICLES)	18
FIGURE 9: FORECASTED MEDIUM- AND HEAVY-DUTY AFV STOCKS (MILLIONS OF VEHICLES).....	19
FIGURE 10: PROJECTED ALTERNATIVE FUEL USE BASED ON ON-GOING AND PLANNED PROJECTS (GALLONS).....	19
FIGURE 11: FLORIDA ELECTRIC PRODUCTION RESOURCE MIX, 2009	22
FIGURE 12: EXISTING NATURAL GAS TRANSMISSION PIPELINES IN FLORIDA	23
FIGURE 13: CURRENT LNG LIQUEFACTION, STORAGE AND IMPORT FACILITIES.....	24
FIGURE 14: U.S. AVERAGE RETAIL FUEL PRICES, 2000 - 2013.....	26
FIGURE 15: REGIONAL COMPARISON OF EV EMISSIONS (ANNUAL LBS CO ₂ E PER VEHICLE).....	29
FIGURE 16: ENERGY EFFICIENCY OF MID-SIZE, LIGHT DUTY VEHICLES	31
FIGURE 17: RELATIVE DRIVING RANGE OF LDVS	32
FIGURE 18: ALTERNATIVE FUEL STATION LOCATIONS	41
FIGURE 19: PROJECTED ON-ROAD TRANSPORTATION SECTOR PETROLEUM DISPLACEMENT FROM ALTERNATIVE FUEL PROJECTS (GALLONS).....	52
FIGURE 20: EV REGISTRATIONS BY ZIP CODE THROUGH SEPTEMBER 2013.....	55

1. EXECUTIVE SUMMARY

The economic, social and environmental security of the North Florida region is strengthened by supporting local actions to reduce petroleum dependence. Alternative fuels, Alternative Fuel Vehicles (AFVs) and their supporting infrastructure are a primary means of achieving this aim. At the same time, these alternatives can generate substantial benefits for local fleet operators and motorists. Benefits include better environmental stewardship, improved public health and enhanced economic competitiveness. This **North Florida Alternative Fuel, Vehicle and Infrastructure Master Plan** focuses on how the North Florida Transportation Planning Organization via its North Florida Clean Fuels Coalition can help secure these benefits for our region through education and strategic investment.

Clean transportation fuels include biodiesel, electricity, ethanol, hydrogen, natural gas and propane. These fuels are used in a variety of light-, medium- and heavy-duty applications. The fuels and applications have differing infrastructure requirements. Each has a distinct history and forecast of use nationally and in our region. Understanding how these characteristics and trends support the needs of North Florida's commercial fleets and private motorists can help shape goals and strategies to rapidly and cost-effectively increase the adoption of alternative fuels, vehicles and supporting infrastructure.

In the U.S. and in North Florida, vehicle fuel consumption has been dominated by gasoline and diesel fuel. However, unprecedented changes are occurring. Petroleum consumption is expected to decrease over the next several decades, while clean fuel use in high-efficiency vehicles will grow swiftly. **Section 3** of this Plan details these national trends and compares them to the situation in our region.

Alternative fuels, in contrast to petroleum fuels, are homegrown, reducing dependence on foreign sources. Prices tend to be equal to or less than gasoline or diesel. They are cleaner, reducing air pollution and greenhouse gas emissions. While advantages are shared, alternative fuels differ in ways that help determine their best use in North Florida. **Section 4** contrasts the sources, prices, energy content and emissions of alternative fuels.

Vehicles that utilize clean fuels are also diverse. **Section 5** reviews the fuel efficiency, range, cost and availability of AFVs. While just as or more fuel efficient than conventional automobiles, AFVs can have reduced travel range and higher upfront costs. In the past, they have been in short supply. These features are changing as manufacturers respond to demand and incorporate new technologies. Still, differences in performance mean AFVs have distinctive roles to play in the region's vehicle stock.

The infrastructure required to support alternative fuels and vehicles in North Florida is underdeveloped and new facilities are required. **Section 6** details the infrastructure requirements of the six clean fuels and their state of implementation in North Florida. The requirements, costs and permitting considerations vary widely and are critical components of investment decisions for fleet managers and car buyers alike.

Rules, programs and incentives exist at the Federal, State and local level to help promote alternative fuels, vehicles and infrastructure. **Section 7** describes regulations at each level of government. A predictable and supportive environment for investment at the local level is



essential. The North Florida Transportation Organization (NFTPO) is playing a critical role in developing this support.

Current and publicly announced projects in our region suggest that North Florida is poised to dramatically expand the share of alternative fuels, vehicles and infrastructure. **Section 8** summarizes these projects and forecasts their effect on petroleum use. Trends suggest that North Florida is capable of meeting and potentially exceeding clean fuel goals set by the U.S. Department of Energy. The North Florida Clean Fuels Coalition can establish goals that reflect the region's ambitions to expand fuel diversity and realize the benefits of petroleum alternatives.

To achieve its goals, the Coalition must strategically direct local resources to initiatives that have the greatest possible impact on the region's use of clean fuels, AFVs and supporting infrastructure. **Section 9** recommends initial implementation priorities. Strategies have been developed for biodiesel, electricity, ethanol, hydrogen, natural gas and propane. These strategies are expected to be the focus of the NFTPO and its North Florida Clean Fuels Coalition as it moves forward in its role as the regional leadership organization for alternative fuels, vehicles and infrastructure.

2. INTRODUCTION

2.1. PURPOSE

The economic, social and environmental security of the North Florida region is strengthened by supporting local actions to reduce petroleum dependence. Alternative fuels, Alternative Fuel Vehicles (AFVs) and their supporting infrastructure are a primary means of achieving this aim. At the same time, these alternatives can generate substantial benefits for local fleet operators and motorists.

North Florida, like the nation as whole, fuels its vehicles primarily with gasoline and diesel. Today these fuels account for about 94% of total use in the United States. Both are finite resources, extracted from underground petroleum deposits first laid down millions of years ago.

While the United States consumed 21% of the world's petroleum in 2012 – more than any other country – domestic production amounted to 12% of the global total. Despite new technologies leading to the first period of increasing domestic petroleum production for 40 years, oil imported from foreign nations is indispensable for meeting our demand.¹ In 2012, about 40% of domestic consumption was imported, with 65% coming from Canada, Saudi Arabia, Mexico, Venezuela and Russia. While imports are expected to decline over the near term, current geological science indicates that the U.S. holds just 2% of global crude oil reserves.

Moreover, it is clear that the globe's current rate of consumption cannot be maintained in a conventional manner indefinitely.² As a result of tightening global supply and demand, petroleum values have been increasingly volatile, with rapidly rising prices projected for the foreseeable future. At the same time, increasing concerns about the health and environmental effects of pollution stands in the way of extracting all of the world's petroleum reserves.

This Plan focuses on how the North Florida Transportation Planning Organization via its North Florida Clean Fuels Coalition can reduce petroleum dependence by accelerating adoption of alternative fuels, fuel-efficient AFVs and supportive infrastructure. This will be most effectively accomplished through education, coalition building, coordinated planning and strategic investment.

2.2. BENEFITS

It is reasonable to expect gasoline and diesel to supply a majority – but diminishing – share of the region's transportation fuel consumption for the foreseeable future. However, increasing the rate at which alternative fuels replace conventional fuels in North Florida's vehicles can result in a host of benefits to the community, including the following:

- Reduced costs of fueling, operating, and maintaining vehicles.
- Improved operational performance (e.g. energy efficiency)

¹ Energy Information Administration. (2013). *International Energy Statistics*. Retrieved January 2, 2014 from <http://www.eia.gov/countries/data.cfm>

² Ibid.

- Enhanced risk management (price volatility, supply volatility)
- Reduced dependence on foreign sources
- Economic development (e.g. infrastructure investment)
- Job creation
- Reduced nuisance (e.g. noise, odor, etc.)
- Improved public health
- Better regulatory compliance
- Reduced toxicity
- Reduction of local air pollution
- Decrease of GHG emissions

The basis for these benefits will be explored in greater depth through a discussion of the specific characteristics of alternative fuels, vehicles and infrastructure in **Sections 4, 5 and 6**.

2.3. STUDY AREA

This strategy applies specifically to North Florida. It is meant to align with the planning scope of the North Florida TPO, whose boundary includes Duval, Clay, Nassau and St. Johns Counties. It is also meant to parallel the scope of the North Florida Clean Fuels Coalition, which includes citizens, businesses, governments and non-profit agencies located in Baker, Clay, Duval, Nassau, Putnam and St. Johns Counties.

The population of the region is just under 1.5 million, with over 90% of the population concentrated in Duval, St. Johns and Clay Counties. The major urban center of the region is Jacksonville. Other incorporated urbanized areas include Maccleny in Baker County; Orange Park and Green Cove Springs in Clay County; the communities of Atlantic, Neptune and Jacksonville Beach in Duval County; Fernandina Beach in Nassau County; Palatka and Crescent City in Putnam County; and St. Augustine and St. Augustine Beach in St. Johns County. Clay, Duval and St. Johns County also include large areas of incorporated or non-incorporated suburban development. While all Counties in the region include rural areas, these predominate in Baker, Nassau and Putnam Counties.

TABLE 1: POPULATION OF NORTH FLORIDA, 2012

County	Population	Percentage
Baker	27,086	2%
Clay	194,345	13%
Duval	879,602	61%
Nassau	74,629	5%
Putnam	73,263	5%
St. Johns	202,188	14%
Total	1,451,113	100%

2.4. CLEAN CITIES PROGRAM AND THE CLEAN FUELS COALITION

Clean Cities supports local actions to reduce petroleum use by 2.5 billion gallons per year by 2020. Organized by the U.S. Department of Energy (DOE), the program has fostered coalitions in nearly 100 communities across the United States. Through these partnerships the



program promotes alternative fuels, fuel economy improvements and fuel-saving technologies. Clean Cities provides funding, informational resources, technical assistance and other tools in support of these strategies. In Northeast Florida, the Clean Cities Coalition is hosted by the North Florida Transportation Planning Organization's North Florida Clean Fuels Coalition.

The North Florida Clean Fuels Coalition (NFCFC) is working to bring more viable alternative fuels and energy-efficient vehicles to our region. A non-profit organization housed within the North Florida Transportation Planning Organization, the Coalition serves business, government and non-profit agencies in Baker, Clay, Duval, Nassau, Putnam and St. Johns counties.

The coalition was launched in January 2014 as a continuation of the region's Clean Cities Coalition. The Coalition is composed of a diversity of stakeholders including businesses; fleet managers; vehicle dealers; fuel marketers; environmental advocates; federal, state and local government agencies; and private citizens, among others. The Coalition advocates using alternative fuels and advanced vehicle technologies to reduce dependence on imported petroleum, develop regional economic opportunities, and improve air quality.

It utilizes education coordinated planning and strategic investment and to achieve the U.S. DOE's goal of displacing local petroleum use by 17% annually. As a consequence of these activities, it is seeking official designation as a Clean Fuels Coalition by the DOE. Designation provides several benefits, including training and technical assistance from the DOE, networking and mentoring opportunities with other Coalitions, and access to human (e.g. interns) and financial resources (e.g. grants).

In addition to regular Coalition gatherings, the NFCFC holds several public educational events throughout the year, including an annual Alternative Fuel Vehicle Exposition. Information on the North Florida Clean Fuels Coalition's accomplishments and progress towards achieving DOE goals is included in **Section 8**.



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3. CONTEXT

Alternative transportation fuels include electricity, ethanol, hydrogen, natural gas, biomass-based diesels, and propane. These fuels are the focus of the U.S. Department of Energy's Clean Cities Program and the Energy Policy Act of 1992. Several other potential transportation fuel sources are under development (e.g. "renewable" or "drop-in" biofuels, biobutanol, methanol, ammonia, etc.); however, these emerging fuels are not addressed in this strategy. The six alternative fuels considered in this strategy may be used in a variety of light-, medium- and heavy-duty vehicles. Each fuel and application has differing infrastructure requirements. In this section, the six alternative fuels are briefly described. In addition, the historical patterns of alternative fuel use and vehicles adoption are reviewed. Forecasts of how these patterns may change in the future are also summarized.

3.1. DEFINITIONS

Alternative transportation fuels include biodiesel, electricity, ethanol, hydrogen, natural gas, and propane. These fuels and the vehicles that utilize them have the potential to meet a significant portion of the transportation needs in North Florida.

BIODIESEL

Biodiesel is a non-petroleum diesel fuel sourced from vegetable oils, waste restaurant grease and animal fats. It is non-toxic, bio-degradable and considered a renewable resource. The fuel is produced domestically via a process called transesterification, which catalyzes fats / oils and alcohol to produce biodiesel and by-products, including glycerol. While this is the most commercial pathway for producing the fuel, other feedstocks (e.g. algae) and production methods (e.g. colocation at petroleum refineries) are being developed.



Pure biodiesel (B100) is blended with petroleum diesel for use in diesel engines. A 20% blend (B20) is the most common alternative diesel fuel in the United States. While blends of any percentage are feasible, blends greater than 40% are not common without modification to standard diesel engines. Blends lower than 20% are typically not considered alternative fuel under various federal programs (e.g. the Energy Policy Act of 1992). The American Society for Testing and Materials (ASTM) standard for conventional diesel fuel allows biodiesel content of up to 5% without labeling the fuel as biodiesel.

ELECTRICITY

A familiar source of power in buildings, electricity may also be used to power all-electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs). Like a building, these vehicles draw electric power produced by electric utilities and supplied by their transmission and distribution network (i.e. "the grid"). Electric power can be produced from a variety of primary energy sources such as coal, natural gas, uranium (i.e. "nuclear power"), moving water (i.e. "hydroelectric power"), wind and sunlight (i.e. "solar power"). The specific mix of sources may vary significantly over time and by location. Unlike most homes, electric vehicles store power on-board in rechargeable batteries. EVs utilize batteries to energize an electric motor. PHEVs

pair battery storage with an internal combustion engine (ICE) fueled by gasoline to enhance fuel efficiency. Standard gasoline / electric hybrid vehicles generate electricity from on-board generators and achieve fuel efficiency gains similar to (although lesser than) PHEVs.

ETHANOL

Ethanol is a renewable fuel derived from fermenting and distilling plant materials in a manner similar to production of alcohol. In the United States, the primary feedstock is corn. Sugar cane is a common feedstock in warmer climates. Non-food based feedstocks (i.e. “Cellulosic ethanol”) are under development in order to improve ethanol’s energy balance. Energy balance is the amount of energy required to produce the energy contained in the fuel.

Most gasoline consumed in the United States includes up to 10% ethanol as an oxygenate. A blend of 85% ethanol to gasoline (E85) is considered an alternative fuel and can be used in Flex Fuel Vehicles (FFVs). FFVs are vehicles capable of operating on gasoline and/or E85.

HYDROGEN

Like electricity, hydrogen is not technically a fuel at all. Instead, it is a way of “carrying” energy produced from other feedstocks. The most abundant element in the universe, it can be produced from a variety of sources. However, the most common source is natural gas, through a process called reforming. Using electric current to split water into hydrogen and water through a method called electrolysis is another, far less common method.

Hydrogen in a gaseous state may be combusted in an ICE or used in fuel cell vehicles (FCVs). Fuel cells generate electricity via an electrochemical process. The electricity is used to power the vehicle in a manner similar to EVs.



While hydrogen has potential as a highly efficient fuel with advantageous environmental characteristics, it is neither widely available nor economical as a transportation fuel today. In addition, hydrogen’s low density presents challenges for feasibly storing fuel on-board an automobile. These and other considerations limit the near-term potential of this alternative fuel.

NATURAL GAS

Natural gas is predominantly methane, with traces of other hydrocarbons. It is typically a non-renewable fossil fuel mined alongside oil from underground rock formations. It can be produced renewably from organic waste. Before use as a fuel, natural gas is refined to remove impurities. It is delivered via an extensive transmission and distribution network designed to meet demand for heating, cooking, industrial processes and electric power generation.

The majority of natural gas consumed in the U.S. is produced domestically. Until recently, increased consumption was forecast to result in greater dependence on foreign sources. However, recent technological advances including horizontal drilling and hydraulic fracturing

(i.e. “fracking”) have allowed previously inaccessible sources to be tapped. The result has been new domestic (and global) abundance.

Presently, less than 3% of U.S. natural gas consumption is devoted to transportation. It must be compressed (CNG) or liquefied (LNG) for use in vehicles. As CNG, natural gas is compressed to about 3,600 pounds per square inch (for comparison, a standard car tire is inflated to about 30 psi) and stored in reinforced containers. LNG is purified and cooled to -260°F and stored in insulated cylinders. LNG occupies about 1/600 the volume of CNG. As a result, more energy can be stored on-board LNG vehicles. Both CNG and LNG vehicles utilize specialized internal combustion engines.

PROPANE

Propane is familiar to many as Liquefied Petroleum Gas (LPG) – the fuel that fires barbeque grills across the country. This fuel has diverse applications and has been used as a transportation fuel for decades. As “autogas,” propane is the world’s third most common engine fuel behind gasoline and diesel (though this is not the case in the United States).

Propane is a non-renewable, petroleum-based fuel produced in roughly equal proportions as a byproduct of oil refining and natural processing in the U.S. It is stored on-board a vehicle as a liquid at about 150 psi. When drawn from its storage tank, the fuel changes to a gas and is combusted in an ICE. Propane is used in vehicles with dedicated fuel systems. It may also be used in bi-fuel vehicles, with two separate fueling systems for Autogas and gasoline. Propane vehicles are available via conversions of gasoline vehicles. Increasingly, original equipment manufacturer (OEM) propane vehicles are available as well.



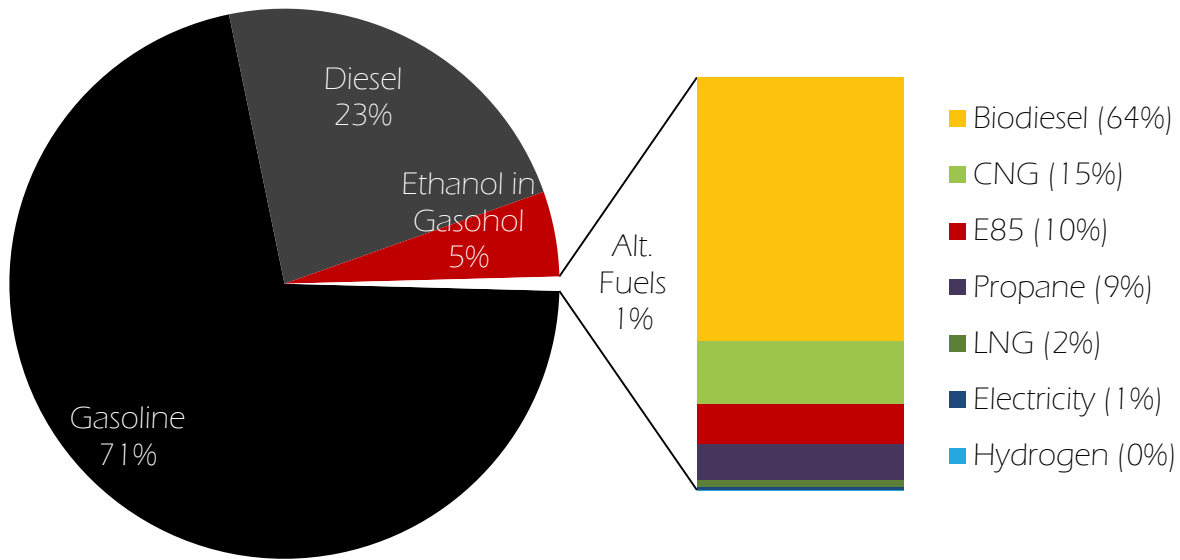
3.2. BASELINE

In the U.S. vehicle fuel consumption has been dominated by gasoline and diesel fuel. In 2011, the most recent year for which data is available, these fuels supplied about 71% and 23%, respectively, of demand. The alternative fuels defined in the previous section comprised the remainder (about 6%). Most gasoline sold in the United States contains up to 10% ethanol by volume. If ethanol in gasoline is not considered, alternative fuels made up just below 1% of the total. These quantities are reflected in **Figure 1**, below.³

Figure 1 also represents the relative share of transportation fuel consumption among the alternative fuels, with biodiesel meeting nearly as much consumption (64%) as all other alternative fuels combined. CNG (15%), E85 (10%) and propane (9%) made up significant proportions of total alternative fuel use, while LNG (2%) and electricity (1%) supplied very little. Hydrogen’s share was essentially zero (0.01%).

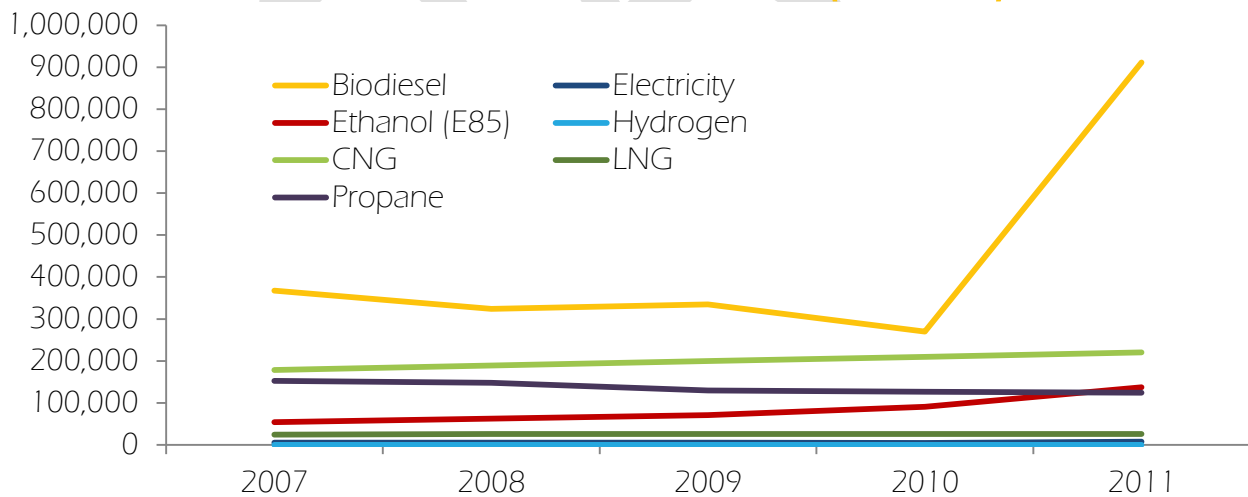
³ Energy Information Administration. (2012). Quantities are measured in gasoline gallons equivalent.

FIGURE 1: ESTIMATED CONSUMPTION OF VEHICLE FUELS (1000 GGES), 2011



The total consumption of alternative fuels excluding ethanol in gasohol has nearly doubled in recent years. Consumption has increased by double-digit rates for hydrogen, E85, biodiesel, electricity and CNG. LNG use increased+ more slowly, while consumption of propane declined slightly over the period. **Figure 2** charts changes in alternative fuel consumption over the period 2007 – 2011 in gaseous gallon equivalents (GGE).

FIGURE 2: ESTIMATED CONSUMPTION OF ALT. FUELS (1000 GGE), 2007 - 2011



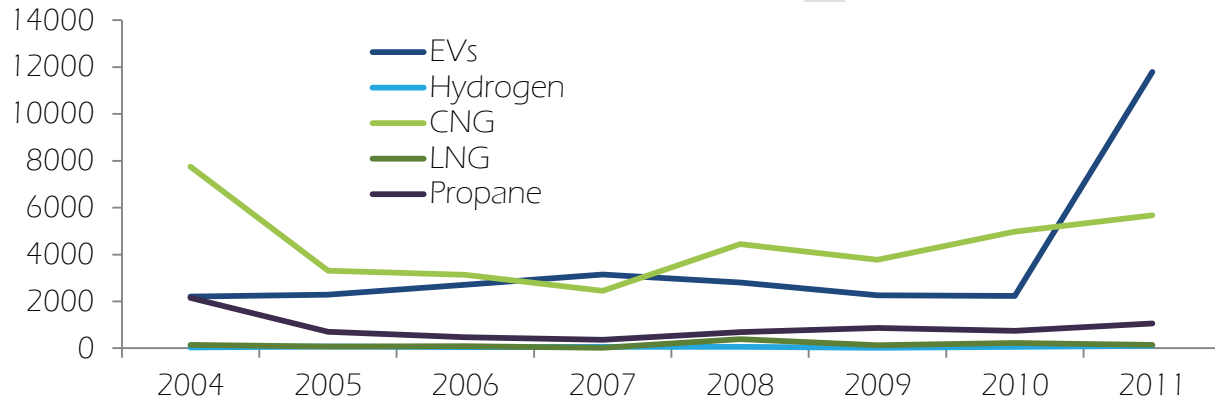
In 2011, there were over 250 million registered highway vehicles in the United States, of which about 92% were classified light duty vehicles.⁴ Alternative fuel vehicles and hybrid-electric vehicles (“hybrids”) make up just less than 1% of the total, though it is important to recall that B20 may be utilized in conventional vehicles. AFVs and hybrids are dominated by Flex Fuel Vehicles, which comprise 88% of AFVs. Hybrids make up 11% of the total. While not

⁴ U.S. DOT Bureau of Transportation Statistics. (2013). *Number of U.S. Aircraft, Vehicles, Vessels and Other Conveyances*. Retrieved January 6, 2014 from http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/publications/national_transportation_statistics/html/table_01_11.html

considered AFVs, hybrids are nevertheless an important strategy for reducing petroleum dependence.

Figure 3 charts the change in AFVs and hybrids in service over the period 2004 – 2011. E85 and hybrid vehicles are excluded from the figure to illustrate the relative change among the remaining AFVs, which are far fewer in number. While not depicted in **Figure 3**, the totals of hybrid and E85 vehicles have grown steadily (66% and 30%, respectively) since 2004, with the exception of 2008 – 2009, a period which coincides with the global economic recession.

FIGURE 3: AFV AND HYBRID VEHICLE SUPPLY, 2004 - 2011



As **Figure 3** indicates, electricity-powered vehicles have grown dramatically since 2010. CNG vehicles have also seen sustained growth after a recent decline. In fact, electric, CNG, LNG and propane vehicles have yet to exceed totals achieved approximately ten years ago.⁵

Conditions in the six county North Florida region are similar to the national baseline. Considering available data, consumption of alternative fuels is well below 1%, or just less than an estimated 500,000 gallons per year in 2013. Based on available data, propane appears to make up about 73% of present alternative fuel consumption in North Florida, with biofuels supplying about 15%, electricity 6% and E85 6%. In the past, there has been little or no natural gas or hydrogen use. Historical time-series data is not available to characterize the rate of alternative fuel use or AFV adoption in North Florida. However, data available for EVs and PHEVs appears to mirror the rapid growth seen nationally. As discussed in the next section, available information indicates that North Florida may be poised to experience unprecedented growth in alternative fuels, vehicles and infrastructure.

⁵ Energy Information Administration. (2013). Alternative Fuel Vehicle Data. Retrieved January 6, 2013 from <http://www.eia.gov/renewable/afv/index.cfm>

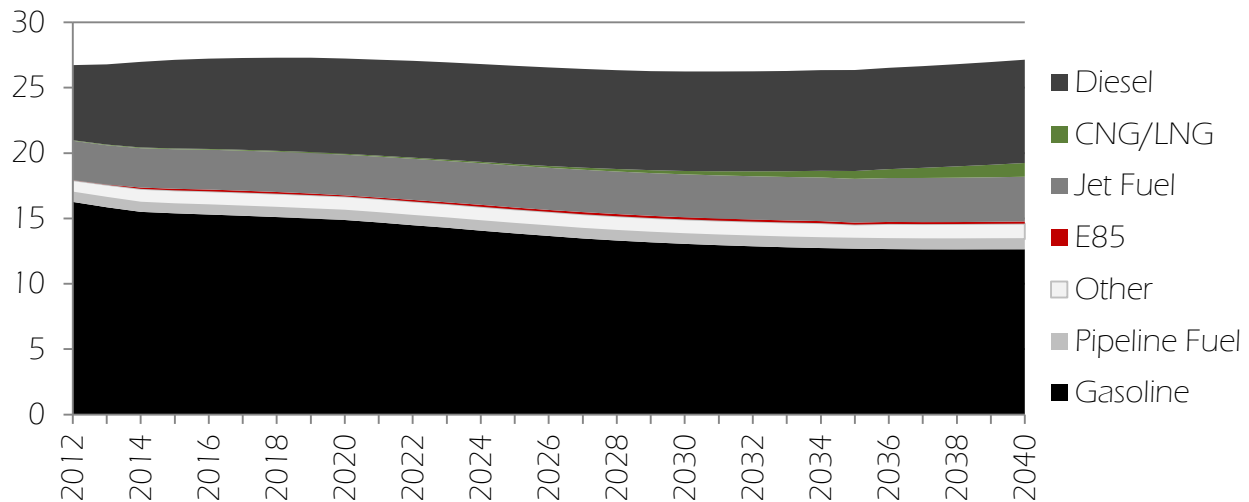
3.3. FORECAST⁶

Through 2040, gasoline consumption in the U.S. is forecast to decrease, while diesel consumption will increase. However, as a whole, petroleum consumption in the transportation sector will decrease. Including all fuels, total energy consumption in this sector will remain flat relative to 2011. These forecasted transportation changes are unprecedented. They are attributable to moderating increases in vehicle miles travelled, increasing use of alternative fuels (biofuels and natural gas, in particular) and increased fuel efficiency for light duty vehicles (LDVs).

Corporate average fuel economy (CAFE) standards, along with rising fuel prices⁷ and changing consumer preferences lead increases in fuel efficiency. These factors are expected to raise fuel economy from 32.5 in 2012 to nearly 50 mpg in 2040. Higher fuel efficiency along with mandates for the use of E85 help explain reduced use of gasoline and increased use of diesel.

While energy consumption is forecast to decrease for LDVs, it will increase for heavy-duty vehicles, which primarily rely on diesel. Increased use of biodiesel and other biofuels, as well as natural gas, may offset some diesel consumption. These trends are reflected in Figure 4, which charts expected changes in transportation energy from 2012 through 2040.

FIGURE 4: FORECASTED TRANSPORTATION ENERGY CONSUMPTION (QUADRILLION BTUS)



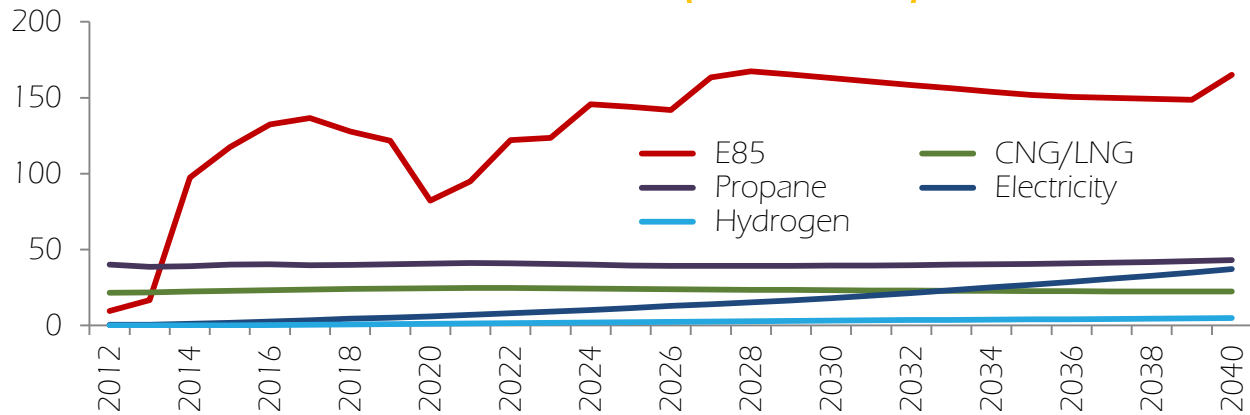
Alternative fuels will continue to make up a small share of total transportation fuel used in LDVs. Nevertheless, electricity and E85 use in LDVs is forecast to grow 17% and 4.3%, respectively, between 2011 and 2040, with E85 making up the majority of alternative fuel use (Figure 5).

⁶ Data in this section is sourced from the U.S. Energy Information Administration (EIA) Annual Energy Outlook 2013 (AEO13):

<http://www.eia.gov/forecasts/archive/aeo13/index.cfm>

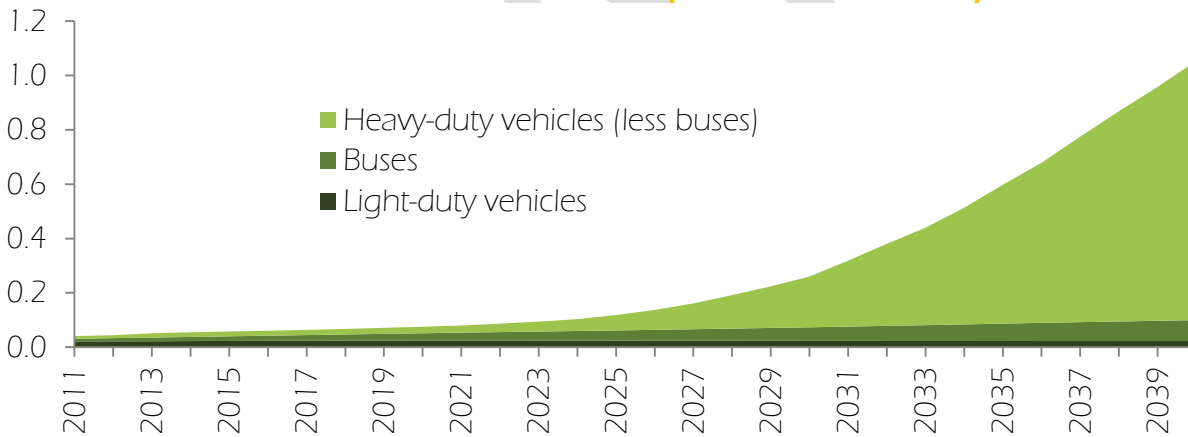
⁷ At the end of 2013, the spot price for oil was just above \$90 per barrel. Looking forward, world prices are projected to range anywhere between \$73 and \$235 a barrel by 2040, with \$160 as a reference case. [EIA (2013). *AEO13: Petroleum Product Prices*. Retrieved January 7 2013 from <http://www.eia.gov/forecasts/archive/aeo13/data.cfm?filter=oil#oil>]

FIGURE 5: FORECASTED LDV ALT. FUEL USE (TRILLION BTU)



In most heavy-duty vehicles (HDVs), diesel will remain the dominant fuel. However, natural gas use in this sector is forecast to grow faster than all other alternative fuels. **Figure 6** charts this growth. Among freight trucks, natural gas use will increase significantly (16.9%), with consumption overtaking propane around 2020 and going on to supply about 20 times more energy than propane by 2040. Natural gas will overtake diesel as the dominant fuel in transit buses by the early 2030s. Among school buses, diesel remains dominant, with relatively small amounts of demand met by natural gas and propane.

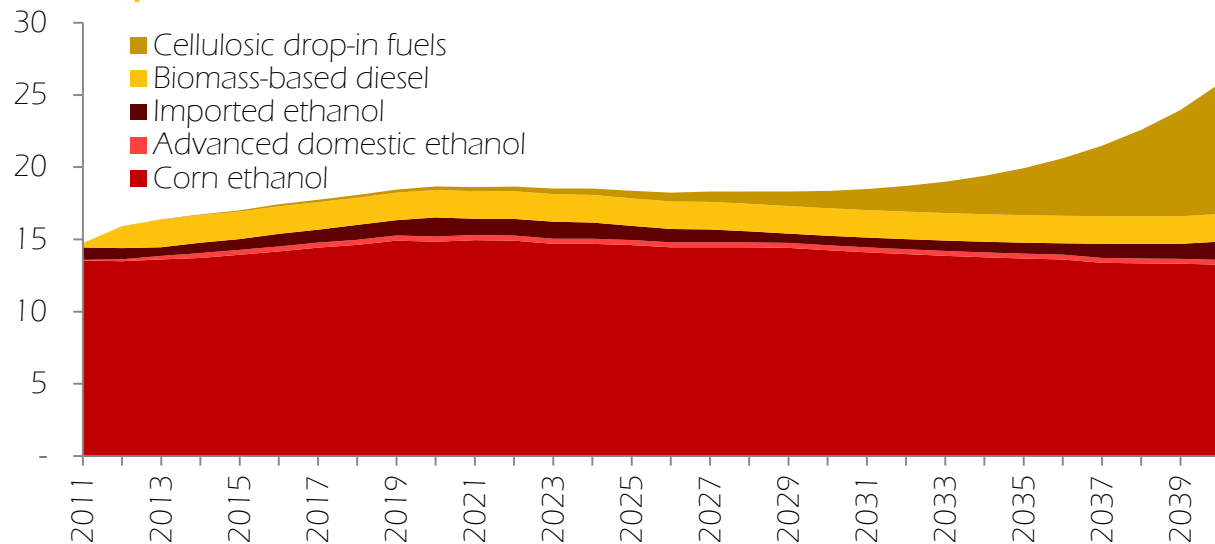
FIGURE 6: FORECASTED NATURAL GAS USE (QUADRILLION BTU)



Biofuel consumption is also forecast to grow, with bio-based diesel alternatives offsetting some diesel use in HDVs. However, consumption of most biofuels will decline after the 2020s as a result of Federal Renewable Fuel Standard (RFS) policies. The RFS sets standards for increasing the volume of biofuels blended into gasoline and diesel. Compliance with the standard is tracked via credits representing gallons of biofuels produced or imported. New federal policies developed between now and 2020 may affect this projection.

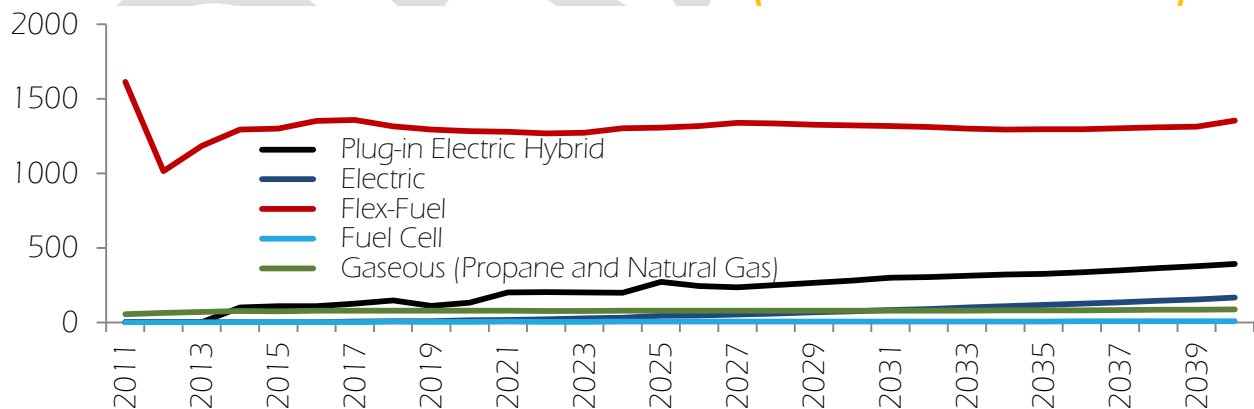
Figure 7 charts the production of biofuels, including E85 and biodiesel in terms of RFS credits. It indicates that cellulosic drop-in fuels, which are not used in significant amounts today, account for all of the increase in biofuels in the latter years.

FIGURE 7: PROJECTED BIOFUELS PRODUCTION (BILLION EISA2007 RFS CREDITS EARNED)



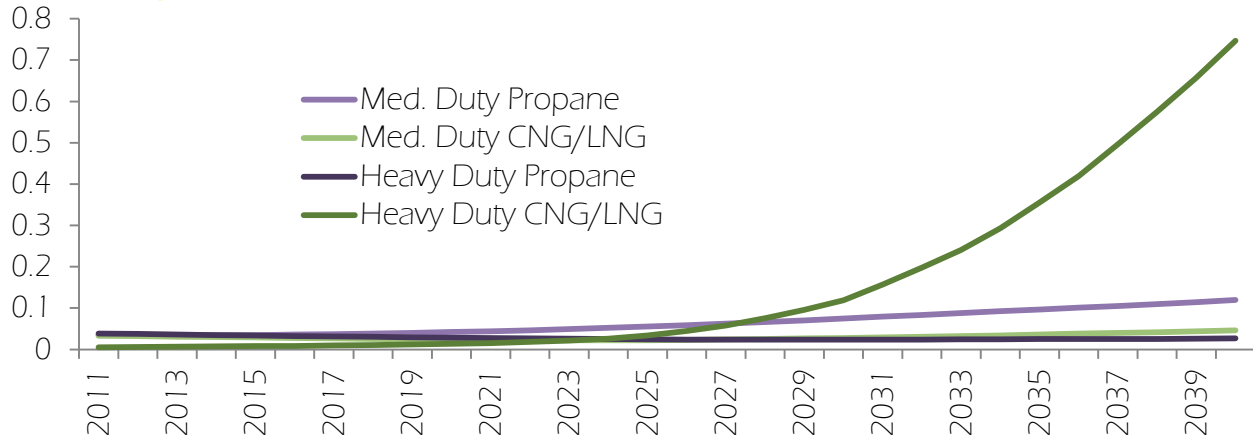
Demand for Alternative Fuel Vehicles is forecast to increasing. In the LDV category, sales will grow from 20% of all new sales in 2011 to 49% in 2040. These vehicles will be dominated by flex fuel and “micro-hybrid” vehicles, which reduce ICE idling. Sales of gasoline- and diesel-hybrid electric vehicles, plug-in electric vehicles and electric vehicles will grow significantly. Within fleets with passenger cars and trucks up to 10,000 pounds (i.e. light-duty trucks), natural gas and propane vehicles will be favored, with electric vehicles also playing a significant role. **Figure 8** charts expected growth in AFVs in the LDV category. Hybrid vehicles, including micro-hybrids, which are not considered AFVs, are excluded from this chart, though they dominate sales.

FIGURE 8: FORECASTED LIGHT-DUTY AFV SALES (THOUSANDS OF VEHICLES)



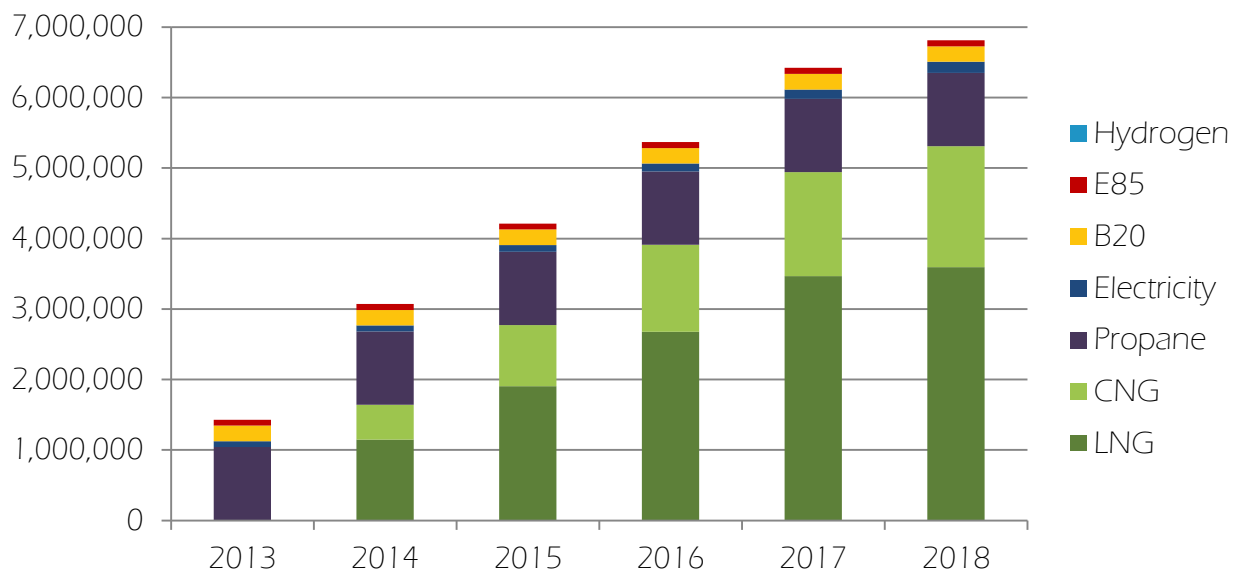
Among larger vehicles, natural gas and propane are projected to be the dominant AFV types. In the mid-size range, they are expected to account for between 1% and 2% of vehicles, respectively. Among HDVs, natural gas vehicles will be the dominant type, growing nearly 20% over the period to 10% of the HDV stock. **Figure 9** shows expected changes in medium and heavy duty AFVs. Note that conventional vehicles utilizing biodiesel blends are not included in the figure.

FIGURE 9: FORECASTED MEDIUM- AND HEAVY-DUTY AFV STOCKS (MILLIONS OF VEHICLES)



Although forecasts for alternative fuel use and vehicle adoption in North Florida are limited by available data, local developments will likely mirror national trends in many cases, based on existing and publically announced projects. In particular, use of natural gas appears to be poised for a dramatic increase over the next few years. **Figure 10** charts current and projected alternative fuel use in North Florida by fuel type. Data in this figure represent known and announced alternative fuel projects. **Section 8** of this Plan details on-going and projected projects in further detail. It does not include non-road projects. Further, it is the intention of this plan to significantly influence the future state of Alternative Fuels in the region. **Section 9** details strategies to expand the presence of petroleum alternatives in North Florida.

FIGURE 10: PROJECTED ALTERNATIVE FUEL USE BASED ON ON-GOING AND PLANNED PROJECTS (GALLONS)





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4. FUELS

In this section, the sources, prices, energy content and emissions of alternative fuels are compared and contrasted. As noted in Section 3, alternative transportation fuels include biodiesel, electricity, ethanol, hydrogen, natural gas and propane. These fuels share in common the potential to significantly displace use of gasoline and diesel fuels. Otherwise, they are each very different, with unique characteristics that help determine their highest and best use.

4.1. SOURCES

In 2012, about 40% of domestic consumption of gasoline and diesel was imported, with 65% coming from Canada, Saudi Arabia, Mexico, Venezuela and Russia. Imports are expected to decline over the near term, but increase over the long term.⁸

Both gasoline and diesel are refined and distributed domestically. Florida has no petroleum refineries. Transportation fuels are imported primarily from refineries in Louisiana, Texas and Mississippi via tanker and barge. Jacksonville is one of the state's primary marine terminals for these imports. Imports to the region are also received via Port Canaveral and Tampa.

By contrast, alternative fuels are largely domestically produced and often locally distributed, providing a variety of potential benefits to the United States and North Florida. The sources and distribution of Alternative Fuels is diverse, as indicated below. These differences have implications for the availability, price and environmental benefits of the various Alternative Fuels.

BIODIESEL

The sources of biodiesel are diverse, including first-generation and second-generation sources. First generation sources include primarily soybean oil, as well as rapeseed oil. Second-generation sources include vegetable oils and animal fats, often the waste products of food production or restaurants. Biodiesel is made at production facilities and shipped or trucked to fuel distributors. Distributors supply conventional retail gas stations. Biodiesel is also commonly locally produced and used on a small scale from secondary sources.

There are no large-scale biodiesel production facilities in North Florida. There are six within a 300 mile radius of downtown Jacksonville, including three in Florida.⁹ The U.S. DOE Energy Information Administration reports an annual capacity of just 3 million gallons per year, significantly less than adjacent states. Biodiesel is produced on a small scale by St. Johns County using secondary sources. In the past, the County has produced up to about 250 gallons of biodiesel per day for exclusive use in its vehicle fleet.



⁸ Florida produced less than 6,000 barrels of oil per day and 18 billion cubic feet of natural gas in 2012. By contrast, the U.S. as a whole produced over 6 million barrels of oil per day and just under 24,500 billion cubic feet of natural gas in the same year.

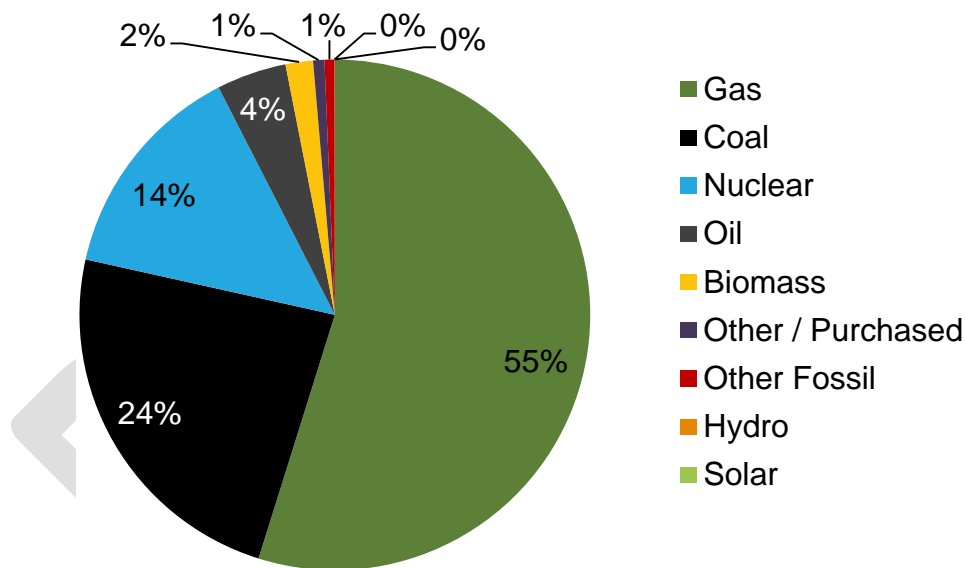
⁹ Producers listed in the National Biodiesel Board database located within 300 miles of downtown Jacksonville include: Down to Earth Energy, Inc. (Monroe, GA), Genuine Bio-Fuel (Indiantown, FL), GGS (FTMyers FL), Seminole Biodiesel (Bainbridge, GA), Southeast BioDiesel (North Charleston, SC) and Viesel Fuel, LLC (Stuart, FL)

While there are no distributors within the North Florida study area, both First Coast Biofuels in Lake City and Daytona Biofuels in Holly Hill are in close proximity. Presently, there are no retailers of biodiesel in North Florida. However, the ASTM standard for conventional diesel fuel allows biodiesel content of up to 5% without labeling the fuel as biodiesel. A private B20 fueling station is operated by Marine Corps Blount Island.

ELECTRICITY

Electricity used in EVs and PHEVs is primarily sourced from the electric grid. The grid is supplied, operated and maintained by a national network of electric utilities. The feedstocks that utilities use to produce electricity vary widely across the nation, ranging from coal to hydroelectric power. Their share of electricity production constantly changes in response to economic, regulatory, technological and logistical factors, among others. In North Florida, electricity is produced locally by JEA and Florida Power and Light. It is distributed to end-users by JEA, Beaches Energy, Clay Electric, Florida Power and Light and the City of Green Cove Springs. The sources of Florida's electricity are shown in **Figure 11**, according to data reported to the U.S. Environmental Protection Agency in 2009 and reported in 2012.

FIGURE 11: FLORIDA ELECTRIC PRODUCTION RESOURCE MIX, 2009¹⁰



E85

As with biodiesel, the potential sources of ethanol are diverse, including starch- and sugar-rich plants traditionally grown as food sources and non-food plants. Corn is the dominant source of ethanol in the United States. Non-food feedstocks are commonly referred to as “cellulosic,” since chemical processes are used to convert plant cellulose into fuel. Cellulosic feedstocks require fewer resources to grow, but technological and economic barriers have limited commercial-scale production.

Historically, there has been no significant ethanol production in Florida. However, several private cellulosic ethanol projects have received state funding in recent years, which may

¹⁰ EPA. (2012). eGRID2012 Version 1.0 Year 2009 Summary Tables.
http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf

result in increased domestic production. Ethanol is distributed by First Coast Biofuels in Lake City. The City of Jacksonville operates a private E85 fueling station for use in the Jacksonville Sheriff's Office Fleet. However, at present, there are no retailers of E85 in North Florida.

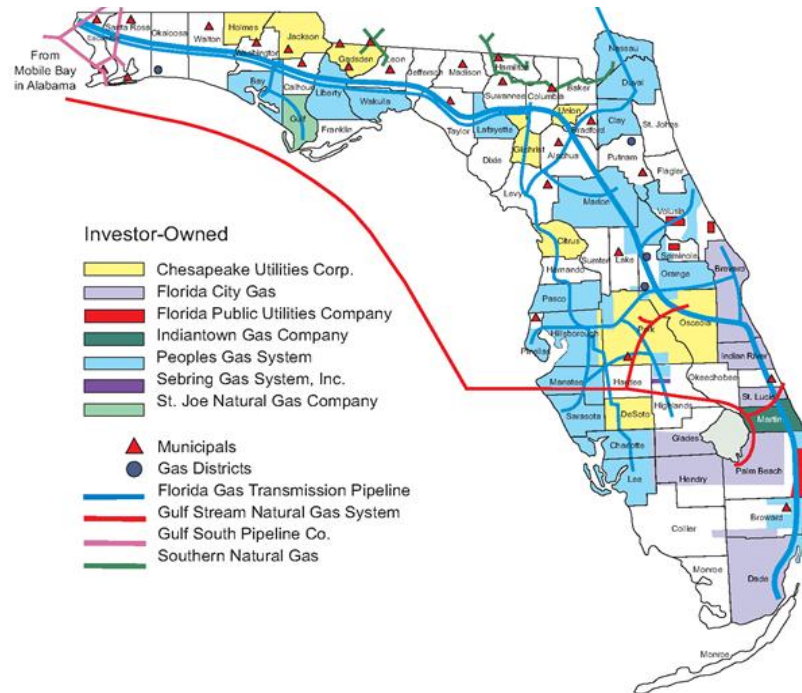
HYDROGEN

Hydrogen is currently produced domestically through steam reforming of natural gas. Electrolysis is a less-used method. Research on cleaner and more efficient methods of producing hydrogen is on-going. Hydrogen is primarily used in industrial applications, where it is typically produced on site. It can be distributed via pipeline, tankers, rail and truck via high pressure or cryogenic containers. However, infrastructure for producing and delivering hydrogen to support the transportation sector does not presently exist in the U.S. There are no sources for hydrogen for use in vehicles in North Florida.

NATURAL GAS

Natural gas is largely produced domestically. An extremely small amount is produced in Florida, with the raw gas processed out of state. Processed natural gas reaches North Florida via an interstate network of transmission pipelines (Figure 12).

FIGURE 12: EXISTING NATURAL GAS TRANSMISSION PIPELINES IN FLORIDA



In the past, these pipelines have predominately transmitted gas from production centers in Louisiana, Texas and Mississippi. Existing pipeline connections to the north, as well as new pipeline projects are expected to allow Florida to diversify its sources by connecting it to shale gas producers in the Midwest.

At the local level, natural gas is distributed to end-users via TECO People Gas, which operates and maintains a gas distribution network.

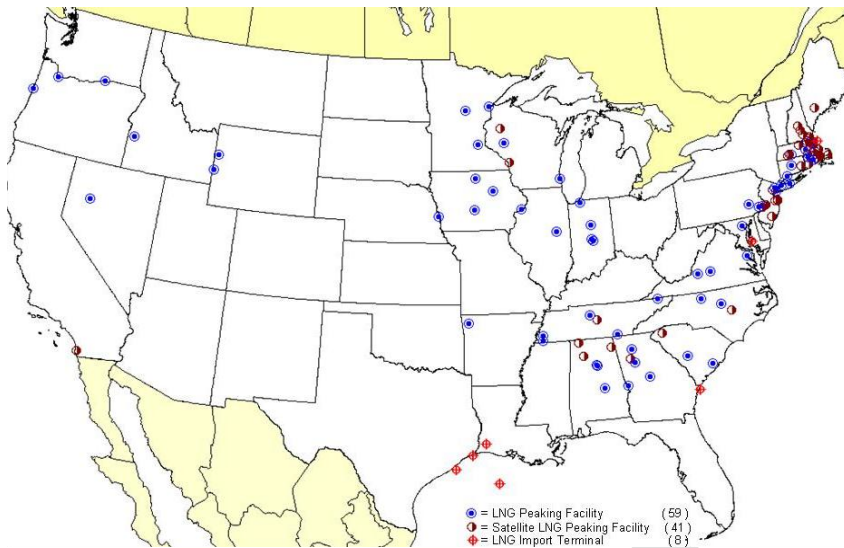


FIGURE 13: CURRENT LNG LIQUEFACTION, STORAGE AND IMPORT FACILITIES

Natural gas is compressed or liquefied for use in transportation. Compressed Natural Gas is produced near the end-use. Natural gas supplied by the local distributor is dried, filtered and compressed to about 3,600 pounds per square inch (psi) for dispensing to vehicles.

LNG is produced regionally in liquefaction plants (Figure 13). The majority of these facilities have been designed to support export of natural gas or to meet spikes in

demand for home heating. A small minority produce LNG for transportation uses, although this number is expected to grow. In liquefaction plants natural gas is purified and cooled to -260°F. It is then trucked to fueling stations, where it is stored on site. LNG may be converted to CNG at such sites.

Presently, there are no LNG production, storage or import / export facilities in Florida. However, in late 2013, Clean Energy Fuels Corporation announced plans to build an LNG fuel production terminal designed specifically to serve the transportation sector in Jacksonville. The terminal would be the first of its kind on the east coast. More detail on CNG and LNG fueling stations is provided in **Section 6: Infrastructure**.

PROPANE

Propane is produced by gulf state refineries as a by-product of oil refining or natural gas processing. The portion of propane ultimately sourced from domestic or foreign oil is not possible to ascertain. Ultimately, the fuel is transported by rail and/or truck to bulk storage plants, which deliver propane to wholesale and retail customers. There are over 13,000 such plants in the U.S. In North Florida, there are over 8 retailers of propane for use in vehicles. More detail on propane fueling stations is provided in Section 6 (Infrastructure).

4.2. ENERGY CONTENT

Because alternative fuels take a variety of forms, ranging from liquid to gas it is challenging to compare alternative fuels on a common basis. The energy content of the fuels varies significantly and this influences the cost to operate AFVs and alternative fuel infrastructure relative to conventional options. **Table 2** summarizes the heat content of petroleum and alternative fuels in their most common unit of consumption and compares them on a gasoline gallon equivalent (GGE) and diesel gallon equivalent (DGE) basis.

In **Table 2** gasoline, diesel, biodiesel, E85, hydrogen, LNG and propane are all evaluated on a per gallon basis. Electricity is evaluated on a per kilowatt-hour basis and CNG on a per Therm

basis. Electricity is a non-volumetric energy “carrier” produced from other feedstocks (e.g. coal, natural gas, etc.). CNG is a gas. CNG and LNG are often retailed on a GGE or DGE basis.

TABLE 2: ENERGY CONTENT COMPARISON OF TRANSPORTATION FUELS

Fuel (unit)	Heat Content (BTU / unit)	GGE	DGE
Gasoline (gal)	115,400	1.00	0.88
Diesel (gal)*	127,500	1.14	1.00
B100 (gal)	117,000	1.05	0.92
B20 (gal)	104,000	1.12	0.98
Electricity (kWh)	3,412	0.31	0.27
E85 (gal)	76,000	0.73	0.64
Hydrogen (gal)	27,800	0.25	0.22
CNG (Therm)	93,000	0.83	0.73
LNG (gal)	71,000	0.64	0.56
Propane (gal)	83,500	0.74	0.65

*Ultra-low sulfur diesel, 10 ppm sulfur

4.3. PRICES

Table 3 compares the current average price of alternative fuels to gasoline and diesel as of October 2013 for the Lower Atlantic Region.¹¹ Prices in this region are generally lower than the national average. Local prices can vary as well based on several factors. Prices are shown in dollars per gallon (Gal), dollars per gasoline gallon equivalent (GGE) and dollars per diesel gallon equivalent.

When comparing prices of alternative fuels, it is important to understand the basis of comparison. Comparisons based on price per gallon alone do not account for the different energy content of fuels. As of October 2013, only the price of CNG is lower than gasoline and diesel fuel on a per gallon and an equivalent energy basis.

TABLE 3: CURRENT AVERAGE PRICES OF FUELS (OCTOBER 2013), LOWER ATLANTIC REGION¹²

Fuel	\$/gal	\$/GGE	\$/DGE
Gasoline	\$3.34	\$3.34	\$3.72
Diesel	\$3.83	\$4.27	\$3.83
B20	\$3.85	\$3.52	\$3.93
B100	\$4.02	\$3.96	\$4.42
Electricity	*	*	*
Hydrogen	**	**	**
E85	\$3.11	\$4.74	\$5.29
CNG	\$2.06	\$2.06	\$2.30
Propane	\$3.00	\$4.15	\$4.62

*Electricity is sold on a per kilo-watt basis not directly comparable to volumetric measures such as gallons.

**Prices for hydrogen are not currently tracked.

¹¹ The Lower Atlantic Region includes Florida, Georgia, South Carolina, North Carolina, Virginia and West Virginia.

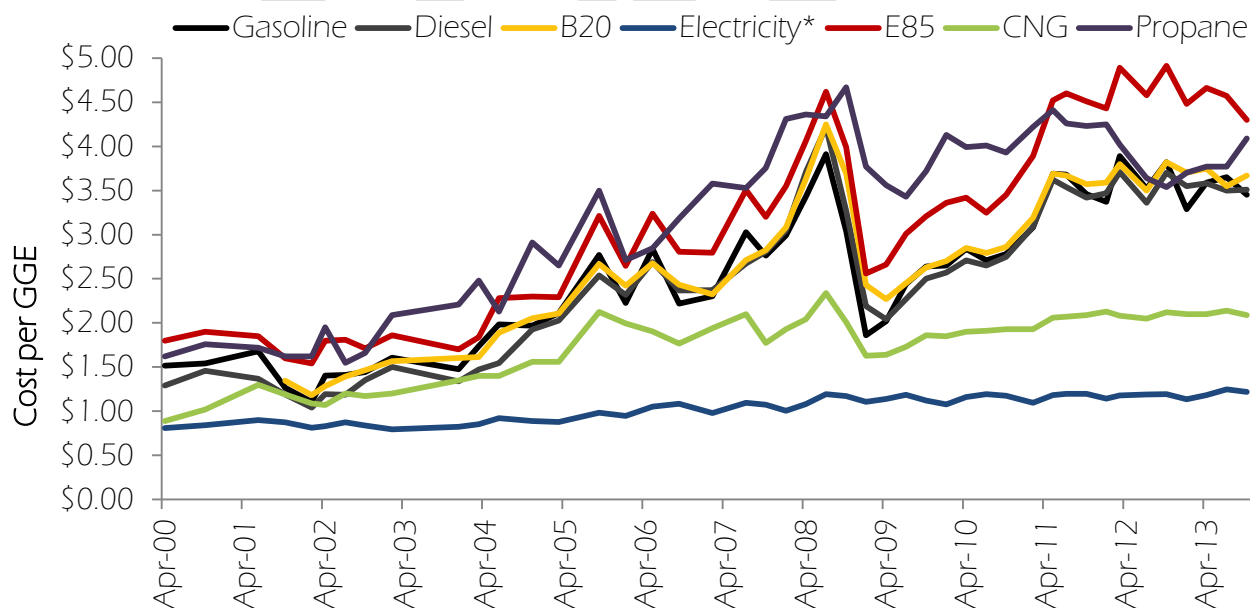
¹² DOE. (2013). Clean Cities Alternative Fuels Price Report. <http://www.afdc.energy.gov/fuels/prices.html>

Biodiesel is produced, distributed and retailed at a commercial scale, generally on a regional basis. The national average price for this kind of production is shown in **Table 3**. Biodiesel may also be produced locally on a small scale. **Table 3** does not reflect the price of this kind of production, which can be substantially lower. Prices for hydrogen and LNG are not yet widely tracked and are not included in the U.S. Department of Energy's quarterly Alternative Fuel Price Reports. LNG prices are generally higher than CNG prices but lower than diesel prices. Electricity is sold on a per kilowatt-hour (kWh) basis rather than a per gallon basis, making direct comparisons between the price of electricity and gasoline difficult. However, the cost to charge an electric vehicle is significantly less than the cost to fuel a comparable gasoline vehicle due to the relatively low cost of electricity and the high efficiency of electric motors.¹³

In addition to these factors are incentives offered at the Federal and State level that affect the price of fuels. Incentives have been available to producers, distributors and consumers of fuel in the past. Section 7 details these incentives.

Figure 14 charts the average retail price of alternative fuels relative to gasoline and diesel over the past 13 years. Prices are presented in terms of dollars per gaseous gallon equivalent (GGE). The chart indicates that the prices for biodiesel, ethanol and propane have generally been equal to or more than diesel and gasoline on a GGE basis. These fuels have exhibited volatility comparable to gasoline and diesel in the past, since the demand for alternative fuels tends to rise as the price of conventional fuels increase. CNG and electricity have been less expensive than diesel and gasoline on a GGE basis. They have exhibited less volatility, since demand for these fuels for transportation purposes is small compared to other end-uses.¹⁴

FIGURE 14: U.S. AVERAGE RETAIL FUEL PRICES, 2000 - 2013



*Electricity prices reduced by a factor of 3.4. An electric motor is approximately 3.4 times as efficient as an ICE.

¹³ Currently, electric vehicles travel approximately 0.25 miles per kilowatt hour. With a North Florida regional average electric rate of about \$0.12 / kWh in 2012, an owner might spend about \$0.03 per mile on electricity to operate an EV. By comparison, the gasoline to operate a gasoline vehicle at 24.6 miles per gallon would cost about \$0.13 per mile.

¹⁴ The price of natural gas is increasingly a major component of the cost of electricity as the nation's electric utilities shift the source of power production from coal to natural gas.

4.4. EMISSIONS

Alternative fuel vehicles have the potential to reduce pollution in the transportation sector, including air pollution and greenhouse gas emissions.

Air pollution from transportation includes so-called Criteria Air Pollutants regulated by the Clean Air Act. These include Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), and Particulate Matter (PM). Some of these pollutants, together with Volatile Organic Compounds (VOC) can form ground-level ozone, pollutant of concern. These pollutants can have significant health and environmental effects, ranging from asthma to acid rain. Several federal programs, including the Congestion Mitigation and Air Quality Improvement (CMAQ) Program, are aimed at reducing air pollution from the transportation sector.



Greenhouse gas (GHG) emissions, including releases of Carbon Dioxide (CO₂), are also closely linked to transportation. The transportation sector is the second largest source of anthropogenic (i.e. “human-caused”) emissions in the U.S., or nearly 30% of the total. Anthropogenic GHG emissions are a leading cause of climate change, which will likely present significant challenges to the economy and society going forward.

To evaluate air pollution and GHG reduction benefits of alternative fuels and vehicles, both fuel production and vehicle operation must be considered. Petroleum, natural gas, coal, biomass and electricity are feedstocks used to produce fuel. Each has a different impact on air quality and GHG emissions. These fuels may be utilized by a variety of transportation technologies, ranging from ICEs to fuel cell vehicles. Assessing both fuel production and vehicle operation technologies allows a common comparison between the fuels.

AIR QUALITY

Increasingly stringent emissions regulations are leading to improved emissions control systems in conventional light and heavy duty vehicles after the 2010 model year. Since these technologies are commonly applied after combustion, air quality from transportation is expected to improve regardless of fuel or efficiency of vehicles. Nevertheless, several alternative fuels can help improve air quality further. A few alternative fuels may have a negative effect on air quality relative to standard fuels. These characteristics are summarized in **Table 4**. It shows [percent reductions](#) (or [increases](#)) relative to standard vehicle emission rates (in grams per mile).



TABLE 4: ESTIMATED AIR QUALITY EMISSIONS OF ALTERNATIVE FUELS RELATIVE TO CONVENTIONAL FUELS¹⁵

Fuel / Technology	NOx	VOC	CO	PM10
Biodiesel	+3%	-20%	-10%	-8%
Electricity (EV) ¹⁶	-96%	-96%	-96%	-11%
Ethanol	+8%	+2%	0%	+1
Hydrogen	-96%	-96%	-96%	-1 to -11%
Natural Gas (CNG)	-19 to 0%	-72%	*	*
Natural Gas (LNG)	-5% to +4%	-72%	*	-1 to -2%
Propane	+3 to +26%	+600%	0%	0%

*Data not available

Use of biodiesel can improve air quality relative to conventional diesel fuel. Some studies indicate that the slight increase in NOx emissions indicated in **Table 4** may be closer to zero. Meanwhile, advances in diesel emissions control technologies may reduce differences between alternative and conventional fuels and vehicles in the future.

Electric vehicles have no tailpipe emissions. As a result, the relative air quality quantities shown in **Table 4** for electric vehicles are predominantly the result of fuel production rather than vehicle operation. PHEV and gasoline or diesel / electric hybrids (HEV) reduce emissions less than EVs, since a portion of their operation is conducted in a conventional mode. For EVs and PHEVs, emissions are highly dependent on the fuels utilized by local electric utilities to generate power.

As with electric vehicles, there are essentially no significant tailpipe emissions from hydrogen vehicles. PM emissions associated with hydrogen are mainly the result of electricity used in production.

The air quality benefits associated with natural gas vehicles are higher for passenger vehicles than for heavy duty vehicles. Benefits for LNG are slightly smaller than for CNG due to the energy used in processing the fuel.

Ethanol is notable for having a negative effect on air pollution relative to gasoline. This is a result of emissions that occur during feedstock farming and ethanol production. There is relatively little variation in emissions among the various potential ethanol feedstocks (e.g. corn, sugar cane, cellulosic, etc.). Importantly, most emissions associated with this fuel occur outside of urban areas. As a result, use of ethanol in an urban context, where air pollution is typically more severe, may still have beneficial effects.

Propane is notable for significantly increasing VOC emissions relative to conventional fuels. This is primarily a result of venting from storage tanks. Currently there is no regulation for

¹⁵ TIAX, LLC (2007) Fuel Cycle Assessment: Well-to Wheels Energy Inputs, Emissions, and Water Impacts, Retrieved January 20, 2014 from: <http://www.energy.ca.gov/2007publications/CEC-600-2007-004/CEC-600-2007-004-F.PDF>

¹⁶ Table 4 reflects conditions in California, which is among the “cleanest” grids in the United States. The air quality benefits of electric vehicles in North Florida may be expected be less than those shown in Table 3.

limiting venting losses. Increases in NO_x are much smaller if propane is sourced as a by-product of petroleum refining rather than natural gas production.

GHG EMISSIONS

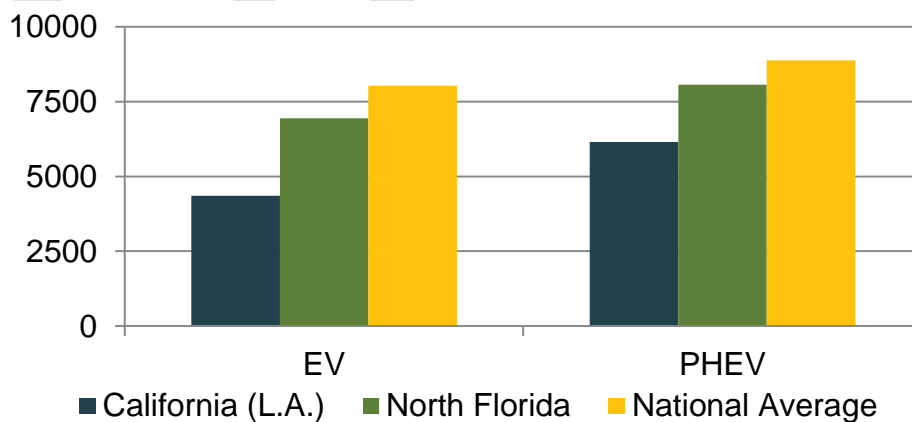
All alternative fuels / technologies are expected to reduce GHG relative to conventional petroleum-based fuels. **Table 5** summarizes the relative rate of GHG emissions (i.e. grams per mile) of alternative fuels relative to gasoline or diesel. The data presented in this table are sourced from a study of alternative fuels commissioned by the California Energy Commission based on conditions in that state.¹⁷

TABLE 5: ESTIMATED GHG EMISSIONS OF ALTERNATIVE FUELS RELATIVE TO CONVENTIONAL FUELS

Fuel / Technology	GHG
Biodiesel	-10 to -13%
Electricity	-48 to -72%
Ethanol	-15 to -28%
Hydrogen	-26 to -91%
Natural Gas (CNG)	-11 to -30%
Natural Gas (LNG)	-11 to -16%
Propane	-18 to -20%

As with air quality emissions, GHG emissions from EVs are a function of the fuel mix of local electricity generators. PHEVs and HEVs reduce emissions less than EVs when operated in the conventional fuel mode. **Table 5** displays the range of emissions reductions expected for EVs operating on the California grid. In Florida, EV emissions are likely to be higher than California, but less than the national average. **Figure 15** shows how EV and PHEV emission rates in Florida would compare to the national average and to Los Angeles, CA. The table suggests that EVs in Florida could reduce emissions by about 47% relative to a conventional gasoline vehicle.

FIGURE 15: REGIONAL COMPARISON OF EV EMISSIONS (ANNUAL LBS CO₂e PER VEHICLE)



¹⁷ TIAx, LLC (2007) Fuel Cycle Assessment: Well-to-Wheels Energy Inputs, Emissions, and Water Impacts, Retrieved January 20, 2014 from: <http://www.energy.ca.gov/2007publications/CEC-600-2007-004/CEC-600-2007-004-F.PDF>

GHG emissions from ethanol are highly dependent on the feedstock. In the U.S. the predominant feedstock is corn, which is less efficient than sugar-cane or cellulosic (e.g. non-food) sources. Both changes in corn-based ethanol farming techniques and development of alternative domestic feedstocks could drive improvements in the GHG emissions profile of ethanol.

Like ethanol, GHG emissions from hydrogen are highly dependent on the source. The greatest emission reductions are from hydrogen produced with renewable electricity (e.g. solar or wind) or biomass, neither of which is widely used for this purpose. Natural gas is currently the primary source. Hydrogen produced from conventional electricity is the least beneficial method of production.

Opposite from the case with air emissions, higher GHG reductions result from propane sourced from natural gas versus petroleum.

5. VEHICLES

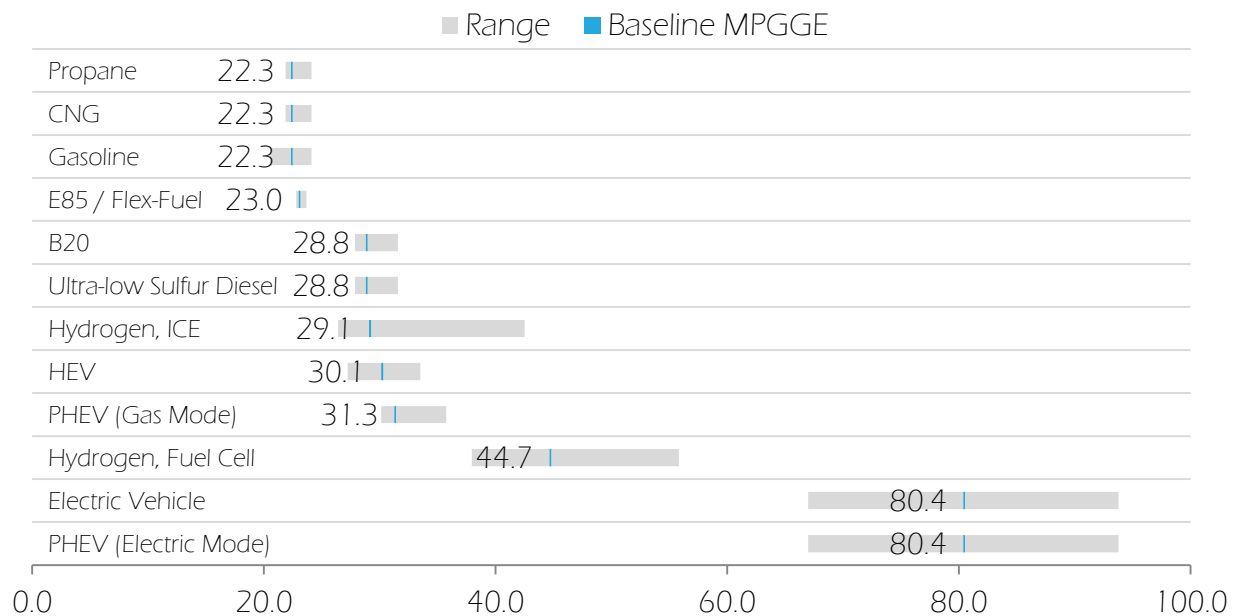
Vehicles that utilize alternative fuels are diverse. Some of these differences are the result of the fuels themselves, others the technologies required to utilize them. The differences lead to end-use applications where certain alternative fuel vehicles may be more appropriate than others, based on operational and economic considerations. In this section, several of the most important characteristics of AFVs are compared and contrasted, including fuel economy, range, cost and availability of vehicles.

5.1. FUEL ECONOMY

As shown in [Section 4.3](#), the energy content of alternative fuels varies. The efficiency with which AFVs convert energy into motion also differs. These differences have implications for the applications in which AFVs are most appropriate.

Figure 16 compares the energy efficiency (i.e. “fuel economy”) of mid-size, light-duty vehicles, including several AFVs. Efficiency is measured in miles per gasoline gallon equivalent (MPGGE). The energy efficiency of differently-sized cars varies but the relative differences are similar. The figure indicates that EVs are the most efficient, followed by hydrogen fuel cell vehicles. Vehicles operating on diesel and B20, as well as gasoline / electric hybrids and hydrogen internal combustion engine vehicles follow. E85, propane and CNG vehicles are similar to standard gasoline vehicles.

FIGURE 16: ENERGY EFFICIENCY OF MID-SIZE, LIGHT DUTY VEHICLES



The relative energy efficiencies of heavy duty vehicle technologies are shown in [Table 6](#). Values are presented in terms of Energy Economy Ratios (EER). EER is a ratio of the fuel economy for AFVs to baseline diesel fuel economy (i.e. the EER for diesel is 1). There is little variation in the efficiency of AFVs relative to conventional HDVs. [Table 6](#) indicates that CNG, LNG and autogas vehicles are slightly less efficient than a conventional diesel vehicle, while B20 vehicles have essentially similar fuel economy.

TABLE 6: ENERGY EFFICIENCY OF HEAVY DUTY VEHICLES

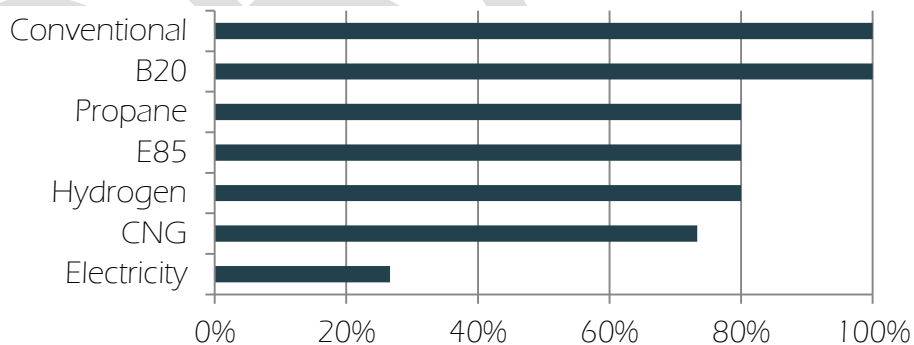
Technology	EER
LNG	0.93
Propane	0.94
CNG	0.94
Diesel	1
B20	1
Hybrid, Gasoline	1.1
Hydrogen, ICE	1.1
Hybrid, Diesel	1.25
Hydrogen, Fuel Cell	1.5
EV	2.7

5.2. RANGE

Range is the distance a vehicle can travel between fuelings. Manufacturers attempt to optimize AFVs to have a driving range as close as feasible to conventional vehicles. Conventional LDVs, for example, have a range of about 300 miles. As with some AFVs, the range of conventional heavy-duty vehicles is largely determined by the amount of fuel carried on-board. This varies considerably according to the vehicle application. The size and weight of some alternative fuel tanks can have the effect of limiting AFV range.

Household-based use of vehicles is composed of short trips. Drives of 100 or more miles account for less than 1% of total trips and 15% of total miles travelled.¹⁸ Commercial use is various. For many fleets, range is a primary operational factor. Figure 17 provides a generalized relative comparison of driving ranges of light-duty vehicles.

FIGURE 17: RELATIVE DRIVING RANGE OF LDVS¹⁹



B20 has an energy content similar to conventional diesel and is used in conventional vehicles. As a result, range is comparable.

The range of EVs depends on battery capacity. Present battery technology limits the range of EVs to far less than conventional vehicles – about 70 miles depending upon several factors.

¹⁸ FHWA. (2008). Percent of Trips and Vehicle Miles by Trip Length. Retrieved 2/20/14 from

http://www.fhwa.dot.gov/policyinformation/pubs/pl08021/fig4_5.cfm

¹⁹ The driving range of propane, hydrogen and CNG vehicles is dependent on the size of on-board tanks, among other factors. Manufacturers attempt to optimize tank size to reduce range losses.

PHEVs have been developed, in part, to address “range anxiety” inherent with current EV technology. Advances in battery technology will extend the range of EVs significantly in the near future. Ethanol contains about 73% of the energy contained in conventional gasoline. Used in Flex Fuel vehicles, which are not optimized to take advantage of its higher octane, E85 reduces range by 15% – 25%.

Range affects the two primary natural gas fuels differently. Natural gas is less energy dense than gasoline or diesel, resulting in reductions in driving range. For both CNG and LNG vehicles, manufacturers attempt to optimize the size of fuel storage tanks to reduce range losses. The amount of CNG that can be stored on-board a vehicle is limited. It is also affected by temperature and the speed with which the tank is filled. The result can be reduced range of about 25%. For example the Honda Civic CNG has a range of 220 miles. Heavy-duty CNG vehicles are commonly used in applications in which range is not a primary concern. In a liquid state, natural gas contains more energy. As a result, the range of LNG vehicles is higher than CNG vehicles. LNG vehicles can have a range of beyond 300 miles, making them a feasible choice for long-range heavy-duty applications.²⁰



Propane is less energy dense than conventional fuels. As a result, range can be reduced by 15 – 25%. As with natural gas vehicles, manufacturers attempt to size propane tanks to reduce range losses.

The range of hydrogen vehicles is also defined by the storage capacity of on-board tanks. Since it is an extremely low density gas, storing sufficient quantities onboard has been one of the main technological barriers to commercialization of hydrogen vehicles. The Honda FCX, for example, has a range of 240 miles.

5.3. COST

Most AFVs have higher purchases / lease prices than conventional vehicles. B20 and E85 vehicles are exceptions. The reason for higher prices relate to technologies specific to AFVs. Examples include batteries used in EVs and reinforced fuel tanks used in CNG vehicles. These price premiums limit adoption of AFVs and use of alternative fuels. As a result, a variety of incentives aimed at defraying the cost of certain AFVs exist. **Section 7** details these incentives. Many AFVs exhibit favorable returns on investment after considering fuel consumption, fuel price, and incentives. As production volumes of AFVs increase and technologies advance, costs are expected to go down for all AFVs.

Table 7 qualitatively summarizes the relative price premiums (i.e. between different AFV technologies) associated with AFVs.

²⁰ As LNG warms, it returns to a gaseous state and must be vented to the environment. Consequently, it must be consumed within a relatively short time frame.

TABLE 7: RELATIVE PRICE PREMIUM FOR AFVS

Fuel / Technology	Premium
B20	None
Electricity	Moderate
E85	None
Hydrogen	High
CNG	Low
LNG	Moderate
Propane	Low

Conventional diesel vehicles can operate on B20. Consequently, there is no price premium for utilizing this fuel. Blends higher than B40 likely require vehicle modifications that would require moderate additional investment. Flex Fuel vehicles carry little or no price premium.

The cost to convert a conventional truck to autogas ranges from \$4,000 - \$12,000. Electric vehicles carried a price premium of about \$10,000 on average in 2012, with a higher premium for PHEVs. However, several manufacturers have recently announced significant price reductions. The Honda Civic CNG carries a price premium of about \$7,500. General Motors recently announced bi-fuel CNG vehicles at \$11,000 premiums. For heavy duty vehicles, premiums range from about \$50,000 for a CNG bus to \$90,000 for a LNG tractor-trailer.

Hydrogen vehicles are not widely available (See [Section 5.4](#)). They are expected to carry a very high price premium. For example, the Honda Clarify FCX is leased at \$600 per month, while a Honda Civic is available for \$159 per month.

5.4. AVAILABILITY

Availability of AFVs has been a limiting factor in the past. However, AFVs are now available for nearly every conceivable automobile application. Auto manufacturers are expected to continually expand their offerings of AFVs. There is wide variation in availability of vehicles between the various alternative fuels. For instance, any diesel vehicle can utilize B20, while there are virtually no hydrogen light-duty vehicles available in the North Florida market.

In the light-duty category OEMs produce dedicated AFV models. In addition, many companies offer standard alternative fuel modifications of OEM vehicles. In the HDV category, the situation is more complex. AFVs are available from OEMs in standard models in much the same manner as LDVs. There are also discrete or integrated manufacturers of chassis, engines, or fuel systems that specifically accommodate alternative fuels. A multi-stage manufacturing process involving these systems can be used to produce a wide array of AFV configurations aimed a variety of applications. As a result, heavy-duty AFVs can be customized to meet most needs. After-market conversions are also widely available.

BIODIESEL

All light- and heavy-duty diesel vehicle and engine manufacturers approve use of B5. In the past, few manufacturers approved use of B20. This has changed, with all “Big 3”

manufacturers offering truck and van options.²¹ Choices are fewer in the passenger vehicle category, with only the Chevrolet Cruze sedan approved for B20. Blends of 20% and higher are commonly used in vehicles. Doing so may affect OEM warranties and service agreements.

In the heavy duty market, engine manufacturers certify use of B5 in standard models. Some also certify use of B20. Anecdotaly, higher blends may be used in warm weather without modifications, though OEM warranties and service agreements may be affected. Higher blends of biodiesel require modification of engine and fuel systems. Diesel-electric hybrid vehicles are also increasingly available. A relatively wide variety of school buses, shuttle buses, transit buses, refuse trucks, tractors and vocational trucks (i.e. package trucks, beverage distribution, and lift trucks) are offered.

ELECTRICITY

In the 2014 model year, EVs are available from most auto manufacturers, with some available only in limited markets. A similar variety of PHEVs are offered. **Table 8** summarizes these options. A broader range of hybrid gasoline / electric vehicles are in production.

TABLE 8: ELECTRIC VEHICLE AVAILABILITY FOR MODEL YEAR 2014

Make	Model	Technology
BMW	i3	EV
	i3	PHEV
	i8	PHEV
Cadillac	ELR	PHEV
Chevrolet	Spark	EV
	Volt	PHEV
Fiat	500e	EV
Ford	Focus Electric	EV
	C-MAX Energi	PHEV
	Fusion	PHEV
Honda	Fit EV	EV
	Accord	PHEV
Kia	Soul EV	EV
McLaren	P1	PHEV
Mercedes-Benz	B-Class Electric	EV
Mitsubishi	i-MiEV	EV
Nissan	Leaf	EV
Porsche	Panamera S E-Hybrid	
Scion	iQ EV	EV
Smart	fortwo electric drive	EV
Tesla	Model S	EV
Toyota	RAV4 EV	EV
	Prius	PHEV

²¹ The following B20 approved vehicles are available in 2014 models: Chevrolet Cruze sedan, Silverado (2500/3500) truck and Express van; GMC Sierra (2500/3500) truck and Savana (2500/3500) van; Ford Super Duty F-250 through F-750, Transit; Ram 2500/3500.

In the heavy duty market, full electric vehicles are well represented. School buses, transit buses, tractors, large vans, and vocational trucks (e.g. delivery trucks) are available. Diesel, CNG and hydrogen / electric hybrids are also increasingly available.

ETHANOL

Conventional gasoline vehicles are capable of running on ethanol blends of up to 15%. In fact, most gasoline consumed in the United States includes up to 10% ethanol as an oxygenate. Flex Fuel vehicles are designed to run on gasoline or ethanol blends up to 85%. Nearly 100 Flex Fuel light-duty vehicle models are available for 2014. SUVs and trucks are particularly well represented in this category, as are domestic passenger vehicles traditionally marketed to municipal fleets.



In the heavy duty market, conventional gasoline vehicles are capable of running on ethanol blends of up to 15%. However, diesel fuel generally predominates in this category, with few E85 applications. Ford's E-Series cutaway and stripped chassis are available for vocational applications.

HYDROGEN

Light-duty hydrogen vehicles are generally not available commercially. A small number of hydrogen Fuel Cell vehicles are produced by Honda (FCX Clarity) and Mercedes-Benz (B-Class F-Cell) in areas with access to fueling stations. Hydrogen is better represented in the heavy-duty sector. Shuttle buses and transit buses are offered by a few manufacturers. Hydrogen / electric hybrid transit buses and tractors are also available.

NATURAL GAS

In the light-duty market, natural gas options remain limited but are growing. The Honda Civic CNG is the only available passenger vehicle. GM provides Chevrolet Express and GMC Savanna vans. Bi-fuel vehicles are offered by GM and Chrysler. The Silverado/Sierra 2500HD and Ram 2500 CNG trucks automatically switch between CNG and gasoline fuels. Several Ford, GM and Chrysler car, truck and van models are available for after-market modification that may not invalidate OEM warranties.



In the heavy duty market a wide variety of school buses, shuttle buses, transit buses, refuse trucks, tractors, large vans and vocational trucks (i.e. street sweepers, dump trucks, package trucks and cement trucks) are manufactured to run on CNG. Transit and refuse truck offerings are particularly

diverse. In the transit bus category a CNG / electric hybrid is also available. Some LNG transit buses, refuse trucks, large vans, and vocational trucks are available. A wider variety of LNG tractors are manufactured.

PROPANE

OEM offerings of propane vehicles is expected to grow dramatically annually over the next several years. GM provides propane options for its Chevrolet Express and GMC Savanna vans. Ford offers F-250 and F-350 vehicles. After-market modifications of several Ford trucks and vans are available without affecting OEM warranties.

In the heavy-duty market, Ford F-450 through F-460 trucks are available via after-market modifications. There are several manufacturers of propane powered school and shuttle buses. A smaller variety of tractors, large vans and vocational trucks (i.e. package trucks) are also available.



In addition to on-road vehicles, off-road vehicles such as propane-powered lawn-mowers and forklifts are also available.



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6. INFRASTRUCTURE

The infrastructure requirements of alternatives to gasoline and diesel vary. Biodiesel fuels and vehicles can be supported with no change to existing fueling and vehicle maintenance infrastructure. By contrast, hydrogen requires an entirely novel system of production, distribution and dispensing that does not presently exist in the U.S. The infrastructure requirements of the six alternative fuels and their state of implementation in North Florida are detailed in this section. Generally, alternative fuel infrastructure in North Florida is underdeveloped and new facilities are required. Regulatory requirements surrounding construction of new infrastructure are also summarized in this section.

6.1. SCOPE

Biodiesel and ethanol blends can be dispensed at existing gasoline and diesel stations via well-established distribution methods. Relative to other alternative fuels, the scope of infrastructure required for these fuels is minimal. Electricity, hydrogen, natural gas and propane have distinct infrastructure needs described below. **Table 9** compares the relative cost of infrastructure for the various alternative fuels, a proxy for the scope of infrastructure required for each fuel.

TABLE 9: RELATIVE COST OF ALTERNATIVE FUEL INFRASTRUCTURE

Fuel / Technology	Cost
Biodiesel	Minimal
Electricity	Low
Ethanol	Minimal
Hydrogen	Very High
CNG Time Fill	Moderate
CNG Fast Fill	High
LNG	High
Propane	Moderate

ELECTRICITY

Electricity is transmitted and distributed via the electric grid. EVs and PHEVs plug in to the grid to charge their batteries, which in turn power the vehicles. Owners of electric vehicles require, at minimum, the ability to charge vehicles at home or at the fleet yard. In addition, publicly accessible electric vehicle supply equipment (EVSE) is regarded as essential for supporting wide-spread adoption of electric vehicles. The scope (i.e. “level”) of EVSE required to meet private and public needs is determined by the rate at which vehicles can be charged.

- Level 1 provides charging through a standard U.S. 120 Volt (V) alternating current (AC) plug. Full charging time for an EV with a 60 mile range could take between 6 and 13 hours and is typically conducted over-night. Specialized EVSE is not required for this level of charging.
- Level 2 charges vehicles via a 208/240 V AC electrical service. Full charging time for an EV with a 60 mile range could take between 2 and 7 hours. EVSE with a dedicated circuit of 20 to 100 amps is required. Connectors and plugs for EVSEs and vehicles have been standardized to the Society of Automotive Engineers (SAE) J1772 standard, which specifies the equipment’s physical, electrical, communications and performance characteristics.

- A third level of charging (i.e. “DC fast charging”) uses a 480 V direct current service to fully charge a vehicle with a 60 mile range in under 20 minutes. Charging at this level requires highly specialized EVSE. It also implies an upgraded electrical service for many commercial applications. This kind of charging has yet to standardize connectors and plugs.

Electric vehicle charging stations are available from a variety of manufacturing sources. They feature various combinations of Level 1, Level 2 and DC fast charging EVSE, with Level 2 being the most common service available. Stations are typically located where electric vehicle owners are concentrated, such as shopping centers, parking lots, airports, hotels, and offices. Public Level 2 charging stations cost between \$2,000 and \$13,000 to install, based on the experience of the Orlando Utilities Commission, which has installed dozens of public stations in Central Florida. Private stations can be substantially less expensive. The price for electricity at public stations range ranges widely – from \$0.00 to \$0.49 per kWh.



HYDROGEN

Standard infrastructure necessary to support hydrogen fueling is poorly defined at present, with only a handful demonstration stations across the country. Stations exist that receive liquid hydrogen via tanker truck. Others produce the fuel onsite via natural gas reformation. Concepts are being developed in which electrolysis is used to produce hydrogen on site. In several concepts a system of compressors is required to process fuel to an adequate energy density. On-site storage of fuel has been demonstrated in a liquid phase and a gas phase, both at grade and below ground. Specialized refrigerated or reinforced containers are required to store the fuel. Hydrogen can be dispensed at 5,000 psi, 10,000 psi or in a liquid phase. Home fueling stations are also in a research and development stage. Expected costs for hydrogen fueling infrastructure vary widely, from \$500,000 to \$5,000,000.

NATURAL GAS

Infrastructure requirements for CNG and LNG differ significantly, although the fuels may be co-located on the same site (i.e. “L/CNG stations”).

CNG stations require access to natural gas supplied by the local distribution company (LDC) at adequate pressure (e.g. 125 psi). Typically, LDCs are willing to extend natural gas lines to a new station if none exist. Equipment must be installed to dry, filter and compress natural gas. CNG may be stored in high pressure vessels and flow and temperature regulators are often installed to control dispensing of fuel. Fuel may be dispensed via a bank of time-fill dispensers, which typically fuel vehicles over several minutes to hours directly from the compressor. Fast-fill stations dispense fuel



from high pressure (e.g. 4,300 psi) storage tanks in a time comparable to conventional fueling pumps. Time-fill stations are appropriate for hub-and-spoke fleets. Fast-fill stations are suitable for retail situations and the operational needs of some fleets. The cost of CNG fueling stations ranges from \$200,000 to \$5,000,000 depending on the number of vehicles to be fueled and the speed at which each vehicle must be filled.

LNG stations receive deliveries of fuel via tanker truck and store the fuel on site. A pump is used to move fuel from storage to the dispenser, where it is dispensed as a super-cooled liquid at 30 – 120 psi. Protective clothing is required to fuel a vehicle. CNG can be produced on site by expanding and compressing LNG. Costs of stations vary from \$1 to \$4 million.

PROPANE

Infrastructure required for fueling propane vehicles is relatively simple, including a storage tank, a pump and a dispenser. Fuel is delivered to the site via truck and stored onsite. A pump moves fuel from storage to dispenser under pressure, where the liquid fuel fills the vehicle tank. Experienced contractors are widespread and regulatory familiarity with the systems is high. The cost of propane infrastructure ranges from \$30,000 to \$200,000, depending on fleet requirements.

6.2. LOCATIONS

Locations for accessing alternative fuels are remain relatively few in North Florida, with propane sources being the most widespread. In the near future, natural gas fueling stations are expected to grow significantly. **Figure 18** plots the location of existing stations.

Presently, there are no public fueling stations within the North Florida study region that offer B20 or E85. Low-level blends of ethanol and biodiesel (e.g. E10, B5) are sold widely, but may not be marketed as such. Private stations are located at the City of Jacksonville, Marine Corps Blount Island and NAS Jacksonville. There is no hydrogen fueling infrastructure in North Florida or in the state as a whole.

There are 14 electric vehicle charging stations in North Florida. The majority are located at Nissan dealerships. Of these, six are private and associated with the dealerships' service centers. There is a public station at King Airport Parking and the St. Johns Town Center. Plans for two public stations within the Water Street Garage in downtown Jacksonville are moving forward. Additional public stations are

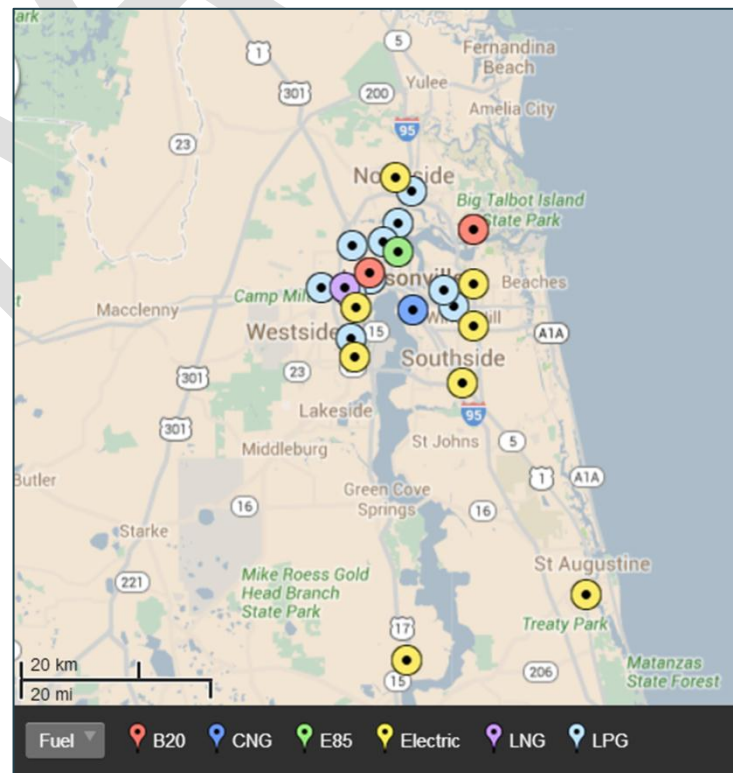


FIGURE 18: ALTERNATIVE FUEL STATION LOCATIONS

in early planning stages.

No public CNG fueling stations exist in North Florida at present. A private station is maintained at TECO Peoples Gas' former customer service center on Philips Highway in Jacksonville. Several CNG stations are in development, including private stations supporting Waste Pro's sanitation truck fleet, Jacksonville Transportation Authority's transit bus fleet, and St. Johns County's mid-duty vehicle fleet. The St. Johns County station will also have a public component. A similar arrangement is being explored for the Jacksonville Transportation Authority (JTA) project. The City of Jacksonville is exploring a Renewable CNG production and fueling facility that would dry, filter and compress landfill gas for use in its vehicle fleet. A public fueling component is being explored.

Several LNG infrastructure announcements have been made in the North Florida area in recent months. A new LNG station opened at Lane Avenue and I-10 in Jacksonville at the beginning of 2014. Another is planned along I-95 in St. Johns County. A private fueling station is planned for the UPS fleet based off of Imeson Road in Jacksonville. In 2013 Tote, Inc. / Sea Star Line and Crowley Maritime announced plans to operate four to ten LNG-fueled container ships out of Jacksonville's port. Tote, Inc. awarded a contract to a joint venture composed of AGL Resources and WesPac Midstream LLC to supply LNG to its ships. The partners have announced their intent to build a LNG plant in Jacksonville. Clean Energy Fuels Corporation has also announced plans to build an LNG fuel terminal to serve the transportation sector in the region. JEA announced an agreement with Sempra U.S. Gas and Power to explore development natural gas infrastructure in the region.



Public, primary propane vehicle fueling infrastructure is available at about eight locations around North Florida. It is associated with propane wholesalers and retailers, as well as U-Haul dealerships. There are two private stations.

6.3. PERMITTING

In Florida, regulation and permitting of alternative fuel infrastructure is not yet well defined. Local jurisdictions are the primary regulatory and permitting entities. However, given the limited amount of alternative fueling infrastructure currently in place, regulatory and permitting agencies may be inexperienced with alternative fuel infrastructure and unfamiliar with applicable specialized codes and standards. Project developers and regulators should consult with one another early and frequently during the planning, design and construction of alternative fuel infrastructure.

Verifying conformance with local zoning is typically the first step in developing alternative fuel infrastructure. Alternative fueling stations are generally "by right" uses in locations zoned industrial. Use "by exception" may be required in commercial or residential zones. Zoning is generally administered by municipalities in the incorporated Cities and Towns in North Florida.

Counties administer zoning in unincorporated areas. Concurrency review may also be required for new commercial developments.

Permitting alternative fuel stations, as with all construction projects, involves compliance with building codes. In North Florida, the building code permitting and inspection process is administered by Counties and incorporated Cities and Towns. Biodiesel, ethanol, hydrogen, natural gas and propane fueling stations all involve flammable liquids, cryogenics, or gas. Accordingly, the “High Hazard” provisions of the *Florida Building Code* apply to these facilities. For CNG and hydrogen, the *Florida Building Code Fuel Gas* also applies. The *Florida Fire Prevention Code* applies to most alternative fueling infrastructure. Accordingly, approvals and inspections by the local fire protection authority will be required for most projects.

The specialty codes detailed in **Table 10** apply to the local permitting and inspection process, and can be expected to be relied upon by local regulatory authorities. This list is not meant to be exhaustive. Greater education on and awareness of these standards among project developers, local designers, contractors and regulatory agencies is necessary to support an expanded network of alternative fuel infrastructure in the region.

TABLE 10: SELECTED CODES & STANDARDS APPLICABLE TO ALTERNATIVE FUEL INFRASTRUCTURE

Code / Standard	B20	Electricity	E85	Hydrogen	CNG	LNG	Propane
American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code	●		●		●	●	●
National Fire Protection Association (NFPA) 2, Hydrogen Technologies Code				●			
NFPA 30, Flammable and Combustible Liquids Code	●		●				
NFPA 30A Code for Motor Fuel Dispensing Facilities and Repair Garages	●		●	●			
NFPA 52, Vehicular Gaseous Fuel Systems Code				●	●	●	
NFPA 58, Liquefied Petroleum Gas Code							●
NFPA 59A, Standard for the Production, Storage Handling of Liquefied Natural Gas						●	
NFPA 68 & 69, Standards on Explosion Prevention and Protection	●	●					
NFPA 70, National Electrical Code (NEC) Article 625: EV Charging System Equipment		●					

Other entities involved in regulating and approving alternative fuel infrastructure include local electric, water, sewer and stormwater utilities, which must verify availability of utility services

and approve utility plans. Work that occurs within a local government or utility right of way or easement will likely require a permit from the applicable jurisdiction.

Environmental permits, including those associated with Federal regulations, such as the Clean Water Act, may also be required. Authority for administering these permits is often delegated to local or regional authorities. Fueling stations that involve above or below ground storage tanks, particularly those containing petroleum fuels (e.g. B20 and E85) will have to obtain permits for these tanks. These permits may be administered by local authorities (e.g. City of Jacksonville) or by the Florida Department of Environmental Protection. An Environmental Resource Permit from the St. Johns River Water Management District (SJRWMD) is required for all new construction projects in the region. Many local jurisdictions also require a Wellhead Protection Permit (e.g. COJ Environmental Quality Division) for new construction projects in proximity to a regulated public water supply well.

Finally, most fueling stations must obtain one or more of several licenses (e.g. blender, retail dealer, etc.) administered by the Florida Department of Revenue. Local governments and mass transit agencies must apply for licenses to operate and obtain rebates for taxes paid on transportation fuel. A new category of licensee has recently been developed for retailers of CNG, LNG and propane.

7. REGULATION

Rules, programs and incentives exist at the Federal, State and local level to promote alternative fuels, vehicles and infrastructure. This section details regulation at each level.

7.1. FEDERAL

The Federal government has developed rules aimed at increasing use of alternative fuels in its own operations. It also administers a variety of programs designed to mobilize use of alternative fuels in communities across the United States. A suite of intermittently available tax incentives provide financial incentives for tax payers to purchase alternative fuels, vehicles and infrastructure.

RULES AND PROGRAMS

The Federal government is a leader in utilizing its purchasing power to transform the market for alternative fuels, vehicles and infrastructure. It has set goals and procurement standards that guide federal agencies. It has attempted to set similar requirements for selected state agencies, though it has thus far declined to do so for local governments. There are a variety of Federal programs that provide support for local alternative fuel programs, most prominently those administered by the U.S. DOE, U.S. EPA and U.S. DOT.

As part of comprehensive greenhouse gas targets established by Executive Order 13514, Federal fleets must reduce petroleum consumption by 2% a year through FY2020 relative to a FY2005 baseline. Seventy-five percent of new light-duty vehicles procured by non-exempt federal agencies must be AFVs. Alternative fuels are required to be used in dual-fuel vehicles, unless specifically exempted by the U.S. DOE, per the Energy Policy Act of 1992 (EPA 2009). Finally, The U.S. Department of Defense must preferentially procure EVs, PHEVs or hybrid electric vehicles. Tactical vehicles are excluded.



Federal agencies administer several programs that provide education, technical support and/or funding to various alternative fuel projects. These include the Clean Cities Program (U.S. DOE), State Energy Program (U.S. DOE), National Clean Diesel Campaign (U.S. EPA), SmartWay Transport Partnership (U.S. EPA), Clean School Bus USA (U.S. EPA), Clean Ports USA (U.S. EPA), Clean Construction USA (U.S. EPA), Clean Agriculture USA (U.S. EPA), Air Pollution Control Program (U.S. EPA), Congestion Mitigation and Air Quality (CMAQ) Improvement Program (U.S. DOT), and the Voluntary Airport Low Emission (VALE) Program.

FINANCIAL INCENTIVES

Several significant federal incentives have been available for alternative fuels in the past. Selected financial incentives provided by the Federal government are provided in **Table 11** below. Many have been subject to annual expiration and extension by the U.S. Congress, leading to uncertainty for project developers relying on them for successful implementation of

projects. Several widely utilized federal incentives have expired as of December 31, 2013. As of early February 2014 these incentives have not been reauthorized.

In addition to direct Federal incentives, the Renewable Fuel Standard sets a goal of national-wide use of 36 billion gallons of renewable fuel (i.e. biofuels) by 2022. Refiners, importers and blenders of gasoline and diesel are required to sell a certain volume of renewable fuel every year. Regulated entities may also comply by purchasing credits from third-parties. The market price of credits has led to an incentive for producing and blending biofuels. However, the price of credits under the program has historically varied significantly, making investment in new biofuels production and blending projects uncertain.

TABLE 11: SELECT FEDERAL ALTERNATIVE FUEL INCENTIVES

Incentive	Description
Alternative Fuel Tax Exemption	Alternative Fuel (AF) used for farming, in intercity, local and school buses, by nonprofit organizations and by state and local governments are exempt from federal fuel taxes.
<u>Alternative Fuel Infrastructure Tax Credit</u>	Fueling equipment for B20, Electricity, E85, CNG, LNG, and propane was eligible for a tax credit of 30% of cost, excluding permitting and inspection fees, not to exceed \$30,000. Purchasers of qualified residential fueling equipment were eligible for a tax credit of up to \$1,000. <u>This incentive expired on 12/31/13 and has not yet been reauthorized.</u>
<u>Alternative Fuel Excise Tax Credit</u>	A tax incentive of \$0.50 per gallon sold / used was available for CNG, LNG and propane (or mixtures thereof). Tax exempt entities were eligible. Any credits in excess of excise tax liability were available as direct payment from the IRS. <u>This incentive expired on 12/31/13 and has not yet been reauthorized.</u>
<u>Second Generation Producer Tax Credit</u>	A tax incentive of up to \$1.01 per gallon of second generation biofuel sold or blended was available to consumers, retailers or producers. <u>This incentive expired on 12/31/13 and has not yet been reauthorized.</u>
Airport Zero Emission Vehicle and Infrastructure Incentives	Funding for 50% of the eligible cost of acquiring Zero Emission Vehicles (ZEVs) and/or supporting fueling infrastructure for use by public airports is available.
<u>Biodiesel Income Tax Credit</u>	An income tax credit of \$1.00 per gallon of B100 dispensed or utilized was available to retailers or producers and consumers, respectively. <u>This incentive expired on 12/31/13 and has not yet been reauthorized.</u>
<u>Biodiesel Mixture Excise Tax Credit</u>	A credit of \$1.00 per gallon blended with petroleum diesel against a biodiesel blender's fuel tax liability, with any excess credit available as direct payment, was available to biodiesel blenders. <u>This incentive expired on 12/31/13 and has not yet been reauthorized.</u>

TABLE 11: SELECT FEDERAL ALTERNATIVE FUEL INCENTIVES, CONTINUED

Incentive	Description
Qualified Plug-In Electric Drive Motor Vehicle Credit	A tax credit ranging from \$2,500 to \$7,500 is available for purchase of qualified PHEVs. The credit will be phased out for vehicles manufacturers that have sold 200,000 or more PHEVs.
Hydrogen Fuel Infrastructure Tax Credit	Hydrogen fueling equipment is eligible for tax credit up to 30% of the cost, not to exceed \$30,000. This credit expires 12/31/14.
Fuel Cell Motor Vehicle Tax Credit	Up to \$4,000 is available for the purchase of fuel cell vehicles. This credit expires 12/31/14.
Hydrogen Fuel Excise Tax Credits	Fuel tax credits of \$0.50 per gallon are available for liquefied hydrogen fuel or blended hydrogen fuel sold or used, with any excess credit available as direct payment from the IRS. This credit expires 12/31/14.

7.2. STATE

The State of Florida has developed rules aimed at increasing use of alternative fuels in its own operations. Grant programs and laws have been aimed at diversifying the state's sources of transportation fuel. Recently, a new program of incentives was initiated for natural gas and propane fuels.

RULES AND PROGRAMS

The State of Florida operates under procurement standards that promote AFVs and use of alternative fuels. It has initiated grant programs to support the development of alternative fuel production facilities and has established laws to aid the growth of electric vehicle supply equipment.

Select state fleets are required by Federal law (EPA 2009) to acquire AFVs. Florida fleets covered by this law include Florida Atlantic University, Florida International University, Florida Power and Light, the Florida Public Utilities Company, and the state Departments of Agriculture and Consumer Services, Children and Families, Environmental Protection, Health and Highway Safety and Motor Vehicles. Alternative compliance rules allow equivalent petroleum reduction activities in lieu of purchasing AFVs. Florida law requires all state agencies, universities, community colleges and local government fleets procuring vehicles under a state purchasing plan to select vehicles with the greatest fuel efficiency available in class. All state agencies must use ethanol and biodiesel blends when available.

In the past, the state provided matching grants for demonstration, commercialization, research, and development projects relating to renewable energy technologies, bioenergy, and innovative technologies that significantly increase energy efficiency for vehicles. EVSE made available to the public by a non-utility is not subject to regulation. Further, it is unlawful to obstruct EVSE with vehicles not capable of using it. Insurance companies are prohibited from imposing surcharges on EVs unless actuarially justified.

FINANCIAL INCENTIVES

Several financial incentives, including rebates and tax advantages, have been provided by the state to promote alternative fuels, vehicles and/or infrastructure. **Table 12** summarizes these financial incentives.

TABLE 12: SELECT FLORIDA ALTERNATIVE FUELS INCENTIVES

Incentive	Description
Decal Fee for Florida Registered Vehicles	This fee has been eliminated for alternative fuel vehicles.
Biofuels Investment Tax Credit	This credit is available for 75% of all capital, operation, maintenance and research and development costs incurred with investment in the production, storage and distribution of biodiesel (blends of B10 or above), ethanol (blends of E10 or above), or other renewable fuel, up to \$1 million annually per income taxpayer. The annual budget for this program is \$10,000,000.
Biodiesel Tax Exemption	Biodiesel manufactured in a volume less than 1,000 gallons by a public or private secondary school for its own use is exempt from the diesel fuel excise tax.
Natural Gas and Propane Vehicle Rebates	As of January 1, 2014, a rebate of 50% of the incremental cost of an OEM natural gas or propane fleet vehicle up to \$25,000 and \$250,000 per applicant, per year, is available. For 2014, \$6,000,000 has been allocated to the program, of which 40% is reserved for public fleets. The remainder is earmarked for private fleets. Funding is subject to annual reauthorization by the Florida legislature.
Natural Gas and Propane Tax Holiday	CNG, LNG and propane will be subject to an excise tax at a rate of \$0.04 per GGE, a \$0.01 ninth-cent fuel tax, a \$0.01 local option fuel tax, and an additional variable component to be determined by the Florida Department of Revenue each calendar year for the following 12-month period. However, these fuels are exempt from sales and excise taxes until 2019.

7.3. LOCAL

While local governments and agencies have begun to use alternative fuels in their fleets, they have generally yet to initiate significant rules, programs or financial incentives. An exception is the North Florida Transportation Organization, whose North Florida Clean Fuels Coalition is the focus of substantial educational and financial support for alternative fuels.

RULES AND PROGRAMS

Local governments and agencies have generally not formally adopted rules or enacted laws specifically aimed at promoting alternative fuels. Several such entities are using alternative fuels in their fleets, as detailed in **Section 8**. The North Florida Transportation Planning Organization, through its North Florida Clean Fuels Coalition, is providing significant educational and

financial support to regional adoption of alternative fuels. Financial incentives from other local sources are not presently available.

The NFTPO has utilized funding from a variety of sources to provide significant incentives to local governments and authorities to adopt alternative fuel vehicles or infrastructure. The CMAQ Improvement Program provides Federal funding to municipal planning organizations (MPOs) for projects and programs that reduce transportation-related emissions. Eligible activities include development of alternative fueling infrastructure and conversion of public fleet vehicles to operate on cleaner fuels. The Transportation Regional Incentive Program (TRIP) provides state matching funds to MPOs for improvements to regionally significant transportation facilities.



Using these sources, approximately \$750,000 has been committed to St. Johns County for purchase of CNG vehicles and \$2,000,000 has been committed to the Jacksonville Transportation Authority for a public CNG fueling station. The NFTPO plans to continue to offer financial support for alternative fuel projects where prudent.

FINANCIAL INCENTIVES

Beyond the activities of the NFTPO, there is no local financial support for alternative fuels, vehicles or infrastructure.

However, state law authorizes local governments to use income from a local infrastructure surtax to provide loans, grants, or rebates to residential or commercial property owners to install electric vehicle supply equipment (EVSE) as well as propane, CNG and LNG infrastructure, if a local government ordinance authorizing this use is approved by referendum. Clay, Duval and Putnam Counties all presently levy a local discretionary sales surtax of 0.5 to 1.0%.

Florida also authorizes Property Assessed Clean Energy (PACE) financing programs. These programs explicitly facilitate local government finance of EVSE through a non-ad valorem assessment secured by a lien on the property. Other forms of alternative fuel infrastructure are very likely eligible projects as well. North Florida local governments can establish PACE programs. Alternatively, they may subscribe to the Florida PACE Funding Agency, which has raised \$500 million in private capital.

There are presently no incentives for EVs, PHEVs or supporting EVSE offered by local electric utilities in North Florida. However, The Orlando Utilities Commission (OUC) provides a model for such a program. OUC offers a rebate of up to \$1,000 for the purchase and installation of commercial EVSE. However, the success of this program has thus far been limited.



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8. GOALS

The goal of the Clean Cities program is to reduce petroleum consumption by 2.5 billion gallons annually by 2020. To reach it, the program estimates the amount of petroleum displaced must increase by 17% per year. Past, current and publicly announced projects suggest that North Florida has the potential to meet this rate and exceed it. Trends established by past and future projects suggest the NFCFC is in a position to establish goals that reflect the region's ambition to expand fuel diversity and realize the benefits of petroleum alternatives.

In North Florida, several alternative fuel projects have recently been implemented or publicly announced. **Table 13** summarizes the majority of these, including estimates of the number of Alternative Fuel Vehicles currently and projected to be involved in these projects. The table includes on-road transportation projects only.

TABLE 13: ON-GOING AND PLANNED ALTERNATIVE FUEL PROJECTS

Project	Owner	Fuel	Current Vehicles*	Projected Vehicles**
Fleet Vehicles	COJ	B20	50	50
Fleet Vehicles	JEA	B20	546	546
Private Production & Use in Fleet	St. Johns County	B20	62	62
Fuel Use in Vehicles	First Coast Biofuels	B20	1	1
Fuel Use in Vehicles	Orange Park Shepherd Center	B20	1	1
Fleet Vehicle (Carts)	NAS Jax	Electricity	80	80
Flex Fuel Vehicles	NAS Jax	E85	112	112
Vehicle Purchases	Private	Electricity	179	294
Private Fuel Dispensing & Use in Fleet	COJ	E85	165	165
Flex Fuel Vehicles	First Coast Biofuels	E85	1	1
Public / Private Fuel Dispensing & Use in Fleet	JTA	CNG	0	80
Public / Private Fuel Dispensing & Use in Fleet	St. Johns County	CNG	0	130
Private Fuel Dispensing & Use in Fleet	WastePro	CNG	0	50
Fleet Vehicles	Mike Davidson Ford	CNG	6	6
Public Fuel Dispensing	Clean Energy	LNG	-	-
Fleet Vehicles	Raven Transport, Inc.	LNG	0	36
Private Fuel Dispensing & Use in Fleet	UPS	LNG	0	80
Fleet Vehicles	Ferrellgas	Propane	5	5
Fleet Vehicles	Veolia Transportation	Propane	100	100
Fleet Vehicles	Gator City/Go Shuttle	Propane	115	115
Private Fuel Dispensing & Use in Fleet	WW Gay	Propane	244	244

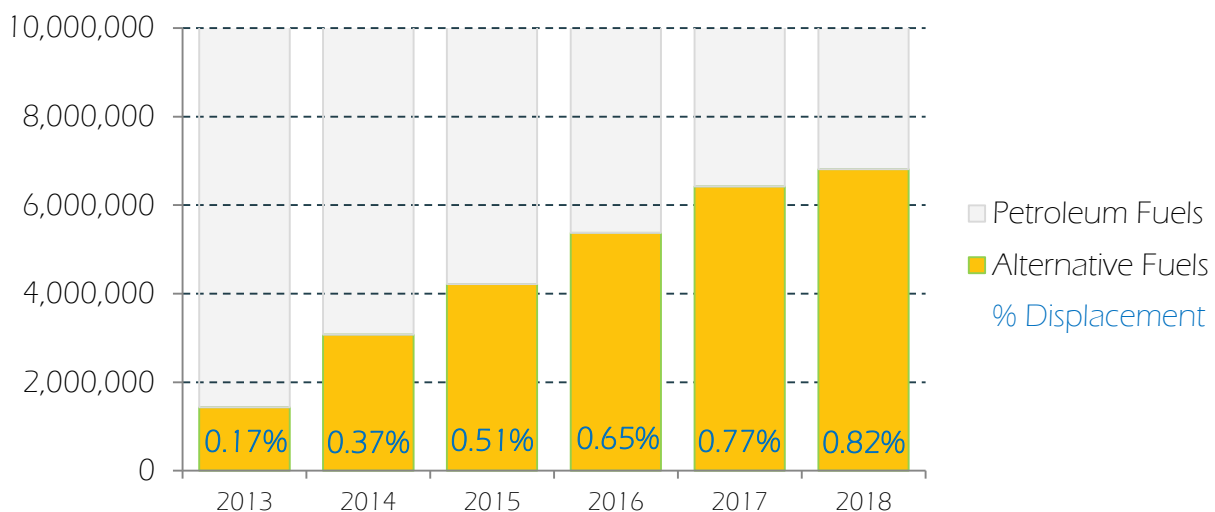
*Estimates, ** Estimated projections for 2017

In addition to the projects listed in **Table 13** are several large alternative fuel projects in the rail and maritime sector. These projects, currently in various stages of development, may dramatically increase consumption of alternative fuels in North Florida.

- Sea Star Line LLC and Crowley Maritime Corporation have announced orders for four to ten LNG-powered ships. Based on the size of ships announced, the associated LNG tanks could hold about 200,000 gallons of fuel each.
- CSX Corporation has announced plans to retrofit locomotives to run on LNG and is exploring other options to utilize natural gas in its rail yard operations.
- A joint venture between AGL Resources and WesPac Midstream, LLC has contracted with Tote, Inc. to supply LNG to its ships. The joint venture has also announced its intent to build a LNG plant in Jacksonville.
- Clean Energy Fuels announced plans to construct a LNG liquefaction plant in proximity to Jacksonville's port, producing up to 300,000 gallons of LNG per day. The plant is intended to provide fuel for trucks, trains and ships.
- JEA and Sempra U.S. Gas and Power have announced a partnership to explore natural gas fuels projects in North Florida.

Figure 19 charts an estimate of petroleum fuel displacement based on the projects detailed in **Table 13**. It does not include the rail and maritime projects listed above. Total petroleum fuel use in the North Florida on-road transportation sector during this period is expected to remain at about 830 million gallons per year. Alternative fuel use in the region may displace an estimated two million gallons through 2014, potentially growing to nearly six million by 2018. The average rate of petroleum displacement over the period is estimated at 25% per year.

FIGURE 19: PROJECTED ON-ROAD TRANSPORTATION SECTOR PETROLEUM DISPLACEMENT FROM ALTERNATIVE FUEL PROJECTS (GALLONS)



9. STRATEGIES

Alternative fuels, vehicles and infrastructure can benefit North Florida in a variety of ways, including fuel savings, improved public health and reduced reliance on foreign suppliers. The NFTPO has organized the North Florida Clean Fuels Coalition to help realize these benefits. To achieve its goals, the Coalition must strategically invest its resources in initiatives that have the greatest possible impact on the region's use of petroleum alternatives. In this section, implementation priorities are described. Strategies have been developed for biodiesel, electricity, ethanol, hydrogen, natural gas and propane.

9.1. BIODIESEL

Biodiesel blends (e.g. B20) may be used in existing diesel vehicles with little or no modification. The impact on maintenance and operations is similarly minimal. The fuel can be sourced locally at prices equal to or less than diesel fuel. It may also be produced in small quantities from widely available secondary sources at a total cost well-below prices for petroleum diesel. Utilizing these secondary sources has the co-benefit of reducing expenses and environmental impacts associated with sanitary sewers. Air quality impacts and greenhouse gas emissions are reduced as well. The following strategies are recommended to increase utilization of biodiesel in North Florida.



B1. PRODUCTION EQUIPMENT INCENTIVES

Provide support to local governments and authorities for investment in biodiesel production equipment.

Given potential fuel savings and benefits to water quality, public investment in small-scale biodiesel production facilities may have a favorable return on investment. However, capital investment in fuel production equipment is significant. Working with public fleets, determine what forms of incentive or recognition is necessary to make production of biodiesel viable.

St. Johns County currently produces biodiesel on the order of 250 gallons per day for the exclusive use of its heavy-duty diesel vehicle fleet. It produces the fuel from waste oils and fats collected from grease traps at kitchens and restaurants. Collection of these secondary sources has helped to reduce sanitary sewer maintenance and improved water quality in the County. St. Johns County is producing biodiesel at a substantial savings relative to the price it would otherwise pay for petroleum diesel. Studies conducted by the County have reflected no additional maintenance costs or operational changes as a result of using biodiesel in its fleet. The County's program serves as a potentially replicable model for other local governments and authorities in the region.

B2. INCENTIVES FOR AVAILABILITY OF BIODIESEL AT FUELING STATIONS

Provide financial incentives and/or recognition to distributors and/or retailers who provide B20 or higher blends at public fueling stations in North Florida.

While ASTM standards permit sale of diesel fuel blended with up to 5% biodiesel by volume, higher blends, particularly those regarded as alternative fuels by EPA Act 1992 (e.g. B20 or above), are not available at any public fueling stations within North Florida.

In the past, federal tax credits for the sale of biodiesel, or blends thereof, encouraged local distributors and/or retailers to offer biodiesel at the pump. However, these incentives have been intermittent and are currently not available. Working with distributors and/or retailers, determine what forms of financial incentives or recognition is necessary to make biodiesel blends widely available at the pump.

B3. MANDATES FOR USE IN PUBLIC FLEETS, FLEETS OF PUBLIC CONTRACTORS

Work with local governments and authorities to require fleets to utilize biodiesel blends in all or a portion of their diesel fleet. Work with local governments and authorities to require contractors utilize biodiesel blends in all or a portion of their diesel fleet.

Federal fleets must reduce petroleum consumption by 2% a year through FY2020 relative to a FY2005 baseline. Seventy-five percent of new light-duty vehicles procured by non-exempt federal agencies must be AFVs. Alternative fuels are required to be used in dual-fuel vehicles. EPA Act 2009 requires acquisition of AFVs or equivalent petroleum reduction activities for certain state agencies and utilities under the Alternative Fuel Transportation Program (AFTP), including two utilities providing services in the region: FP&L and Florida Public Utilities Company.

There are a significant number of large public fleets in the region. These fleets can have a significant impact on local petroleum consumption, while providing leadership by example to private fleets. The same is true of public contractors. For instance, the City of Jacksonville Councilman John Crescimbeni introduced legislation requiring WastePro to construct a CNG fueling facility and procure CNG sanitation trucks as a condition of contract extension. The company subsequently announced plans to construct a private, time-fill CNG fueling station and convert its fleet to CNG trucks.

Working with local governments and authorities with large vehicle fleets (e.g. over 50 vehicles) and elected representatives thereof, develop either voluntary or statutory standards for use of B20 in public fleets and/or the fleets of contractors.

B4. EDUCATION AND OUTREACH FOR FLEET OPERATORS

Educate public and private operators of diesel fleets on the benefits of biodiesel blends.

Biodiesel is not widely used, despite its many benefits. Continue to provide actionable information to public and private fleet operators on these benefits.

9.2. ELECTRICITY

Electric vehicles are extremely energy efficient and inexpensive to operate relative to conventional options. As the electric grid shifts to cleaner fuels, they can play a role in significantly reducing air pollution and greenhouse gas emissions. However, despite recent price reductions and increasing availability, electric vehicles remain more expensive to procure than conventional vehicles. In addition, while electricity is widely available, new, relatively inexpensive infrastructure is required to support wider use of electric vehicles and extend the range of EVs and PHEVs in our region. The following strategies are recommended to increase utilization of electricity to fuel both on and off-road transportation in North Florida.



E1. DEVELOP PLAN FOR REGIONAL NETWORK OF CHARGING STATIONS.

Develop a plan that determines the optimal number of charging stations, the most favorable areas for their location, and a strategy for implementation.

A regional network of public charging stations, located at workplaces, major destinations and along major transportation corridors, would facilitate electric-only travel region-wide among early-adopters of EV technology. In addition, it would reduce range anxiety, which is critical for making EVs a mainstream choice.

Identifying solutions for siting EVSE, selecting appropriate EVSE, usage policies and fees, risks and liability issues, zoning and land use regulations, and permitting can support greater deployment of EV charging infrastructure in the region. Significant local planning is required to accomplish these tasks. Figure 20, which plots the location of current EV registration in the North Florida region by zip code, is an example of the kind of data and analysis that might support such planning.

The Southeast Florida Clean Cities Coalition has developed an *EV Community Readiness Plan* which generally identifies several critical factors contributing to wider use of electric

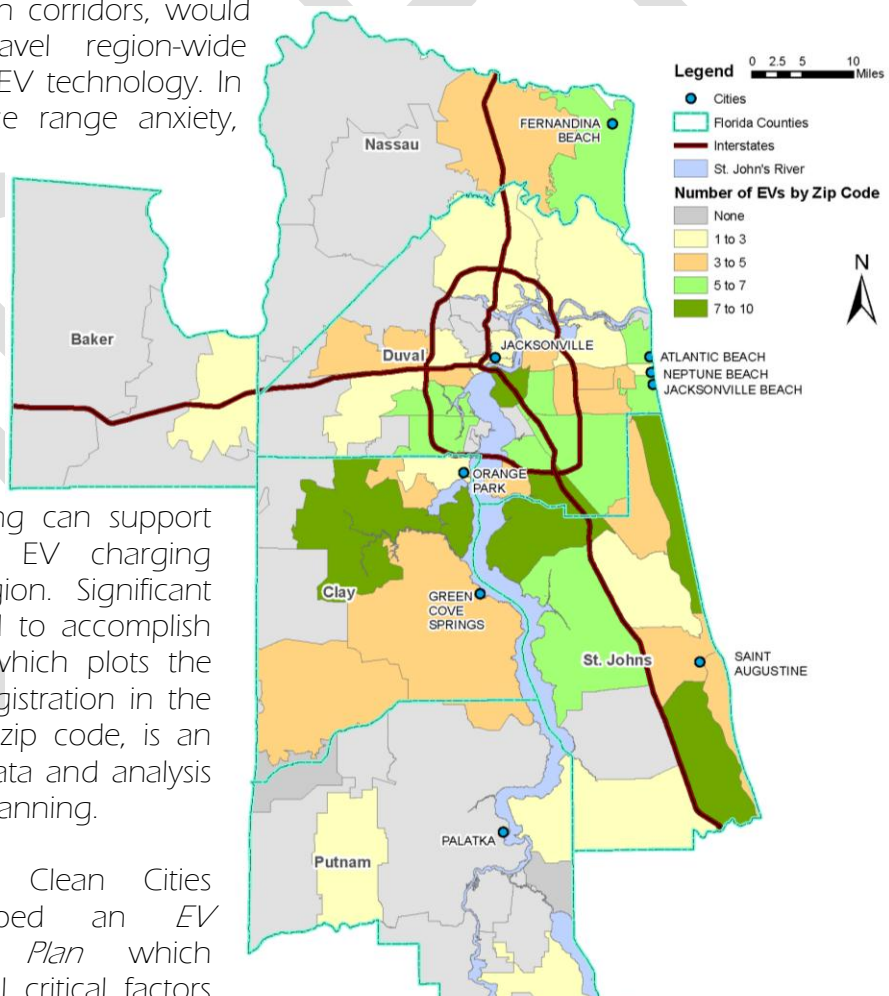


FIGURE 20: EV REGISTRATIONS BY ZIP CODE THROUGH SEPTEMBER 2013

vehicles in Florida, including planning for local EVSE infrastructure. This plan could serve as a basis for local planning in North Florida.

E2. INCENTIVES FOR EV STATIONS

Provide financial and non-financial incentives for installation of EVSE.

There are only two fully public EV charging stations in North Florida, and North Florida Counties have the fewest EVs per 10,000 residents among the state's major regions. The Orlando and Tampa regions each have well over 100 public stations and lead the state in EVs per 10,000 residents. Greater availability of public EVSE is required to boost the number of EVs and PHEVs in North Florida.

The Orlando Utilities Commission (OUC) offers a rebate of up to \$1,000 for the purchase and installation of commercial EVSE. It also holds site licenses with host customers (e.g. workplaces, retailers, etc.) for OUC-operated EVSE. The City of Jacksonville's Environmental Protection Board offers a rebate of \$1,000 for facilities that receive certification under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program. The LEED program encourages installation of EVSE at facilities. CSX is utilizing Federal grant funding from the City of Jacksonville to install EVSE in a city-owned public parking garage in the downtown area.

Identifying sources of funding and working with local governments and authorities, utilities as well as major employers and venues, to develop or support effective incentive programs will reduce the cost of installing EVSE, while extending its benefits to employees, tenants, visitors, patrons, etc. of local buildings.

E3. INCENTIVES FOR INCREMENTAL COST OF EVS & PHEVS IN PUBLIC FLEETS

Provide financial incentives to reduce the incremental cost of procuring EVs and/or PHEVs for use in public fleets.

EVs and PHEVs provide significant life-cycle cost savings compared to conventional gasoline vehicles, due to their high energy efficiency and the relatively low cost of electricity. However, the purchase price of these vehicles remains several thousand dollars higher than conventional automobiles.

The City of Jacksonville utilized Federal grant funds to provide funds covering the incremental cost of high-efficiency vehicles. Two Chevrolet Volts were procured by the City under this program. Identifying sources of funding and working with large local fleets can identify opportunities to cost effectively increase the number of EVs in the region, while reducing the lifecycle operational costs of government fleet vehicles.

E4. SUPPORT DEVELOPMENT OF UTILITY POLICIES AND PROGRAMS FOR ELECTRIFICATION OF TRANSPORTATION

Work with power providers to develop and/or support policies and programs that are mutually beneficial to utilities and electrified-transportation technology owners.

EV and PHEV owners primarily charge their vehicles at home. The optimal time to do this is overnight, when power providers have substantial excess capacity and their marginal cost of electricity is low. EVSE located at multi-family dwellings, workplaces and other high-density locations provide a new source of sales for utilities and support a highly energy-efficient transportation option for the community. Electrification of forklifts, idling trucks (i.e. “truck stop electrification”), airport vehicles (i.e. gated airplanes, airside support vehicles, etc.), rail and port vehicles (i.e. “cold-ironing” of ships, electric cranes, etc.) also have the potential to increase sales, boost efficiency and reduce emissions. Over the long-term, in conjunction with “smart-grid” development, EVs may be a source for power during times of high demand. Specific utility incentives or policies can help spur investment in electric vehicles and infrastructure and guide how it is used for the benefit of the North Florida’s economy and environment.

Financial incentives for the incremental cost of electric equipment, utility-provided public EVSE, time of Use (TOU) rates that make electricity cheaper overnight, separate metering and rates for EVSE are some examples of utility policies or programs that could support electrification of transportation. JEA is currently developing an electrifications strategy covering both EVs / PHEVs as other transportation infrastructure. Working with local power providers, such as JEA, electric service policies and programs may be developed that align incentives for increasing adoption of electric vehicles and electrification of transportation infrastructure.

E5. EDUCATION AND OUTREACH FOR OFFICES AND MULTIFAMILY DEVELOPMENTS

Provide actionable information to residential developers, employers and property managers on EVSE as an amenity.

Multifamily dwellings are a significant source of new residential development in North Florida. However, residents are not typically able to install charging infrastructure. EVSE at workplaces can complement home charging. Deployment of EVSE at multifamily dwellings and workplaces can be an important amenity for both owners/renters as well as employees. Helping residential developers, employers and property managers understand the benefits of installing EVSE, while communicating solutions to problems concerning ownership, liability, operations and maintenance, can help foster a market for developing public EVSE.

E6. DEVELOP REGULATORY POLICIES AND PROCEDURES TO FACILITATE EVSE DEVELOPMENT

Facilitate collaboration between developers, owners and regulatory officials to establish reasonable and predictable processes for EVSE development and use.

Regulatory policies and procedures that promote rather than impede EVSE are needed to expand its availability. Comprehensive planning, zoning and land development regulation may presently contain barriers to establishing EVSE. Changes to these standards present opportunities for greatly expanding access to EVSE. The same is true for permitting. Streamlined and expedited permitting, including pre-approval processes for this relatively simple equipment can speed its adoption.

The Southeast Florida Clean Cities Coalition has reviewed national best practices and developed a series of recommendations for enhancing regulation of EVSE. These

recommendations are included in its “Getting Southeast Florida Plug-In Ready” report. Using the recommendations of this report as a starting point and establishing a forum for communication between the parties involved in EVSE projects can help create a supportive regulatory environment in North Florida.

9.3. ETHANOL

Ethanol blends (e.g. E85) may be used in Flex Fuel vehicles. These vehicles are widely available at little or no incremental cost, particularly in the mid-duty category and in models available to public fleets. However, Flex Fuel vehicles travel fewer miles per gallon when using ethanol, due to its lower energy content. While predominately sourced renewably from corn in the U.S., new technologies are opening up cellulosic feedstocks to producers in Florida. Such sources have the potential to provide substantial greenhouse gas emissions reductions. The following strategies are recommended to increase utilization of ethanol in North Florida



A1. INCENTIVES FOR INCREASING AVAILABILITY AT FUELING STATIONS

Provide financial incentives and/or recognition to distributors and/or retailers who provide E85 or higher blends at public fueling stations in North Florida

While ASTM standards permit sale of diesel fuel blended with up to 10% ethanol by volume, higher blends, particularly those regarded as alternative fuels by EPA Act 1992 (e.g. E85 or above), are not currently available at any public fueling stations within North Florida. Flex Fuel vehicles are widely available and are by far the most numerous AFVs in the U.S.

In the past, federal tax credits for the sale of ethanol, or blends thereof, encouraged local distributors and/or retailers to offer biodiesel at the pump. However, these incentives have been intermittent and are currently not available. Working with distributors and/or retailers, determine what forms of financial incentives or recognition is necessary to make ethanol blends widely available at the pump.

A2. MANDATES FOR USE IN PUBLIC FLEETS, FLEETS OF PUBLIC CONTRACTORS

Work with local governments and authorities to require fleets to utilize ethanol blends of E85 or higher in all or a portion of their Flex Fuel fleet. Work with local governments and authorities to require contractors to utilize biodiesel blends in all or a portion of their Flex Fuel fleet.

Federal fleets are required to reduce petroleum consumption, purchase AFVs and utilize alternative fuel in Flex Fuel vehicles. FP&L and Florida Public Utilities Company are required to purchase AFVs or enact equivalent petroleum reduction activities.

There are a significant number of large public fleets in the region. Many of these fleets have procured a large number of Flex Fuel vehicles. However, they are often fueled with conventional fuel rather than ethanol. These fleets can have a significant impact on local petroleum consumption, while providing leadership by example to private fleets. The same is true of public contractors.

Working with local governments and authorities with large vehicle fleets (e.g. over 50 vehicles) and elected representatives thereof, develop either voluntary or statutory standards for procurement of AFVs

Working with local governments and authorities with large vehicle fleets (e.g. over 50 vehicles) and elected representatives thereof, develop either voluntary or statutory standards for procurement of Flex Fuel Vehicles and use of E85 in Flex Fuel vehicles in public fleets and/or the fleets of contractors.

9.4. HYDROGEN

Hydrogen vehicles are fuel efficient and largely free of emissions, depending on the source of the fuel. However, near-term deployment is limited by the present lack of fuel sources, vehicles and infrastructure. Important aspects of hydrogen fueling technology remain to be defined. Advances in hydrogen technologies will be monitored and opportunities for developing strategies will be periodically reevaluated.



H1. DEMONSTRATION PROJECTS

Position North Florida to take advantage of programs and grants for hydrogen research and demonstration projects.

Methods for producing and distributing hydrogen, as well as developing vehicles to utilize it, are the subject of research and development projects that have and will continue to occur in communities that have demonstrated a commitment to alternative fuel innovation. The region's proximity to higher education institutions positions it well to participate in such efforts. Facilitating coordination between research institutions, students and progressive fleet operators can present opportunities for demonstrating leadership on this emerging alternative fuel.

9.5. NATURAL GAS

Natural gas is now domestically produced in quantities which make its use very advantageous to fleet operators on a cost per mile basis. The fuel is significantly cleaner than gasoline or diesel and can play a role in reducing greenhouse gas emissions. Nevertheless, natural gas vehicles (NGVs) are more expensive than conventional models. New, relatively costly fueling infrastructure is required and local experience with this infrastructure is limited. The following strategies are recommended to surmount barriers to realizing the benefits of natural gas fuels in North Florida



N1. INCENTIVES FOR INCREMENTAL COST OF FLEET NATURAL GAS VEHICLES

Provide financial incentives to reduce the incremental cost of purchasing natural gas vehicles in public fleets or private fleets within proximity to future public stations.

CNG and LNG fuel is significantly cheaper than gasoline or diesel fuel on a GGE or DGE basis. However, the incremental cost of light and heavy duty NGVs is substantial. Vehicles with low fuel-economy and high rates of fuel consumption are good candidates for replacement with NGVs, since fuel cost savings offset higher incremental costs more rapidly. Financial incentives that reduce the incremental costs can help hasten investment in NGVs by raising the rate of return. Large fleet operators who commit to long-term replacement with NGVs can attract private investment in fueling infrastructure.

Working with public and private fleets with large numbers of mid- to heavy-duty vehicles to identify hurdle rates for investment and develop financial incentives can lead to long-term commitments to replacement of vehicles with NGVs. The NFTPO is providing funding to St. Johns County to help purchase medium-duty NGVs. The funding has been provided in conjunction with a commitment by the County to construct a CNG fueling complex with both public and private fuel dispensers.

Currently there are no public CNG stations in North Florida. The first LNG station opened at the beginning of 2014. Identification of smaller fleets in proximity to future CNG stations or the LNG station at Lane Avenue and I-10 for whom financial incentives may be a decisive factor in the purchase of NGVs provide additional opportunities for financial incentives to catalyze adoption of natural gas fuels.

N2. ACCESS TO EXISTING STATIONS

Provide financial and non-financial incentives for developers of private fueling stations to add public fueling dispensers to their projects or allow controlled access by other fleets.

For large fleets with high rates of fuel consumption, purchase of NGVs and construction of fueling facilities can make good business sense without any incentives. For fleets of this size, it is often practical to establish private fueling facilities. The incremental cost of adding additional dispensers available to the public is less than building a separate station. Further, opportunities for generating revenues from fuel sales can be significant.

Working with large public and private fleets that have made commitments to natural gas fueling and vehicles, identify opportunities to fund a public fueling component. For example, the NFTPO has proposed to provide approximately \$2,000,000 to the JTA to construct a public fueling station as part of its plan to purchase 100 CNG transit buses and construct a private fueling facility.

Additionally, specialty fleets, such as transit buses and refuse trucks, often only utilize their private fueling facilities during specific times of day (e.g. overnight). At other times, the facilities are idle. Providing controlled access to other fleets during these times can facilitate purchase of NGVs. In addition to a public component, JTA is exploring plans to make its private facilities available to other local government fleets during times when it is not in use.

Providing recognition to organizations that provide access to their natural gas fueling infrastructure highlights the economic, social and environmental benefits they are providing to the community, and provides examples for other organizations to follow.

N3. CNG AT LNG STATIONS

Work with operators of LNG stations to provide CNG.

LNG may be used to produce CNG on site via high pressure vaporization. In this way, CNG can be produced at less cost than a standalone station in locations that do not have access to natural gas distribution pipelines.

Clean Energy Fuels Corporation opened an LNG station in Jacksonville in early 2013. As more fleets acquire CNG vehicles and new LNG stations come online, financial and non-financial incentives may be identified that prompt station operators to provide a CNG fueling option.

N4. NATURAL GAS LOGISTICS HUB

Support development of projects that position North Florida as an international hub for multi-model transportation fueled by natural gas.

Natural gas is expected to fuel an increasing share of mid- to heavy-duty fleets in sectors such as sanitation, transit and various vocational applications. It is also expected to play a role in international logistics, including trucking, rail transportation and shipping. Large volumes of LNG are required to meet the demands of these sectors. Proximity of LNG production to North Florida's port operations facilitates use of natural gas transportation technologies and may provide a competitive advantage to the region. Advantages include lower operating costs, cost-effective reduction of air emissions and access to new markets for fuel exports, among others. These advantages could lead to new industries and jobs in the region.

In 2013 Tote, Inc. / Sea Star Line and Crowley Maritime announced plans to operate a total of four to ten LNG-fueled container ships out of Jacksonville's port. Tote, Inc. awarded a contract to a joint venture composed of AGL Resources and WesPac Midstream LLC to supply LNG to its ships. Clean Energy Fuels Corporation has also announced plans to build an LNG fuel terminal designed to serve the transportation sector in the region. The terminals would be the first of its kind on the east coast. Meanwhile, JEA recently announced an agreement with Semptra U.S. Gas and Power to explore development of natural gas infrastructure in the region.

Continuing to educate economic development leaders, logistics professionals and the public on the advantages of establishing an LNG production facility in North Florida can help it become a reality. On-going collaboration with the logistics sector to realize synergies associated with such a facility can lead to opportunities for expanded use of L/CNG in non-road applications, fleet conversions, and establishment of L/CNG stations.

N5. DEVELOP REGULATORY POLICIES AND PROCEDURES TO FACILITATE DEVELOPMENT OF NATURAL GAS FUELING INFRASTRUCTURE

Facilitate collaboration between developers, owners and regulatory officials to establish reasonable and predictable processes for building natural gas fueling facilities.

In Florida, regulation and permitting of natural gas infrastructure is not yet well defined. Developers, owners and regulatory agencies may be inexperienced with alternative fuel infrastructure and unfamiliar with applicable specialized codes and standards. Providing a

forum for project stakeholders to consult with one another early and frequently during the planning, design and construction of North Florida's initial projects can lead to best management practices appropriate for the region. Several states and regions have developed permitting guides for prospective developers. Comprehensive planning, zoning, land development regulation and permitting all present opportunities for identifying policies and procedures that promote rather than impede development.

9.6. PROPANE

Propane fueling infrastructure is currently available in North Florida. The incremental cost of propane vehicles is relatively low, and the cost of private fueling infrastructure is relatively moderate. Construction and regulation of such facilities is relatively well understood locally. The fuel is less carbon-intensive than gasoline and diesel. The availability of OEM propane vehicles is expected to expand dramatically over the next few years. The following strategies are recommended to surmount barriers to realizing the benefits of autogas in North Florida



P1. EDUCATION AND OUTREACH FOR FLEET OPERATORS

Educate public and private operators of fleets on the benefits of autogas.

The propane industry is characterized by a diverse network of marketers providing a variety of services, which include providing transportation fuel. For this reason, as well as others, the potential benefits of propane to the transportation sector are perhaps not as widely known as other alternatives. A compelling business case can be assembled for purchasing propane vehicles and supporting fueling infrastructure. Working with fuel marketers, OEM and after-market vehicle manufacturers and fleet operators to disseminate case studies can help spur wider use locally.

P2. INCENTIVES FOR INCREMENTAL COST OF FLEET PROPANE VEHICLES

Provide financial incentives to reduce the incremental cost of purchasing OEM propane vehicles or converting vehicles to autogas fueling systems in public and private fleets.

Propane fueling infrastructure already exists in North Florida and the incremental cost of mid-duty propane vehicles is moderate. However, the price of propane can be volatile, adding risk to business planning. Financial incentives that reduce the incremental costs of OEM or after-market vehicles can help hasten investment. Working with public and private fleets, including operators of school bus fleets, to identify hurdle rates for investment and develop financial incentives can lead to long-term commitments to replacement of vehicles.

APPENDIX

DEFINITIONS

ALTERNATIVE FUEL: The Energy Policy Act of 1992 defines an alternative fuel as biodiesel, natural gas, propane, electricity, hydrogen, ethanol, among others.

ALTERNATIVE FUEL VEHICLE: A dedicated, flexible fuel or dual-fuel vehicle designed to operate on at least one alternative fuel.

AUTOGAS: Propane used as a transportation fuel.

BI-FUEL VEHICLE: A vehicle designed to run on two unblended fuels, either simultaneously (i.e. in parallel) or one-at-a-time. Bi-Fuel, or dual fuel, vehicles typically combine gasoline or diesel with alternative fuels such as natural gas, propane or hydrogen.

BIODIESEL: Vegetable oil or animal fat based diesel fuel used as an alternative to petroleum-based diesel fuel.

CARBON DIOXIDE (CO₂): A naturally occurring chemical compound of two oxygen atoms and one carbon atom. Carbon dioxide is produced as a result of combustion of fossil fuels, fermentation of sugars and respiration of living organisms. In the atmosphere carbon dioxide acts as a long-lived (e.g. 200 years) greenhouse gas. Human activities following the industrial revolution have significantly increased atmospheric concentration of carbon dioxide in the atmosphere, leading to global warming.

CARBON DIOXIDE EQUIVALENT (CO₂E): A quantity that describes the amount of carbon dioxide that would have the same global warming potential when measured for a specified timescale (e.g. 100 years) for a given mixture and amount of greenhouse gas. It allows different emissions streams to be compared on a common basis.

CELLUSLOSIC ETHANOL: A type of ethanol produced from wood, grasses or other inedible (i.e. by humans) parts of plants.

CLIMATE CHANGE: Significant and lasting change in the distribution of weather patterns over long periods of time due to global warming.

COMPRESSED NATURAL GAS (CNG): Natural gas that is dried, filtered and compressed to about 3,600 pounds per square inch for use as an alternative to gasoline and diesel fuels. It is less energy dense than LNG.

CRITERIA AIR POLLUTANTS: A set of air pollutants regulated by the clean air act that cause smog, acid rain and several other health hazards. They are typically emitted from industry, mining, transportation, electric generation and agriculture activities.

DIESEL GALLON EQUIVALENT (DGE): The amount of alternative fuel it takes to equal the energy content of one liquid gallon of diesel. It allows common comparisons between standard and alternative fuels.

ELECTRICITY: The set of physical phenomena associated with the presence and flow of electric charge. In an electric vehicle, this charge is utilized to energize one or more electric motors for propulsion.

ELECTRIC VEHICLE SUPPORT EQUIPMENT: Equipment required to supply electricity for charging the batteries of electric or plug-in electric hybrid vehicles.

ETHANOL: A volatile, flammable, colorless liquid used as an alternative to gasoline. Ethanol is produced from a variety of feedstocks, including corn, sugar cane, sweet sorghum and so-called "cellulosic" feedstocks.

FLEX FUEL VEHICLE: Vehicles designed to run on gasoline or a blend of up to 85% ethanol.

FUEL CELL: A device that converts the chemical energy from a fuel into electricity through a reaction with an oxidizing agent. Hydrogen is the most common fuel cell. It differs from a battery in its requirement for a constant source of fuel and an oxidizer.

FUEL ECONOMY: A ratio between the distance a vehicle travels and the amount of fuel consumed by the vehicle, commonly expressed in miles per gallon. Fuel economy of light-duty vehicles in the United States is regulated by the Corporate Average Fuel Economy standards administered by the EPA.

GASEOUS GALLON EQUIVALENT (GGE): The amount of alternative fuel it takes to equal the energy content of one liquid gallon of gasoline. It allows common comparisons between standard and alternative fuels.

GLOBAL WARMING: An unequivocal and continuing rise in the average temperature of earth's climate system, including both the air and sea. Since the early 20th century, global air and sea surface temperatures have increased by about 1.4°F, with about 66% occurring since 1980. Climate scientists are more than 90% certain that most global warming is a consequence of increased greenhouse gas concentrations resulting from human activities, such as combustion of fossil fuels.

GREENHOUSE GAS: An atmospheric gas that absorbs and emits radiation within the thermal infrared range. As a whole, these gases are responsible for the greenhouse effect, which greatly affects the temperature of the earth. The primary greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide and ozone.

HEAVY-DUTY VEHICLE (HDV): A truck with a gross vehicle weight rating above 26,000 pounds. This category includes most tractor trailer trucks, transit buses, as well as many vocational vehicles (e.g. refuse trucks).

HYDROGEN: The most abundant and lightest chemical substance in the universe. Hydrogen may be used as an energy carrier in conjunction with fuel cell electric vehicles.

INTERNAL COMBUSTION ENGINE: An engine that utilizes combustion of fuel and an oxidizer (e.g. Air) in a chamber to convert chemical energy to mechanical energy.

LIGHT-DUTY VEHICLE (LDV): Passenger vehicles and trucks with a gross vehicle weight rating ranging from 0 to 14,000 pounds (e.g. Ford F-350)

LIQUEFIED NATURAL GAS (LNG): Natural Gas that is purified and cooled to -260°F for use as an alternative to gasoline and diesel fuels. It is more energy-dense than CNG.

MEDIUM-DUTY VEHICLE: A truck with a gross vehicle weight rating ranging from 14,001 (e.g. a Ford F-450) to 26,000 pounds (e.g. a Ford F-650).

NATURAL GAS: A non-renewable hydrocarbon gas mixture formed from geologic deposits of organic material. The principal constituent is methane. It may be compressed or liquefied for use as an alternative to gasoline or diesel fuels.

ORIGINAL EQUIPMENT MANUFACTURER: The company that originally manufactured the product. OEM products or components are often purchased by another company, modified and retailed under that purchasing company's brand name.

OCTANE: A short form of "octane rating" that measures the performance of motor fuels in gasoline internal combustion engines. The higher the octane number, the more compression the fuel can withstand before igniting.

PROPANE: A gas by product of natural gas processing and petroleum refining that is compressible to a transportable liquid used as an alternative to gasoline and diesel fuels.

PROPERTY ASSESSED CLEAN ENERGY FINANCING: A means of financing energy efficiency or renewable energy projects with funding secured by annual property tax assessments.

RANGE: The distance a vehicle can travel between fueling episodes based on the size of its fuel tank, the energy content of the fuel and the fuel economy of the vehicle, among other factors.

RENEWABLE FUEL STANDARD: A federal program administered by the EPA that requires refiners, importers and blenders of gasoline and diesel to sell a certain volume of renewable fuel every year.

ZERO EMISSIONS VEHICLE (ZEV): A vehicle that emits no tailpipe pollutants from the onboard source of power as certified by the California Air Resources Board. The definition does not include emission from well-to-well (i.e. emissions produced during electricity generation).

ACRONYMS

AF:	Alternative Fuel
ASTM:	American Society for Testing and Materials
AFV:	Alternative Fuel Vehicle
B5:	A biodiesel fuel blend composed of 95% petroleum diesel and 5% biodiesel
B20:	A biodiesel fuel blend composed of 80% petroleum diesel and 20% biodiesel
CMAQ:	Congestion Mitigation and Air Quality Improvement Program
CO:	Carbon Monoxide
CO₂:	Carbon Dioxide
CO₂e:	Carbon Dioxide Equivalent
CNG:	Compressed Natural Gas
DGE:	Diesel Gallon Equivalent
DOE:	United States Department of Energy
DOT:	United State Department of Transportation
E85:	An ethanol fuel blend composed of 15% gasoline and 85% ethanol
EPA:	United States Environmental Protection Agency
EV:	Electric Vehicle
EVSE:	Electric Vehicle Support Equipment (e.g. an electric vehicle charging station)
GGE:	Gaseous Gallon Equivalent
GHG:	Greenhouse gas
HDV:	Heavy-duty Vehicle
HEV:	Hybrid Electric Vehicle
ICE:	Internal Combustion Engine
JTA	Jacksonville Transportation Authority
LDC:	Local Distribution Company
LDV:	Light-duty Vehicle
LNG:	Liquefied Natural Gas
MPGGE:	Miles per Gaseous Gallon Equivalent
NFCFC:	North Florida Clean Fuels Coalition
NFTPO:	North Florida Transportation Planning Organization
NGV:	Natural Gas Vehicle
NOx:	Oxides of Nitrogen
OEC:	Orlando Utilities Commission
OEM:	Original Equipment Manufacturer
PACE:	Property Assessed Clean Energy Financing
PHEV:	Plug-in Electric Hybrid Vehicle
PM:	Particulate Matter
SAE:	Society of Automotive Engineers
VOC:	Volatile Organic Compound
ZEV:	Zero Emission Vehicle