Alternative Fuel Implementation Toolkit (AFIT)

Introduction

Prepared by the NC Clean Energy Technology Center in collaboration with:
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Land of Sky Clean Vehicles Coalition
Triangle Clean Cities Coalition

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Introduction

Purpose of the Toolkit

This Toolkit is intended to provide a “one stop” set of resources for fleet vehicle and fuel purchasers, program managers, and organization leaders who are interested in using alternative fuel vehicles. The Alternative Fuels Decision Table will guide users through selecting the fuels that are most likely to complement their operations and organizational goals, and direct them to the appropriate fuel chapter where additional “how to implement” resources are compiled: fuel overview, cost calculator, case studies, and an implementation checklist. This Toolkit is available online as a single PDF document, and separated into downloadable chapters for those who already know which fuels are the best fit for them.

Considering Alternative Transportation Fuels?

*Alternative Fuels, the Smart Choice:*

Alternative fuels – biodiesel, electricity, ethanol (E85), natural gas, and propane - are a smart choice for fleets looking to save money, improve air quality, and comply with air quality and petroleum displacement mandates that may apply. Alternative fuels are largely domestically produced, often less expensive, and are cleaner burning than gasoline and diesel. Lifetime costs are often lower with alternative fuels, due to reduced maintenance requirements, and some fuels offer increased flexibility and range through bi-fuel vehicle options. While some alternative fuel implementation scenarios offer impressive return on investment with no external funding, there are also federal incentives and grants available that can help some fleets reduce upfront costs, making alternative fuels even more appealing as a way to cut fleet costs. For those organizations with environmental and sustainability goals/benchmarks, alternative fuels can be a great way to achieve those goals while also making a positive impression on current and future customers.

Introducing the Alternatives to Gasoline and Diesel

- Biodiesel is a renewable liquid fuel that can be refined from vegetable oil, animal fat, recycled cooking oil, seed crops, and algae. It is often blended with petroleum-based diesel to produce various ratios like B20 (20% biodiesel), B50 (50% biodiesel), and can be used “straight” as B100 (100% biodiesel).
- Electricity can be used to charge the on-board battery on plug-in electric vehicles, which then powers the vehicle’s electric motor for zero tailpipe emissions. There are several types of plug in electric Vehicles (PEVs), including EV-only battery electric vehicles (BEVs), and plug in hybrid electric vehicles (PHEVs) with an electric motor, battery, and an internal combustion engine.
- Ethanol (E85) is a liquid fuel that can be refined from corn, grains, and crop and forestry waste materials. It is usually blended with gasoline at different ratios, with E85 being an 85% ethanol / 15% gasoline mix. E85 can be used in flex fuel vehicles (FFVs).
- Natural Gas is a low-carbon gaseous fuel that is widely used in industrial and home applications, and increasingly as a clean burning vehicle fuel. It can be recovered from underground gas reserves, as a byproduct of the petroleum refinery process, or as a byproduct of landfill waste decomposition. For transportation use it can be compressed (CNG) or liquefied (LNG).
- Propane, or Liquefied Petroleum Gas (LPG), is a low carbon (i.e. clean burning) fuel that is produced from natural gas processing or from crude oil refining. It is the world’s third most common engine fuel source.
In addition to evaluating the potential to reduce operating costs, fleets may place a value on the emissions benefits of alternative fuels versus gasoline and diesel. Below is an analysis of carbon dioxide (CO₂) generation from various transportation fuels, looking at just the tailpipe emissions (on the left) and well-to-wheels emissions (on the right), including CO₂ release from fuel production, transportation, and combustion. CO₂ is considered a primary greenhouse gas responsible for climate change.

Figure 1. Various assumptions were used in generating this graph. For example, it was assumed that the ethanol and biodiesel came from the most common feed stocks used in North Carolina (corn and soy respectively), and regular diesel was assumed to be the ultra-low sulfur diesel that most stations dispense for fleet use. For electricity, a North Carolina statewide generation mix was used, and it was assumed that an electric motor was 3.2 times more efficient than an internal combustion engine. [Source: Argonne AFLEET 2013, http://greet.es.anl.gov/afleet]
Barrier Busters and Measures for Success

There are several potential barriers to implementing alternative fuels that must be considered and planned for in order to have a successful transition from using only gasoline or diesel in your fleet vehicles.

Organizational change dynamics
It is important to have “buy-in” from decision makers when making any major change. Determine how prepared your organization is for changes to fleet composition by asking: What is the current level of awareness of and attitude towards alternative fuels among those involved in purchasing, maintaining, and using vehicles? Conduct a fleet assessment\(^1\).

Plan for refueling and/or budget for building infrastructure
Different fleets have different refueling practices and needs based on operations and mission. It is vital to consider factors that affect vehicle refueling when deciding which alternative fuel is the best fit.

Vehicle/fleet transition plan (short and long-term): Using certain alternative fuels may require refueling infrastructure siting, design and installation; vehicle conversions; etc.

Training: Vehicle operators may need additional fueling/operation training with certain alternative fuels.

Maintenance: If vehicle maintenance is normally performed ‘in-house’, maintenance staff may need safety and technical training. Maintenance bays may require alteration to comply with regulations and best practices.

Measuring and tracking costs and savings: Documenting the full impacts of alternative fuels use can help justify program expansion and make it easier to develop compelling publicity materials (see below).

Publicity plan – recognition and reward: Positive publicity represents an added benefit of using domestically-produced, lower-emission fuels. Organizations will be positioned to apply for fleet recognition programs, submit content to industry and technical journals, and sit on alternative fuel and fleet-related conference panels.

Sustaining continuous improvement: Some methods of sustaining positive momentum include: developing a staff recognition/reward program for improvements in fuel efficiency, establishing a revolving fund for alt fuels project seeded with cost savings, and establishing “Green Fleet” procurement and efficiency policies/procedures\(^2\) (require life cycle cost analysis, prioritization of alternative fuel vehicles, and fleet fuel efficiency benchmarks).

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Additional opportunities for fleet cost savings

- “Right sizing” – Shrink the total fleet and retain/select the smallest vehicles capable of accomplishing the mission to realize significant fuel use reduction and cost savings.
- Vehicle usage patterns – Avoid wasted miles driven through prudent vehicle assignment and routing.
- Fleet assessment/consultation – Consider contracting a professional fleet consultant to help with “right sizing” and route optimization. The NC Solar Center and NC Clean Cities coordinators can conduct an alternative fuel assessment and help fleets develop a plan, and as part of the AFIT project will offer free consultation using this Toolkit to a select number of fleets in 2014.
- Eco-driving training – Teaching drivers eco-driving practices maximize the fuel efficiency of each vehicle, resulting in savings from reduced fuel, maintenance, and accident related costs.

Which Alternative Fuels Best Fit Your Fleet?

Fleet Profile

The first step in considering which alternative fuels best fit a particular fleet is to summarize current operations, assets, and utilization patterns into a Fleet Profile, and then analyzing it for opportunities to include alt fuels.

The profile includes:

- Current annual fuel usage and costs
- Route/duty profile (how are vehicles used)
- Range requirements
- Load/use requirements
- Geographic location of the fleet (centralized versus dispersed)
- Fueling options/availability (how are vehicles fueled)

Refer to the Fleet Profile Survey as a template for preparing a Fleet Profile.

Fleet Plan

Once a Fleet Profile is completed, the next step is to draft short- and long-term goals and objectives for lowering fleet costs and/or emissions. Ideally this plan should be drafted by a ‘green fleet team’ with representation including organizational leadership as well as those who buy, use and maintain the vehicles. In addition to laying out tangible steps to achieving cost and emissions reduction goals, the fleet plan also facilitates broader buy-in and more sustainable commitment to accomplishing the outlined tasks.

For information about the alternative fuel/vehicle options on the North Carolina state contract, refer to the State Contract Bid Calendar, a document that provides a list and links to currently available alternative fuel vehicles and alternative fuels on the state purchasing contract.

Trends and Fleet Examples: Alternative Fuel Decision Table

The Alternative Fuel Decision Table below is designed to help fleets identify which fuel(s) are likely to maximize costs and/or emissions reductions, so they can focus on the most relevant chapter(s) of this Toolkit. "Best Application” descriptions generally hold true for each alternative fuel, but other factors can and will influence which fuel is truly the best fit for any particular fleet. Refer to the Alternative Fuels Information Matrix for a summary of emission benefits, costs and applicability of each alternative fuel.
<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Criteria to Utilize/Maximize Benefits</th>
<th>Best Applications</th>
</tr>
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| Biodiesel (B20- B100)   | Diesel engines. Fuel access on site, mobile refueling or nearby retail service stations: [www.afdc.energy.gov/fuels/biodiesel_locations.html](http://www.afdc.energy.gov/fuels/biodiesel_locations.html) | • Any light duty (LD) and heavy duty (HD) diesel vehicles and equipment are capable of running biodiesel with no vehicle modifications.  
• B20 (20% biodiesel, 80% ULSD) is most common blend for fleets and the ASTM standard by which the fuel is regulated. See [www.biodiesel.org/using-biodiesel/oem-information](http://www.biodiesel.org/using-biodiesel/oem-information)  
• 1993 and older diesel engines need rubber hoses and seals replaced with non-rubber. |
• LD trucks/vans, MD/HD vehicles, Class 8 trucks.  
• Time fill scenario: fleets that return to centralized locations which are out of operation for a period of time (overnight).  
• Fast fill scenario: vehicle that needs to be refueled in a 5-15 minute period.  
• LNG provides greater fuel storage (increased range) for HD vehicles. |
| Electric Dedicated EV and Plug-In Hybrid (PHEV) | Daily mileage to utilize range capacity (80-120 miles for EV passenger vehicles, 20-40+ miles for PHEV).  
EVSE infrastructure at location of overnight vehicle storage. | • LD and MD passenger and delivery vehicles.  
• Particularly advantageous in stop/go urban duty cycles.  
• Ability to utilize up to $7,500 federal tax credit. |
• Best applications: sales and delivery, taxi service.  
• Particularly advantageous in stop/go urban duty cycles. |
| Ethanol (E85) | Flex fuel vehicles (FFVs). Over 90 makes and models produced since 1999 at no extra cost to purchaser.  
Sufficient number of FFVs to justify on site refueling and/or travel/location near E85 stations. | • E85 (85% ethanol / 15% gasoline) in flex-fuel vehicles (FFVs) capable of running on either E-85 or gasoline and any blend in between.  
• LD vehicles (cars, trucks, vans), SUVs, Class A school buses and transit vehicles.  
| Propane (LPG) | On site refueling and/or proximity to fueling infrastructure [http://www.afdc.energy.gov/fuels/propane_station_s.html](http://www.afdc.energy.gov/fuels/propane_station_s.html) | • Best applications: police cruisers, school buses, para-transit vans, delivery, trade/service, forklifts/mowers.  
• LD & MD vehicles (cars, trucks, vans).  
• Opportunity for no upfront costs for vehicle conversions and fueling can be paid for through savings on fuel costs. |

Table 1. LD = light duty, MD = medium duty, HD = heavy duty.