Clean Fuel Advanced Technology (CFAT) 2010-2012: Iredell County Sheriff Propane (LPG) Vehicle Summary

Clean Fuel Advanced Technology (CFAT) Project 2006-2012:

Administered by the NC Solar Center at NC State University, CFAT is a six (6) year project running from 2006 through 2012. The project objective is to reduce transportation related emissions in NC counties designated as non-attainment and maintenance areas for air quality standards in accordance with the federal Clean Air Act. Twenty-four (24) counties were identified by the NC Department of Environment and Natural Resources as eligible areas. Figure 1 shows the current designated non-attainment and maintenance areas. Partial or entire counties included are: Cabarrus, Catawba, Charlotte, Davidson, Davie, Durham, Edgecombe, Forsyth, Franklin, Gaston, Granville, Guilford, Haywood, Iredell, Johnston, Lincoln, Mecklenburg, Nash, Orange, Pearson, Rowan, Swain, Union, and Wake.

The project was funded by $2.6 million in federal Congestion Mitigation Air Quality funds through the NC Department of Transportation. The NC Division of Air Quality and State Energy Office contributed an additional $200,000 each. Local sub-award recipients contributed $1.8 million for a project total of $4.8 million. Funding provided up to 80% of project costs for alternative fuel vehicles, refueling infrastructure, idle reduction technologies, heavy duty and light duty hybrid electric vehicles, and diesel retrofits. CFAT project education and outreach are supported through sub-contracts with Centralina Council of Governments and Triangle J Council of Governments.

Liquefied Petroleum Gas (a.k.a. LPG, Propane, LP-gas or Autogas) Conversions:

The CFAT project assisted in an liquefied petroleum gas (LPG) sub-award with the Iredell
County Sheriff's Office. Thirteen (13) 2010 Ford Crown Victoria patrol cars were converted to gasoline-LPG bi-fuel vehicles. The conversion cost was $4,615 per vehicle for a total project cost of $59,990. Project funding contributed $38,865 with the Sheriff’s Office cost share of $21,125 coming from Drug Interdiction Funds (an added positive aspect and story in itself). The vehicles are on track to drive an average of 40,000 to 45,000 miles per year. Using, 40,000 miles, this represents an annual displacement of an estimated 2,850 gallons of gasoline per vehicle (total 37,050 gallons per year). With an expected service life of eight years for each vehicle, the project’s LPG bi-fuel deployment is expected to displace 296,400 gallons of gasoline.

**LPG Overview:**

LPG is the most widely used and accepted alternative automotive fuel used in the world today. As of September 2011, there were more than 17 million LPG vehicles on the roads worldwide. However, use is concentrated in only five (5) countries – Korea, Turkey, Russia, Poland and Italy. Together, these countries account for more than half of global transportation use of LPG. In Turkey, the share of LPG as a total of automotive fuel consumption is 18% versus 0.1% in the United States. The variation in penetration success of LPG is explained by government incentives and policies. (Source: [www.worldlpgas.com/autogas](http://www.worldlpgas.com/autogas))

Environmental considerations are the primary reason for LPG use as an automotive fuel. Being a simple low carbon compound, propane burns much cleaner than gasoline, reducing emissions of harmful gases. As a cleaner burning fuel, there are also reduced operating and maintenance costs associated with its use. The fuel is delivered to the engine in vapor form which does not wash away the lubrication on the rings and cylinder walls. This causes less engine component wear, resulting in longer engine life. It is not uncommon for LPG fueled engines to last up to three times longer than the same engine run on gasoline. LPG is a domestic resource with approximately 97% of consumption produced from North America. As a domestic resource, propane exhibits better price stability than gasoline and historically has been cheaper. This gap has increased in recent years due to shale gas developments and rising world oil demand. Moreover, the use of propane as a transportation fuel reduces dependence on foreign oil.

The LPG conversion is achieved with minimal engine modifications. Several of the OEM’s have a CNG/LPG engine prep package option. GM and Dodge are offering vehicles with the CNG/LPG fuel systems direct from the factory, requiring no aftermarket upfitting. The from the factory systems are EPA and CARB certified and carry full manufacturer warranties. In the upfit market, there are a number of OEM certified installers and several choices of EPA and CARB certified systems. These systems maintain full manufacturer warranty on the engines and emissions systems. See NGVAmerica ([www.ngvamerica.org/gov_policy/fed_regs/fed_AfterMarket.html](http://www.ngvamerica.org/gov_policy/fed_regs/fed_AfterMarket.html)) for an overview of EPA rules for aftermarket conversions. Vehicles can be converted to run solely on LPG (dedicated) or to switch between LPG and gasoline (bi-fuel). The operators notice little dif-
ference whether operating on gasoline or propane, except that the propane vehicles are quieter. The tanks fit compactly into car trunks, cargo areas of pickups and vans, or can replace the gasoline tank in any vehicle. LPG tanks are tested to greater than four (4) times normal operating pressures and are twenty (20) times more puncture resistant than gasoline tanks. LPG has a narrower range of flammability and higher ignition temperature than gasoline and diesel. It will also dissipate quickly in open atmosphere, making ignition less likely. LPG as an alternative transportation fuel is a safe and uncomplicated conversion.

**LPG Emissions Benefit Summary:**

Using emissions test data from the U.S. Environmental Protection Agency (EPA) for Ford 4.6L engine for gasoline versus LPG, the estimated annual emissions benefit of deployment of the 13 LPG patrol cars is shown in Table 1 (right). The values for PM and CO₂ are estimated using industry reported averages for light duty vehicles. Figure 1 (below) shows what this translates to as a percentage of emissions reduction the LPG fleet achieves versus the baseline gasoline fleet. As expected, the cleaner burning propane has reduced emissions over gasoline for the same powertrain. Looking at NOₓ, the primary criteria pollutant in NC, the thirteen (13) LPG patrol car deployment is equivalent to removing six and a half (6.5) gasoline powered patrol cars from the roads.

### Table 1: Average Annual CFAT LPG Deployment Emissions Reductions

<table>
<thead>
<tr>
<th>Emission Gas</th>
<th>LPG Reduction (KG/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOₓ</td>
<td>3.12</td>
</tr>
<tr>
<td>CO</td>
<td>244.40</td>
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<tr>
<td>PM</td>
<td>8.32</td>
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<tr>
<td>NMOC</td>
<td>0.57</td>
</tr>
<tr>
<td>CO₂</td>
<td>39,937</td>
</tr>
</tbody>
</table>

**Emissions Notes:**

NOₓ = Oxides of Nitrogen: NOₓ is a lung irritant. When combined with hydrocarbons and sunlight, NOₓ compounds form smog.


NMOC = Non-Methane Organic Compounds: Compounds containing carbon which, when combined with NOₓ in the presence of sunlight, form smog.

PM = Particulate Matter: Tiny particles of solid matter that lodge in the lungs and form deposits on buildings. PM is likely a cancer-causing carcinogen.

CO₂ = Carbon Dioxide: The major greenhouse gas component of combustion. Greenhouse gases trap heat in the atmosphere, thereby creating a greenhouse effect.

(Source: [http://ofmpub.epa.gov/greenvehicles/Glossary.do#standard](http://ofmpub.epa.gov/greenvehicles/Glossary.do#standard))

**Iredell County Feedback and Results:**

The Iredell County Sheriff’s Office has given high praise and is very pleased with their decision to convert a portion of their patrol cars to LPG. They are realizing 40%-50% in fuel savings, as well as reduced maintenance costs. The first conversion phase was the thirteen (13) vehicles through CFAT, previously discussed. Because of their success with the initial phase, they have since added sixteen (16) additional LPG vehicles to bring their alternative fuel fleet count to 29.
twenty-nine (29). The objective is to increase their deployment to fifty (50) units over the next few years. The deputies report that the LPG cruisers perform just as well, if not better than their former gasoline cruisers. Captain Mike Phillips said, “It has really has been a smooth transition. We are very pleased with the conversion. It’s not often you don’t sacrifice power and range with an alternative fuel. With LPG, you get the benefit of driving green in a high performance vehicle. It has allowed us to reduce emissions, save money, and use a domestic fuel.” Furthermore, Iredell also plans to utilize LPG in other areas of county services. The Iredell County Area Transit has followed the sheriff’s office example and converted four (4) passenger vans to LPG.

**CFAT Project Summary:**

The six year CFAT project supported 48 projects including participants from 18 counties in the non-attainment and maintenance areas. See Figure 4 for a bar chart showing project breakdown. An added benefit is that through exposure and experience with the alternative fuel CFAT project purchased vehicles, sub-award recipients, as well as their employees have purchased an additional 20 to 25 plug-in electric, hybrid electric and propane vehicles.

![Figure 4: Project Participation by County](image-url)