

# Alternative Fuel Tool Kit

## How to Implement: Ethanol (E85)

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## Introduction to Ethanol (E85)

### What is E85?



E85 is a renewable alternative transportation fuel blend of gasoline and ethanol. Ethanol ( $C_2H_5OH$ , a.k.a. ethyl alcohol or grain alcohol) is a flammable and colorless chemical compound, which can also be used as a biodegradable fuel additive. It is domestically produced, and can be made from grains, such as corn or wheat, or from biomass or cellulose sources, such as prairie grass and agricultural, forestry, or municipal waste matter. The E85 ethanol blend is a low carbon, clean-burning, high-octane fuel, and a versatile solvent which mixes easily with water and most organic liquids. A detailed listing of ethanol and ethanol blended transportation fuel properties can be

found on page 5 of the "[Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends](#)" by the US Department of Energy (US DOE).<sup>1,2</sup>

Per the **ASTM D5798-13a** (*Standard Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engine*), the E85 gasoline ethanol mixture can vary from 51-83% denatured ethanol by volume. The reason for the variation is to optimize starting and performance in different geographic conditions; i.e., temperature and altitude.<sup>2</sup>

The dominant ethanol/gasoline blends in the United States are up to 10% ethanol (E10) and up to 83% ethanol (E85). More than 95% of the regular gasoline sold in the US is E10.<sup>3</sup> E10 is safe for any vehicle made after 1980.<sup>4</sup> The EPA has approved up to E15 for vehicles made after 2001. A recently released research paper by the National Renewable Energy Lab compiles vehicle testing results that address engine durability and fuel system component life. **The research paper concludes that E15 is safe for fuel system and engine components, as well as emissions and exhaust components for vehicles 2001 and newer.**<sup>5</sup> The E85 blend is only for vehicles designated as flexible-fuel vehicles (FFV's). FFV's can run on ethanol, gasoline, or a mixture of the two. Refer to manufacturer recommendations regarding approved fuels.

E85 has lower energy content per gallon than gasoline. Gasoline has an energy content of 116,900 BTU's per gallon. Depending upon the hydrocarbon mixing composition, the blended E85 (assuming ethanol content of 83%) has an energy content that varies from 83,600 to 89,400 BTU's per gallon. A fuel economy reduction of approximately 25% would be expected when using E85 versus gasoline. For a detailed comparison of the properties ethanol, gasoline and E85 see page 6 of the US DOE's "[Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends](#)".<sup>1</sup>

**E85 must cost less than Gasoline in order to 'break even' on total fuel costs.**

If the cost of Gasoline \$/gal. is:	E85 \$/gal. must cost:
\$2.75	\$2.06
\$3.00	\$2.25
\$3.25	\$2.44
\$3.50	\$2.63
\$3.75	\$2.81
\$4.00	\$3.00

## Benefits of Using E85 and other Ethanol Blended Fuels

Ethanol is domestically produced from renewable resources, helping the US work towards energy security and fuel diversity. With the US importing approximately 40% of the petroleum that it uses, domestic ethanol production directly contributes to reducing that dependence. With petroleum dependence comes a need to

<sup>1</sup> [http://www.afdc.energy.gov/uploads/publication/ethanol\\_handbook.pdf](http://www.afdc.energy.gov/uploads/publication/ethanol_handbook.pdf)

<sup>2</sup> [http://enterprise.astm.org/filtrexx40.cgi?+REDLINE\\_PAGES/D5798.htm](http://enterprise.astm.org/filtrexx40.cgi?+REDLINE_PAGES/D5798.htm)

<sup>3</sup> [http://www.afdc.energy.gov/fuels/ethanol\\_blends.html](http://www.afdc.energy.gov/fuels/ethanol_blends.html)

<sup>4</sup> <http://www.epa.gov/otaq/fuels/renewablefuels/documents/420f10010a.pdf>

<sup>5</sup> <http://ethanolrfa.org/page/-/rfa-association-site/studies/RFA%20NREL%20Review%20and%20Evaluation%20of%20E15%20Studies.pdf?nocdn=1>

protect access to oil reserves in unstable areas of the world, creating military and foreign policy risks. In addition, ethanol can significantly reduce our country's trade deficit in crude oil, which has increased from \$27 billion in 1987 to \$50 billion in 2012.<sup>6</sup> The U.S. Commerce Department estimates that each \$1 billion of trade deficit costs the U.S. 19,100 jobs. In a recent study of the economic impacts of ethanol production by the Economics Department at the University of Iowa, sponsored by the USDA National Institute for Agriculture, the 13.9 billion gallons of ethanol produced in the US in 2011 added 44,000 jobs and \$3 billion in income.<sup>7</sup>

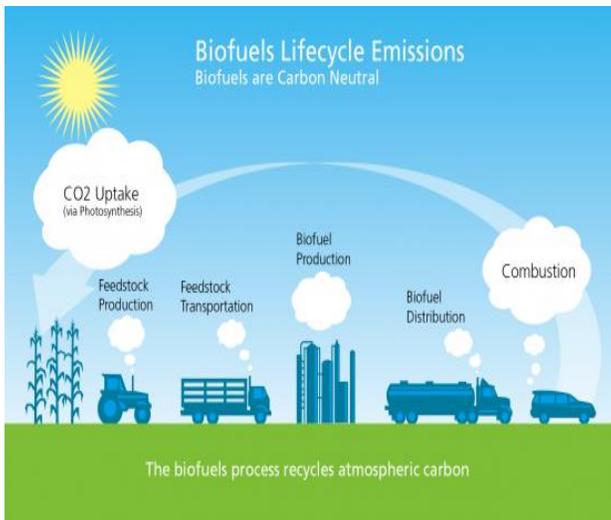


Figure 1. Ethanol growth & production CO<sub>2</sub> cycle.<sup>9</sup>

Beyond the economic and energy security benefits, there are the environmental benefits of E85 and ethanol fuels. Ethanol produced from corn and blended as E85 can achieve a 30% reduction in fossil energy use and a 20% reduction in greenhouse gas emissions compared to gasoline.<sup>8</sup> E85 tail pipe CO<sub>2</sub> emissions are lower than gasoline. Moreover, the net CO<sub>2</sub> emissions benefit is further increased by the consumption of CO<sub>2</sub> in the growing of the feedstock. An illustration of this additional contribution to greenhouse gas reduction is shown in figure 1.<sup>9</sup> Further greenhouse gas reductions (up to 85%)<sup>8</sup> can be achieved with cellulose-derived biomass as ethanol feedstock. While the technology exists today to turn cellulosic sources into ethanol, research and development efforts continue to focus on improving the cost-effectiveness and scalability of the process. Using E85

versus gasoline also reduces criteria air pollutants<sup>10</sup>, which includes carbon monoxide (CO), nitrogen oxides (NO<sub>x</sub>) and

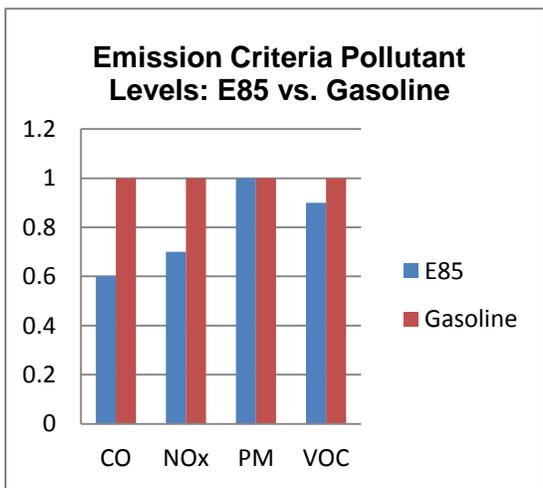


Figure 2. Emission Criteria Pollutant Comparison .<sup>11</sup>

**Criteria Pollutants<sup>10</sup>**

The Clean Air Act requires the EPA to set [National Ambient Air Quality Standards](#) for six common air pollutants. The EPA calls these pollutants "criteria" air pollutants because it regulates them by developing human health-based and/or environmentally-based criteria (science-based guidelines) for setting permissible levels. These pollutants are:

- [Ozone](#)
- [Particulate Matter](#)
- [Carbon Monoxide](#)
- [Nitrogen Oxides](#)
- [Sulfur Dioxide](#)
- [Lead](#)

<sup>6</sup> <http://ethanol.org/index.php?id=34&parentid=8>

<sup>7</sup> <http://www.cvcia.org/files/CVC-Ethanol-Report-8-9-2012.pdf>

<sup>8</sup> [http://iopscience.iop.org/1748-9326/2/2/024001/pdf/erl7\\_2\\_024001.pdf](http://iopscience.iop.org/1748-9326/2/2/024001/pdf/erl7_2_024001.pdf)

<sup>9</sup> <http://www.ethanolrfa.org/pages/ethanol-facts-environment>

<sup>10</sup> <http://www.epa.gov/air/urbanair/>

### Ethanol Facts.<sup>8,9</sup>

- Using ethanol in place of gasoline helps to reduce CO<sub>2</sub> emissions by 19%-52%.
- The 13.2 billion gallons of ethanol in 2012 reduced greenhouse gas emissions from on-road vehicles by 33.4 million tons. **That's equivalent to removing 5.2 million cars and pickups from the road for one year.**
- E85 has the highest oxygen content of any fuel available, making it burn even more cleanly and even more completely than any other fuel.
- E85 has 80% fewer gum-forming compounds than gasoline.
- Ethanol is rapidly biodegraded in surface water, groundwater and soil, and is the safest component in gasoline today.

volatile organic compounds (VOC) (see figure 2).<sup>11</sup>

Lastly, ethanol blended fuels do not have some of the adoption barriers faced by other alternative fuels. The E10 blend can be used in current vehicles. The E85 blend requires that the vehicle be a flex fuel vehicle (FFV), discussed in the next section.

### **Various Applications, Available Vehicles, Vendors in the NC Market**

E85 is used in FFV's which are capable of operating on pure gasoline, as well as blends

of gasoline and ethanol up to 83% ethanol. FFVs do not cost the consumer any more to purchase; the cost to change fuel lines to ethanol compatible materials and install fuel sensors is born by the manufacturer in exchange for receiving credit toward fleet wide corporate average fuel economy (CAFE) standards. As of 2012, there were an estimated 11 million FFV's on the road in the US (RL Polk) and 441,754 FFV's on the road in the state of North Carolina in April 2013 (Growth Energy). Automobile manufacturers have made a commitment to increase the number of FFV's, thus FFV's have grown from 34 model offerings in 2010 to 84 models available in 2013. FFVs can be identified by drivers in a number of ways: yellow caps on fuel ports, sticker above fuel door and vehicle badges.

### **Vehicle types and availability**

FFV's are available in a wide range of fleet applications including police, para-transit, delivery and utility vehicles. While FFV's are predominately larger size vehicles, notable vehicles with smaller engine displacements include the Ford Focus, Buick Regal and Dodge Dart. All U.S. manufacturers and increasingly foreign manufactures offer FFV's. The U.S. Department of Energy's Alternative Fuel Data Center annually compiles a list of [available FFV's](#).<sup>12</sup> Another source is list of [available FFV's maintained by the NC Clean Energy Technology Center](#).<sup>13</sup>

### **State Contract FFV's**

Any state agency and local government as well as some non-profit service agencies can procure vehicles from the NC Department of Administration Purchasing and Contracting Division contract. Please refer to the [current state bid calendar](#)<sup>14</sup> which includes available vehicles, bid and contract dates. FFVs on the state contract:

- Passenger Vehicles- Dodge Avenger SE , Chevy Impala, 22 MPG
- Police Package- Chevy Caprice, Impala and Tahoe



<sup>11</sup> <http://greet.es.anl.gov/afleet>

<sup>12</sup> [http://www.afdc.energy.gov/vehicles/search/light?fuel\\_type\\_code=E85\\_GSLN](http://www.afdc.energy.gov/vehicles/search/light?fuel_type_code=E85_GSLN)

<sup>13</sup> [http://nccleantech.ncsu.edu/wp-content/uploads/E85-Flex-Fuel-Vehicle-List-6\\_13.pdf](http://nccleantech.ncsu.edu/wp-content/uploads/E85-Flex-Fuel-Vehicle-List-6_13.pdf)

<sup>14</sup> [https://docs.google.com/a/ncsu.edu/file/d/0B1L\\_uScUzTktMmd0V2ZvLU9aV2c/edit?pli=1](https://docs.google.com/a/ncsu.edu/file/d/0B1L_uScUzTktMmd0V2ZvLU9aV2c/edit?pli=1)

## Fuel & Infrastructure Providers

### Fueling options and availability:

The National Renewable Energy Lab has developed an iPhone application for users to locate the 20 closest alternative fueling stations within a 30-mile radius of any specified address. The app is available for free download at [Apple's App Store](#).

For current NC E85 refueling/station availability see the "[E85 Retail Station Locations in North Carolina](#)"<sup>15</sup> document maintained by the North Carolina Clean Energy Technology Center's Clean Transportation group. Also, the Alternative Fuels Data Center has a nationwide [alternative fueling station search tool](#).<sup>16</sup>

City	Retail Location	Address	Phone
Benson	Carlie C's IGA	604 South Wall Street	919-207-0744
Charlotte	R & K Express BP	8712 Pence Road	704-532-4136
Durham	Cruizer's Biofuels	1914 Sedwick Road (at NC-55)	919-806-3458
Erwin	Carlie C's Express	801 S. 13 <sup>th</sup> Street	910-897-4141
Lexington	Sparky's Marketplace	106 Regents Center Court (US-52, exit 86)	336-242-2729
Lumberton	Spinx #347	1302 Roberts Ave.	910-738-2603
Magnolia	Magnolia Marketplace	1486 South Kenansville Bypass	910-447-1112
Pittsboro	Cruizer's #46	32 Powell Place Lane	919-542-2836
Raleigh	Crown Express Mart	1210 New Bern Avenue	919-828-5293
Raleigh	Bull Market BP	6712 Glenwood Ave	919-781-1831
Waxhaw	Fill Good	2538A Cuthbertson Rd.	704-243-2083

### Establishing an E85 fuel dispensing facility in North Carolina



If you are a fleet that currently operates or wants to manage your own fueling, there are a number of considerations regarding E85 fueling infrastructure. The mechanical considerations are outlined below. **It is important to work with your distributor regarding pricing. It is possible to obtain better pricing through direct negotiations versus accepting the published price.** There have been instances where a retailer considered abandoning E85 because of pricing, but after negotiation with the distributor the retailer was able to obtain pricing that made economic sense to maintain E85 as an option.

### Underground Storage Tank (UST) Systems

The current forms required for permitting E85 UST installations are available under the Permits section at: <http://portal.ncdenr.org/web/wm/ust/forms#PIB>. The UST- 20 "[Alternative Fuel Compatibility Checklist](#)"<sup>17</sup> form insures E85 compatibility by requiring that applicants provide Underwriters Lab (UL) numbers, manufacturer approval, or approval by a Professional Engineer (PE) on all components (not including the dispenser) of an underground storage tank system.

<sup>15</sup> [http://nccleantech.ncsu.edu/wp-content/uploads/Retail-Locations-Ethanol-5\\_13.pdf](http://nccleantech.ncsu.edu/wp-content/uploads/Retail-Locations-Ethanol-5_13.pdf)

<sup>16</sup> [http://www.afdc.energy.gov/locator/stations/#results?utf8=%E2%9C%93&location=North+Carolina&filtered=true&fuel=E85&owner=all&payment=all&v\\_level1=true&ev\\_level2=true&ev\\_dc\\_fast=true&radius\\_miles=5](http://www.afdc.energy.gov/locator/stations/#results?utf8=%E2%9C%93&location=North+Carolina&filtered=true&fuel=E85&owner=all&payment=all&v_level1=true&ev_level2=true&ev_dc_fast=true&radius_miles=5)

<sup>17</sup> [http://portal.ncdenr.org/c/document\\_library/get\\_file?p\\_l\\_id=38491&folderId=467318&name=DLFE-13308.pdf](http://portal.ncdenr.org/c/document_library/get_file?p_l_id=38491&folderId=467318&name=DLFE-13308.pdf)

The following “rules of thumb” can help determine the potential for an existing site to be converted to E85:

- Most fiberglass (FG) tanks, pipes and adhesives used to seal/connect pipes are compatible. Single-or double-wall fiberglass tanks are non-corrosive and may be used for storing fuel ethanol if approved by UL. Xerxes and Owens Corning (now Containment Solutions) are the primary manufacturers of FG tanks. FG tanks manufactured prior to 1992 MAY NOT be able to handle E85. Smith and Ameron are primary piping manufacturers of FG piping. Anything made by Smith after 1984 is E85 compatible including adhesives.
- Flex pipe systems are generally compatible. APT (Franklin Fueling Systems) and OPW are primary manufacturers. No sealant is required in these installations. Steel piping is likely NOT compatible because sealant used on steel pipes is not compatible.
- If you need to modify piping below the shear valve, it is required to bring the entire UST up to current standards, which could cost \$40,000 to \$50,000.
- Most metal underground storage tanks that meet EPA December 1998 codes can be used to store E85. Underground tank systems can use double-walled, low-carbon, cold-finished steel tanks, but welded tanks are preferred and must be corrosion protected to meet EPA requirements. Do not use plated-metal tanks.

<b>Materials NOT to be used with Ethanol<sup>1</sup></b>	
<u>Non-metals</u>	<u>Metals</u>
• Natural Rubber	• Zinc
• Polyvinyl Chloride (PVC)	• Brass
• Cork gasket materials	• Lead
• Leathers	• Lead based solder
• Polyurethane	• Aluminum
• Polyamides	• Terne plating (lead-based found in older tanks)
• Methyl-methacrylate	
• Polyester-bonded fiberglass laminates	

### **Above Ground Tank Systems**

An above-ground system can typically be installed at a lower cost if all regulations and fire codes are met. As with the underground systems, stainless steel, cold-finished steel, or fiberglass tanks are recommended and must meet the requirements for storing ethanol. The above-ground tank sizes are typically smaller than the underground tanks – usually 1,000 to 2,000 gallons, but up to 12,000 gallons if regulations and spacing allow. It is important to consult your ethanol supplier when deciding on tank size because the cost per gallon may increase significantly for orders less than a full tanker (typically 7,000-7,500 gallons). It should be noted that above ground tanks in NC are not covered by the NC UST fund. Therefore, they would require private pollution insurance.

### **E85 dispensers**

Research has shown that high concentrations of ethanol in blended fuels may cause corrosion. The following manufacturers have dispensers that are UL certified E85 compliant:

- Gasboy model Atlas E85
- Gilbarco models Encore 300, 500, 550, 700, NJ2, NJ4 and NL3
- Wayne models G520, G610, G620 and Ovation E

See the “[Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends](#)”<sup>18</sup> Appendix D for a complete list of UL certified E25 & E85 fuel dispensing equipment and hardware. North Carolina’s State Fire Marshal (who, along with local inspectors, has authority over dispensing equipment) is requiring that, in lieu of any 3<sup>rd</sup> party verification (UL), entities wishing to install or retrofit a pump to dispense E85 must get a NC Professional Engineer (PE) to attest to the compatibility of the new and/or retrofitted dispenser pump.

### **Converting an existing gasoline or diesel fuel dispensing facility to E85**

A suitable tank must be cleaned completely before switching fuels:

- Pump all remaining diesel or gasoline fuel out of the bottom and any moisture that may have accumulated.

<sup>18</sup> [http://www.afdc.energy.gov/uploads/publication/ethanol\\_handbook.pdf](http://www.afdc.energy.gov/uploads/publication/ethanol_handbook.pdf)

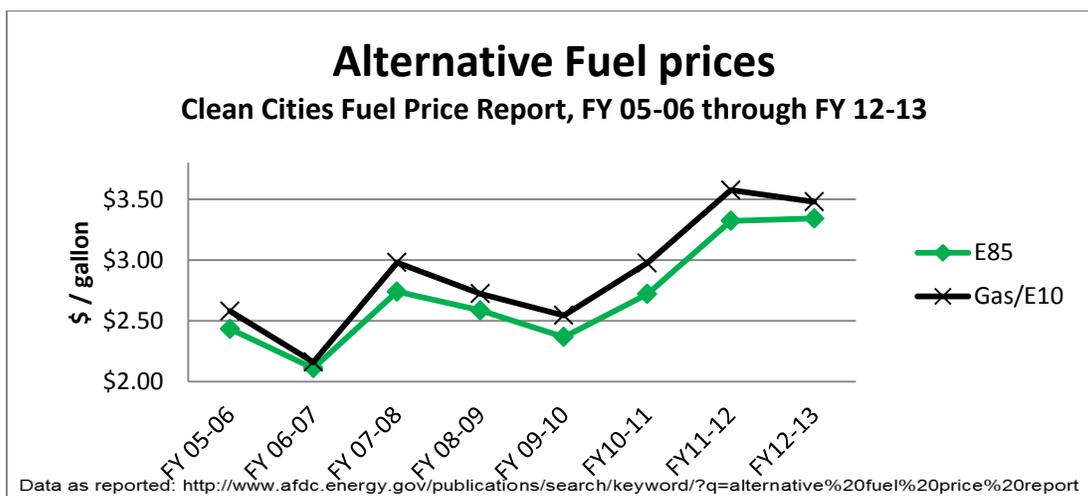
- Clean the tank walls by one of these methods: using a filter agitator device, physically entering the tank and steam cleaning the sludge, using a robotic cannon to liquefy the sludge, or using a chemical cleaner.
- Pump out the sludge that was cleaned from the tank walls, and dispose of properly.
- Add 100 gallons of E10 (10% ethanol 90% gasoline) and then pump out all E10 and any remaining residue. Add and sell out 500 gallons of E10. E10 is fully compatible with any gasoline engine.

This last step is recommended, but not always necessary. The costs for the cleaning process to prepare the tank for E85 storage vary. Typical costs for cleaning are \$1,500 to \$2,000.

For additional information regarding ethanol storage and dispensing see the U.S. DOE's "[Handbook for Handling, Storing, and Dispensing E85 and Other Ethanol-Gasoline Blends](#)"<sup>19</sup> and "[Compatibility of UST Systems with Biofuels](#)" by the Association of State and Territorial Solid Waste Management Officials, June 2013.<sup>19</sup> Contractors that have expertise in ethanol fueling systems include [Protec Fuel Management](#)<sup>20</sup> and [Jones & Frank Fluid Handling Equipment](#).<sup>21</sup>

### North Carolina E85 Retail Price Data

Over the past 9 years, E85 transport load prices on the North Carolina state contract have tracked slightly lower than E10 and/or gasoline, with the largest +/- deviations coming in FY11-12 when E85 was \$0.442 lower than E10 and in FY FY06-07 when E85 was \$0.196 higher than E10.<sup>22</sup> The same trend was seen in the public/retail market, with the price of E85 tracking slightly lower but generally more closely to gasoline/E10 prices than on the state contract.



**Figure 1.** Data from [surveys completed by Clean Cities Coalitions](#).<sup>23</sup> The prices are compiled and reported quarterly by region (Lower Atlantic was used for this graph), and then averaged over each fiscal year. Data for FY 05-06 was incomplete, and is based on a single quarter.

Transportation fuel prices change often, sometimes dramatically, so while the graphics above can provide some insight into longer term fuel price trends, it is best to [contact local biofuel retailers directly](#) for the most current prices in your area.<sup>24</sup>

<sup>19</sup> [http://astswmo.org/Files/Policies\\_and\\_Publications/Tanks/2013.06-Biofuels\\_Compatibility-Alt\\_Fuels.pdf](http://astswmo.org/Files/Policies_and_Publications/Tanks/2013.06-Biofuels_Compatibility-Alt_Fuels.pdf)

<sup>20</sup> <http://www.protecfuel.com/>

<sup>21</sup> <http://www.jones-frank.com/about.html>

<sup>22</sup> In FY 06-07 an error was made in contract price negotiations resulting in a significantly higher price for E85 than gasoline. This error was corrected, and since that time the price of E85 has tracked more consistently lower than gasoline and E10, exceeding gasoline only in FY 09-10 by just \$0.03.

<sup>23</sup> <http://www.afdc.energy.gov/publications/#search/keyword/?q=alternative%20fuel%20price%20report>

<sup>24</sup> <https://docs.google.com/a/ncsu.edu/file/d/0B1LuScUZTktmMmd0V2ZvLU9aV2c/edit?pli=1>

## North Carolina E85 Case Study

There are a number of fleets successfully using E85 throughout North Carolina. Details regarding motivation, factors tied to the decision, lessons learned and the overall experience for select fleets can be found at “[E85 Case Studies](#)”. A few example NC fleets using E85 are:

- NC State University: Annual E85 usage of greater than 35,000 gallons.
- NC Department of Transportation: Annual E85 usage of greater than 42,000 gallons.
- UNC-Chapel Hill: Annual E85 usage of greater than 77,000 gallons.
- NC Department of Administration: Annual E85 usage of greater than 235,000 gallons.

## Trends Looking Ahead

The Energy Independence and Security Act (EISA) of 2007 expanded the Renewable Fuel Standard (RFS) program, which established specific categories of renewable fuels and increasing levels required each year up to 36 billion gallons by 2022.<sup>25</sup> The RFS volumes set by the EPA have been met each year, except for the cellulosic biofuels. For more information regarding the RFS see [the EPA RFS site](#)<sup>21</sup>, [the AFDC RFS site](#)<sup>26</sup> and “[Renewable Fuel Standard \(RFS\): Overview and Issues](#)” by the Congressional Research Service.<sup>27</sup> The objective of the RFS is to incentivize development and usage of domestic biofuels, reduce foreign oil dependence, and foster domestic job growth. The result has been significant investment and growth of the biofuels industry. However, in recent years the ethanol industry has faced challenges. This is due to a number of unforeseen factors:

- There have been dramatic fluctuations in the price of corn (the primary feedstock for ethanol) and in the price of crude oil (which influences ethanol prices).
- In 2012, the ethanol producer tax credit of \$0.45 per gallon was allowed to expire.
- Because of increased vehicle fuel economy and economic factors, gasoline consumption has decreased. When the RFS was put in place, consumption was expected to increase over time.

### RFS Fuel Categories<sup>25</sup>

- **Conventional Biofuel:** Any fuel derived from starch feedstock – corn, sorghum, and wheat (almost exclusively corn).
- **Biomass-Based Diesel:** Diesel fuel substitute made from renewable feedstock, including biodiesel and non-ester renewable diesel. It cannot be co-processed with petroleum, which are considered ‘undifferentiated advanced biofuels’.
- **Cellulosic Biofuel:** Any fuel derived from cellulose, hemicellulose, or lignin—nonfood-based renewable feedstock. Cellulosic biofuels must have life cycle GHG emissions at least 60% lower than the baseline petroleum fuel.
- **Other Advanced Biofuels:** Any fuel derived from renewable feedstock. This may include sugarcane or sugar beet-based fuels; renewable diesel co-processed with petroleum; and other biofuels that may exist in the future. Both biomass-based diesel and cellulosic biofuel that exceed volumes in their respective categories may be used to meet this category.

- Only **2%** of ethanol production is blended into E85. This is due to the lack of awareness and infrastructure.
- Only about 30% of those who own an FFV are aware that their vehicle is E85-capable.<sup>27,28</sup>

<sup>25</sup> <http://www.epa.gov/otaq/fuels/renewablefuels/index.htm>

<sup>26</sup> <http://www.afdc.energy.gov/laws/RFS>

<sup>27</sup> <http://www.fas.org/sgp/crs/misc/R40155.pdf>

- Despite the auto industry offering a significant number of FFV's at no increased cost, proliferation and adoption of E85 has been below expectations because many FFV owners are still not aware that they are driving an E85 compatible vehicle.<sup>28,29</sup>
- E85 infrastructure remains limited – as of the end of 2012 there were only 2,351 public E85 stations<sup>30</sup> versus 156,065 public gasoline stations<sup>31</sup> in the United States. This leaves the more than 11 million FFVs with limited ability to choose E85.
- The petroleum industry is not interested in blending more than E10, which is needed as a fuel oxygenate after MTBE was banned in 2007.

As a result of these factors the so-called “blend wall” has become a concern. The “blend wall” means that the consumption of renewable fuels, mainly ethanol as an E10 blend, has reached its limit, but is still below the RFS requirements. Without increased usage of higher blends of ethanol, like E15 (approved by EPA for use in 2001 and newer vehicles) and E85, it will be difficult to meet the increasing requirements of the RFS.

Some of the opportunities for expanding ethanol use in North Carolina include:

- Identifying attractive locations and willing retailers for E85 refueling to serve the large number of FFV's in state and federal government fleets.
- Providing “blender” dispensers whereby consumers can choose E15 up to E85 based on vehicle compatibility and pricing preferences.
- Increasing awareness about E85 by [distributing informational brochures](#).<sup>32</sup>

**Barrier Busters:**  
**Increase Your Fleet's E85 Usage**

- Look for FFV capable vehicles when purchasing new vehicles—more than 84 models available.
- ID FFV's that may already be in your fleet.
- Make operators aware of E85 station locations.
- Have a policy in place that generates E85 awareness and promotes E85 usage.

**Advanced Feedstocks and Methods: Cellulosic Ethanol**

The next step for ethanol is to develop and utilize advanced methods and feedstock that are less costly, more stably priced, more readily available, and have better energy yield. Researchers and industry are looking at cellulosic ethanol, which is a biofuel that uses waste or non-food crops as a feedstock. Potential biomass feedstock includes crop and crop residues, mill waste, and urban waste. The U.S. Department of Energy's Bioenergy Feedstock Development Program (BFDP) has determined that hybrid poplars, hybrid willows, and switch grass have the greatest potential for dedicated energy and raw material (fiber) crops across a wide geographic range.

In general, biomass materials are more difficult to break down into sugars than corn. There are primarily two methods used for processing biomass materials-- biological with enzymes and microbes, and thermochemical.

While there have been delays in bringing plants on line, there is much optimism regarding cellulosic biofuels production. [Kior](#)<sup>33</sup> has a commercial scale biomass facility in Mississippi that produces a renewable biocrude, which is refined into gasoline, diesel and fuel oil blend stock meeting current ASTM gasoline and diesel fuel quality standards. [POET](#)<sup>34</sup>, a US-based bio-refining company, plans to open a commercial scale cellulosic

<sup>28</sup> <http://www.cars.com/go/advice/Story.jsp?section=fuel&subject=fuelAlt&story=e85>

<sup>29</sup> <http://www.consumerreports.org/cro/2011/01/the-great-ethanol-debate/index.htm>

<sup>30</sup>

[http://www.afdc.energy.gov/locator/stations/#results?utf8=%E2%9C%93&location=&filtered=true&fuel=E85&owner=all&payment=all&ev\\_level1=true&ev\\_level2=true&ev\\_dc\\_fast=true&radius\\_miles=5](http://www.afdc.energy.gov/locator/stations/#results?utf8=%E2%9C%93&location=&filtered=true&fuel=E85&owner=all&payment=all&ev_level1=true&ev_level2=true&ev_dc_fast=true&radius_miles=5)

<sup>31</sup> <http://www.thedailybeast.com/articles/2013/05/05/farewell-to-the-gas-station-the-demise-of-a-car-culture-icon.html>

<sup>32</sup> <http://nccleantech.ncsu.edu/wp-content/uploads/E85-pamphlet-Final.pdf>

<sup>33</sup> <http://www.kior.com/>

<sup>34</sup> <http://www.poet.com/>

ethanol plant in early 2014 that will use corn crop residue (cobs, leaves, husks and some stalk) as feedstock. With support from the USDA, [ChemTex International](http://www.chemtex.com/en)<sup>35</sup> with operations in Wilmington, NC in partnership with [Novozymes](http://www.novozymes.com/en/Pages/default.aspx)<sup>36</sup> (North American Headquarters in Franklinton, NC), are expected to have a cellulosic ethanol plant operational by mid-2015 in Sampson County NC.

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<sup>35</sup> <http://www.chemtex.com/en>

<sup>36</sup> <http://www.novozymes.com/en/Pages/default.aspx>