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**Fuels Institute**

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# E85

**A Market Performance Analysis  
and Forecast**



# Fuels Institute

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# E85–A Market Performance Analysis and Forecast

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# Executive Summary

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- E85 is subject to the fuel specification standard used by ASTM which applies to fuel blends that contain 51%–83% ethanol. The U.S. Energy Information Administration (EIA) uses an average ethanol concentration of 74% for its evaluations.
- There are between 2,685 and 3,349 retail fuel stations selling E85 in the United States. On the high side, E85 is available at 2.2% of the nation's 152,900 retail fueling stations.
- As of January 2014, there were between 14.2 million and 16 million flexible fuel vehicles (FFVs) registered in the United States. Only FFVs are able to operate on E85.
- On average, there are 1,466 light duty vehicles per retail fueling station. By comparison, there are 5,289 FFVs per E85 station. This difference in Vehicle-Station Density indicates there is room to accommodate additional E85 stations.
- When comparing E85 with gasoline (assuming a 10% ethanol concentration) on a strict energy-content basis, E85 (when blended with 74% ethanol) contains on average 22.8% fewer BTUs (British thermal units). This energy deficit represents the maximum potential reduction in miles per gallon when FFVs operate on E85, however vehicle efficiencies can offset some of this reduced energy content to deliver more miles per gallon.

- Minnesota leads the nation in E85 retail sites, reaching a peak of 357 in 2011 and operating 303 in 2014. Since January 2009, Minnesota E85 retail stations have averaged 4,083 gallons of E85 sales each month at an average price that was \$0.51 (16.5%) below unleaded.
- More than 100 stores that contribute sales data to the NACS-CSX benchmarking application also report information about E85 sales. Since January 2009, these sites averaged 2,845 gallons per month at \$0.347 (11.4%) below unleaded. E85 sales at these sites averaged 3.3% of unleaded sales.
- Stores in the NACS-CSX sample report E85 margins that averaged \$0.265 per gallon, 43% higher than unleaded, peaking at \$0.94 per gallon in July 2013 when the value of Renewable Identification Numbers (RINS) peaked.
- The Fuels Institute collected store-level data regarding E85 and unleaded sales from 304 locations. These stores averaged 5,490 gallons of E85 per month at an average \$0.436 (12.6%) below unleaded. E85 sales at these sites averaged 2.8% of unleaded sales.
- Fuels Institute stores report E85 margins that averaged \$0.134 per gallon, 20% lower than unleaded.
- Stores in the Fuels Institute sample that represented the Top Quartile of performance in terms of E85 sales volume averaged 364 gallons per day at \$0.453 (12.8%) below unleaded, compared to 66 gallons per day at \$0.441 (12.6%) below unleaded for stores in the Bottom Quartile. Top Quartile E85 sales equaled 4.4% of unleaded sales; Bottom Quartile E85 sales equaled 1.4% of unleaded sales.
- The Top 10 locations in the Fuels Institute sample based upon E85 sales averaged 520 gallons per day at \$0.499 (13.6%) below unleaded. E85 sales equaled 6.2% of unleaded sales.
- The most common E85 price discount in the Fuels Institute sample was between \$0.40 and \$0.60 per gallon. When the discount was greater than \$0.60, E85 sales increased to an average of 727 gallons per day and averaged 8.0% of unleaded sales.



*Minnesota leads the nation in E85 retail sites, reaching a peak of 357 in 2011 and operating 303 in 2014.*

- By 2023, there could be between 8,907 and 11,151 stations selling E85, and there could be 25.9 million FFVs capable of buying E85.
- Theoretically, if every FFV were to use E85 100% of the time, by 2023 E85 sales could reach 31.9 billion gallons, although this scenario is highly unlikely.
- Based upon past performance at retail locations, by 2023, E85 sales could range from as little as 401.5 million gallons per year to as high as 4.4 billion gallons per year.

# Introduction

The role of biofuels in the U.S. domestic motor fuels market has grown significantly since 2001, from 1.75 billion gallons to 14.544 in 2013. The vast majority of this fuel is ethanol. As the fuels market develops, there is debate concerning the potential for additional biofuels market expansion, although most agree ethanol will represent the majority of growth opportunities. If the use of the nearly ubiquitous fuel E10 (a blend of gasoline containing 10% ethanol) is constrained by the size of the gasoline market, what is the potential for alternative ethanol fuel blends? (Figure 1)

This is a popular topic in the fuels industry and, specifically, around Washington, D.C., as federal regulators consider strategies to meet the goals of the Renewable Fuel Standard (RFS). (See sidebar on page 5.) The most mature alternative renewable fuel is E85, a blend of gasoline with 51%–83% ethanol. Although other blends are beginning to enter the market (i.e., E15, E30, etc.), E85 specifically is attracting significant attention for its potential to contribute to the RFS. There is strong disagreement, however, among interested parties concerning the capacity of the market to sell significant volumes of E85. Proponents from the biofuels industry argue that E85 sales can increase if more stations sold the product and it was offered at an attractive price. Others argue that consumers have rejected E85 because it does not deliver the same miles per gallon as gasoline and is often sold at a price that does not compensate the consumer for this reduced fuel efficiency.

An objective analysis of the current performance of E85

in the market and the range of its market potential is essential to provide guidance regarding the potential for E85 to meet the goals of the RFS. In response to interest from the Fuels Institute participants for analysis of this market, and in direct response to requests from multiple congressional committees, the Fuels Institute developed this report to provide a comprehensive source for information about the market for E85.

It is important to note that this report is focused on the fuel blend commonly referred to as E85, containing 51%–83% ethanol, and does not address emerging market

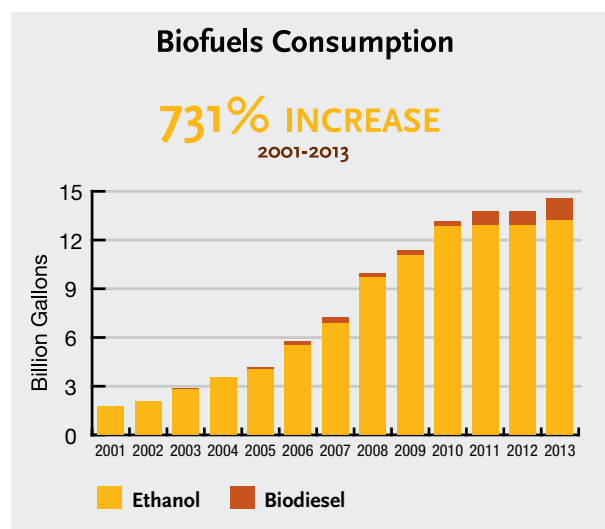


Figure 1: Biofuels Consumption (Source: U.S. EIA<sup>1</sup>)

<sup>1</sup> <http://www.eia.gov/totalenergy/data/monthly/#renewable>

opportunities for other ethanol fuel blends. It is also important to note that this report uses the term E85 even though the vernacular is beginning to switch to “flex fuel.” By using E85 specifically, the report attempts to clearly differentiate from other “flex fuel” options entering the market.

## Methodology

The Fuels Institute sought to evaluate the following thesis: Demand and consumption of E85 is contingent upon the availability of E85 at retail fueling stations, the inventory of FFVs and the price at which E85 is offered for sale, taking into account the relative efficiency of the fuel.

To evaluate this thesis, the Institute leveraged publicly available data from the U.S. Energy Information Administration (EIA), the Alternative Fuels Data Center, state government agencies and previously released Fuels Institute reports. In addition, the Institute utilized data contributed by NACS-CSX, Growth Energy, the Renewable Fuels Association and others, as well as direct reports from fuel retailers who currently sell E85.

This report has been reviewed by the Fuels Institute Board of Advisors and participating organizations of the Institute and their feedback has been incorporated when possible to ensure a robust presentation of data relevant to the E85 market. It does not reflect the individual position of any participating organization or individual, but represents a collective effort to best capture a comprehensive picture of the E85 market.

In addition, this report does not take into consideration

### RENEWABLE FUEL STANDARD (RFS)

First established by Congress in the Energy Policy Act of 2005, the original RFS set a requirement that a minimum of 7.5 billion gallons of qualified biofuels be incorporated into the fuel supply by the year 2012. In 2007, Congress passed the Energy Independence and Security Act, which expanded this program to set an escalating requirement that would culminate with a 36 billion gallon standard in 2022. This revised program, referred to as RFS2, included specific requirements for the lifecycle greenhouse gas reduction capabilities of each qualified renewable fuel.

### WHAT IS E85?

E85 is subject to the fuel specification standard (D5758) used by ASTM, which applies to fuel blends that contain 51%–83% ethanol, with the balance comprised of gasoline.<sup>2</sup> The specification formerly covered fuel ethanol containing 70%–85% ethanol that was commercially referred to as E85. The Federal Trade Commission currently requires E85 to be labeled as containing a minimum of 70% ethanol, but a proposal is under consideration to change labeling requirements.

Currently, this slate of fuel blends is commonly being marketed as “flex fuels.” For purposes of this report, the term E85 will be used to refer to all blends containing 51%–83% ethanol. The product is suitable for use only in specially designed vehicles known as flexible fuel vehicles (FFVs).

consumer perceptions regarding FFVs or E85. A supplemental report developed from a nation-wide survey conducted for the Fuels Institute by Penn Schoen Berland will be released separately. That report will look closely at consumer attitudes and experiences with ethanol fuel blends, including E15 and E85.

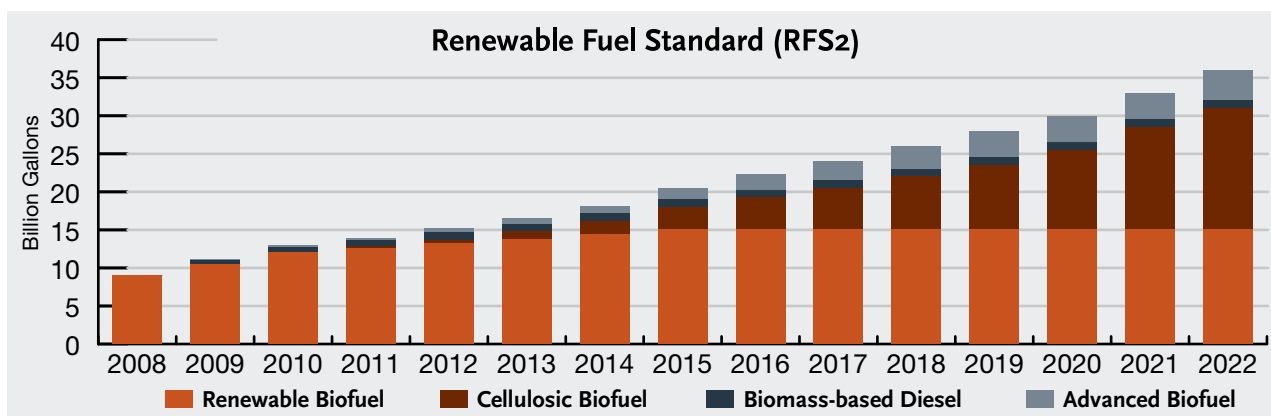


Figure 2: Renewable Fuel Standard (RFS2)

<sup>2</sup> <http://www.astm.org/Standards/D5798.htm>

# The Basics

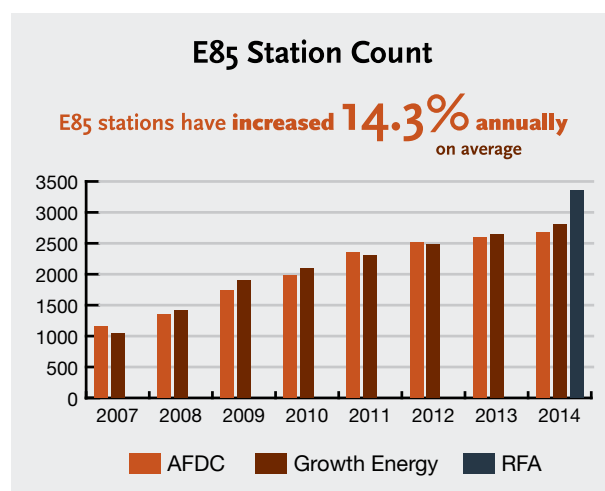
## E85 Retail Stations

One of the factors restricting E85 consumption is its relatively limited availability at retail. In fact, approximately only 2% of retail fueling locations offer E85. It is often argued that if E85 were more readily and conveniently available in the market through additional retail locations, more consumers would purchase E85 on a regular basis. This assumption is supported in a recent Fuels Institute survey of consumer perceptions—73% of respondents who drive FFVs say they would be more likely to buy E85 if it were more available where they live.<sup>3</sup> Of course there are several factors involved in determining the potential sales of E85, but station availability is definitely one of them.

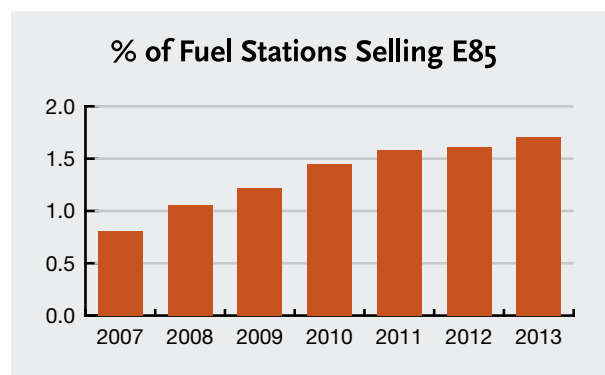
According the Alternative Fuels Data Center (AFDC)<sup>4</sup>, the number of outlets selling E85 has increased 131% since June 2007, reaching a total of 2,685 in June 2014. Expansion of this market was most aggressive in the early years of the data set, with 2008 recording a 28.2% increase in E85 stations followed by 2009 with a 21.2% increase. Growth in subsequent years slowed and the average annual growth rate was 13.0%.

<sup>3</sup> Additional consumer attitudes concerning E85 and other ethanol-blended fuels will be released in another Fuels Institute report. Consumer perspectives were collected in a nationwide survey conducted for the Fuels Institute by Penn Schoen Berland.

<sup>4</sup> The Alternative Fuel Data Center is a resource provided by the Department of Energy ([www.afdc.energy.gov](http://www.afdc.energy.gov)).

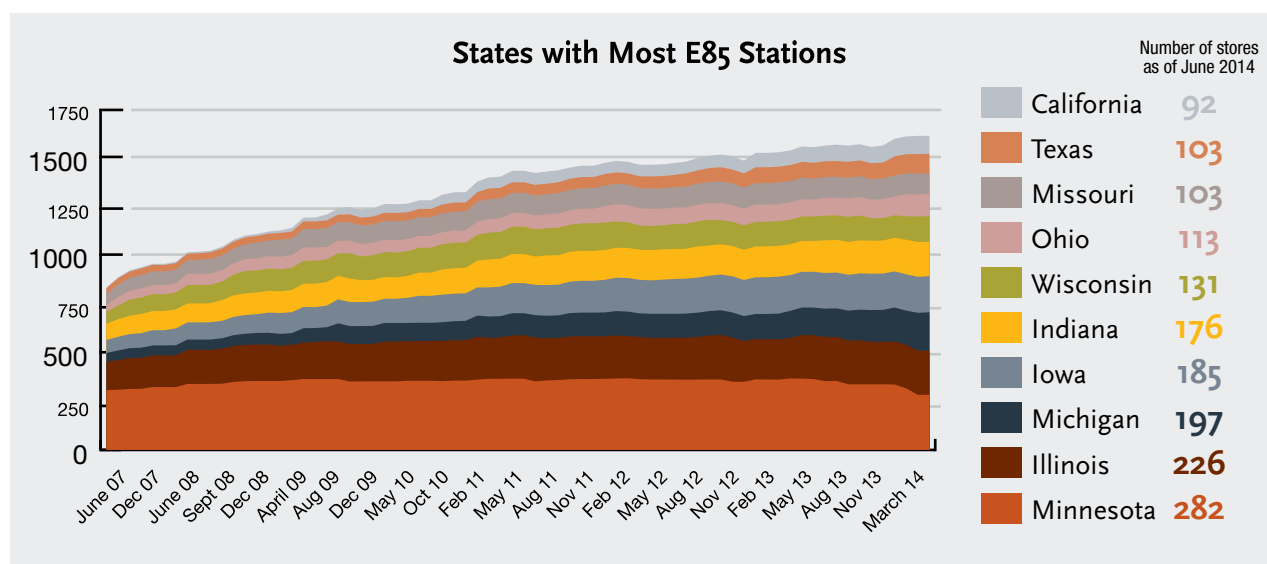


**Figure 3: E85 Station Count** (Source: AFDC, Growth Energy, Renewable Fuels Association)



**Figure 4: % of Fuel Stations Selling E85** (Source: AFDC, National Petroleum News)





**Figure 5: States with Most E85 Stations (Source: AFDC)**

AFDC data is slightly lower than the station count reported by Growth Energy and significantly lower than that reported by the Renewable Fuels Association (RFA). RFA estimates that 3,349 stations were selling E85 as of summer 2014<sup>5</sup>. Growth Energy reports 2,804 E85 stations as of January 2014 with an annual growth rate of 15.7% since 2007. Taken together, Growth Energy and AFDC growth rates yield an annual growth rate of 14.3%. (Figure 3)

As a percentage of total retail fueling stations, the presence of E85 is limited. Even when using RFA's station count, E85 has not yet reached more than 2.2% of retail fueling locations. The total number of fueling stations, as reported by *National Petroleum News (NPN)*, has declined for several years and reached 152,900 in 2013<sup>6</sup>. Figure 4 plots the AFDC E85 station count as a percentage of NPN's total station count. (Figure 4)

### E85 Stations are Regionally Concentrated

The 10 states with the most E85 stations represent 60% of all stations in the country, and eight of those are located in the Midwest. Minnesota leads the nation with 282 stations as of June 2014, according to AFDC. (The Minnesota Department of Commerce reports E85 station count in 2014 at 303, with a peak of 357 in 2008 and 2011.) Minnesota is

followed closely by Illinois (226), Michigan (197), Iowa (185) and Indiana (176). (Figure 5)

Increasing the E85 station count would improve the potential for additional E85 sales, but several other factors must also be evaluated to determine the potential E85 market. These factors include the number of flexible fuel vehicles, the Vehicle-Station Density and the pricing strategy required to attract consumers. All of these factors will influence the decision of a retailer to sell or to not sell E85 and are covered in subsequent sections of this report.

## Flexible Fuel Vehicle (FFV) Inventory

Influencing a retailer's decision to sell E85 is the number of potential customers in the market who can purchase the fuel. Given that the number of FFVs registered in the United States represents only about 6% of all registered light duty vehicles (LDVs), the potential demand for the fuel is limited. Increasing the share of consumers who can and will purchase E85 will provide greater incentive to retailers to sell the fuel.

It stands to reason that the more vehicles in the market that can use a fuel product, the greater chance there is that

<sup>5</sup> On July 25, 2014, RFA publicly challenged AFDC to update its numbers, citing as its source the "crowd-sourced" website E85prices.com. <http://www.ethanolrfa.org/news/entry/rfa-to-doe-update-your-e85-data/>

<sup>6</sup> NPN went out of business and did not publish a station count for 2013. However, NPN shared with NACS that it would have reported 152,900 stations in 2013.

## RETAIL COMPATIBILITY WITH E85

Retailers interested in selling E85 should consult with local authorities who have jurisdiction over equipment compatibility. These individuals are authorized to enforce fire code requirements and must provide the retailer with approval to add a new fuel.

Retailers must also be aware that federal regulations require equipment used to dispense flammable materials, like motor fuels, be listed by a nationally recognized testing laboratory as compatible with the product being stored and dispensed.<sup>7</sup> In addition, tank insurance policies, state tank programs and bank loan covenants require retailers to use only listed equipment. Retailers who proceed to dispense fuel through equipment that is not properly listed for that fuel, in addition to violating regulations and policies as noted above, may also be subject to litigation for negligence per se for using a non-listed device.

Most retail fuel equipment is listed by Underwriters Laboratories (UL). In October 2006, UL suspended the use of existing UL listings for equipment to dispense fuel containing more than 15% ethanol.<sup>8</sup> UL took this action due to concerns of greater corrosive potential of these fuels with certain components, although UL acknowledged that it had “no documented reports of field failures or safety issues associated with UL Listed or Recognized components

used with E85.” In November 2007, UL issued standards (UL 87a) for listing dispensers to handle E85. Equipment manufacturers were then able to submit equipment for evaluation and potential listing.

As of September 2013, there were a number of listed dispensers and associated equipment approved for E85.<sup>9</sup> However, any dispenser put into service prior to an E85 listing being approved for that equipment is beholden to the restrictions of its original listing—UL listings are not retroactively applied to previously manufactured units, even if such units are identical to those subject to the new listing.

Retailers interested in selling E85 are required to replace equipment not listed under UL 87a, which could result in additional costs to accommodate the fuel. In some cases, retailers may only need to replace the hanging hardware on their dispensers. In others, retailers may need to replace equipment located underground, which would result in additional costs associated with excavation.

There are a variety of federal, state and local incentives available to retailers to help defray the costs of compatible equipment to accommodate higher blends of ethanol fuels. Two resources providing information for those seeking incentives are [www.afdc.energy.gov/fuels/laws/ETH](http://www.afdc.energy.gov/fuels/laws/ETH) and [www.by ethanol.com/incentives.html](http://www.by ethanol.com/incentives.html).

retailers will decide to sell that product. Like determining the number of stations selling E85, however, determining how many FFVs are on the road is often a point of debate. That is because there are several sources of data that can be used to determine how many FFVs are operating in the market.

Figure 6 shows the calculation for total number of FFVs beginning in 2012 and forecast through 2023 from two sources, EIA and the Fuels Institute.<sup>10</sup> EIA reports in 2012 there were 11.4 million FFVs, in 2014 there would be 14.2 million and 24.0 million in 2023. The Fuels Institute reported 11.7 million FFVs in 2012, estimated 15.3 million in 2014 and forecast 26.1 million in 2023.

Figure 7 plots the percent of LDVs that are forecast

by EIA to be FFVs through 2023. EIA reports a 2014 FFV market share of 6.3%, increasing to a 2023 market share of 9.8%. The inventories reported by EIA and the Fuels Institute are slightly lower than those reported by Growth Energy and the Renewable Fuels Association (RFA), both of which report the number of FFVs as of January 2014 at 16 million.<sup>11</sup> If the 2014 inventory of FFVs were in fact 16 million, FFVs would command a market share of 7.0%, based upon EIA's reported number of LDVs, just slightly higher than the 2014 market share reported by EIA.

The market for FFVs clearly has increased in the past several years, regardless which data source is evaluated. In 2008, the domestic automobile manufacturers pledged to increase the production of FFVs, with a goal of 50% of new

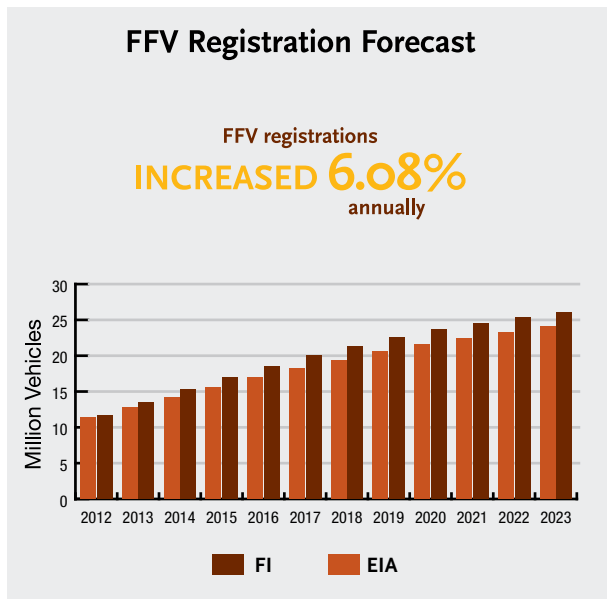
<sup>7</sup> 29 C.F.R. 1926.152(a)(1) (“Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids.” “Approved” is defined at 29 C.F.R. 1910.106(35) (“Approved unless otherwise indicated, approved, or listed by a nationally recognized testing laboratory.”)

<sup>8</sup> [http://ul.com/wp-content/uploads/2014/07/e85\\_faqs.pdf](http://ul.com/wp-content/uploads/2014/07/e85_faqs.pdf)

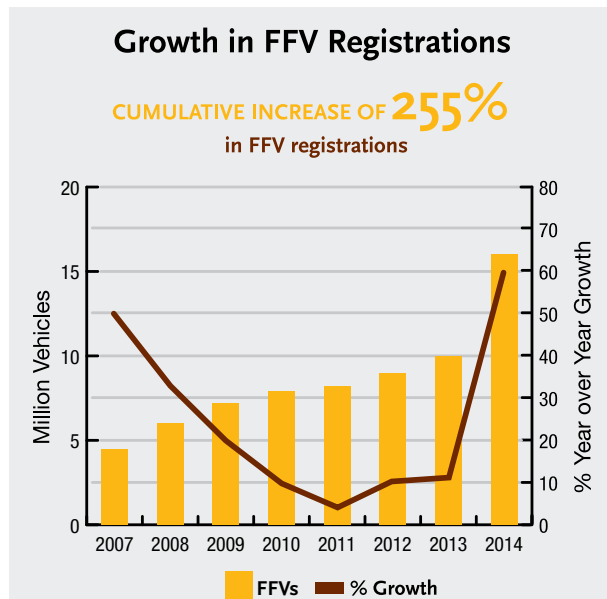
<sup>9</sup> [http://www.afdc.energy.gov/fuels/images/Dispensing\\_Equipment.pdf](http://www.afdc.energy.gov/fuels/images/Dispensing_Equipment.pdf)

<sup>10</sup> Data is derived from EIA's Annual Energy Outlook 2014 Early Release and the Fuels Institute report, “Tomorrow's Vehicles: What will we drive in 2023?,” prepared using data provided by Navigant Research. For this analysis, we use the “aggressive case” evaluation presented in the Fuels Institute report. <http://www.fuelsinstitute.org/ResearchArticles/TomorrowsVehicles.pdf>

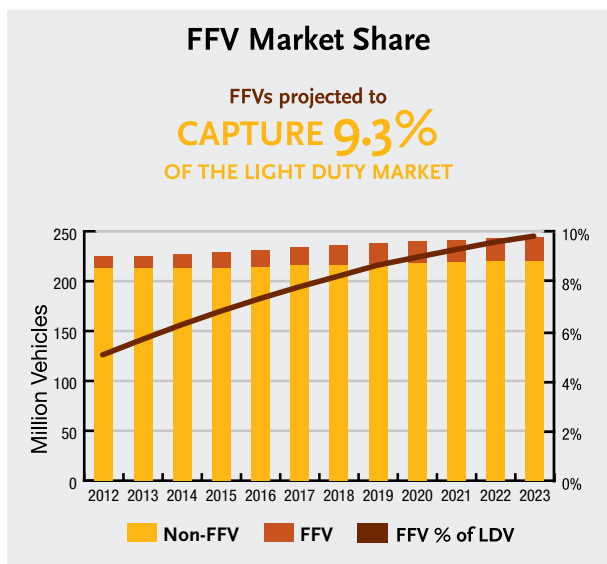
<sup>11</sup> Growth Energy reports that, according to R.L. Polk, as of July 2014 there were 18,263,769 registered FFVs in the U.S.



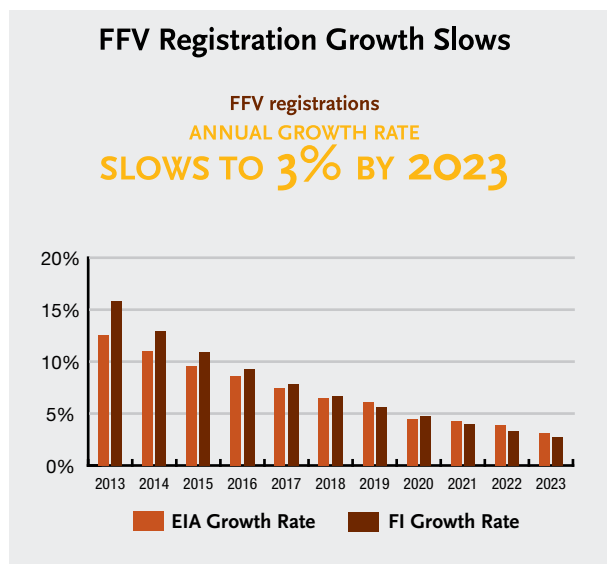
**Figure 6: FFV Registration Forecast**  
(Source: U.S. EIA, Fuels Institute)



**Figure 8: Growth in FFV Registrations**  
(Source: Growth Energy)



**Figure 7: FFV Market Share**  
(Source: U.S. EIA)



**Figure 9: FFV Registration Growth Slows**  
(Source: U.S. EIA, Fuels Institute)

vehicles being equipped to operate on E85. The result was a significant increase in the number of FFVs in the market. In fact, using data provided by R.L. Polk and Company through January 2014, Growth Energy reports a 255% increase in the number of registered FFVs since 2007. (Figure 8)

Whether such growth rates continue is unclear. Auto-

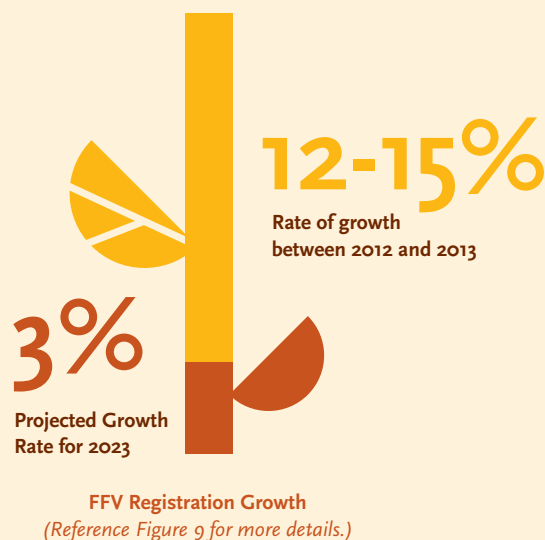
makers have been awarded a credit towards meeting their Corporate Average Fuel Economy (CAFE) standards for every FFV they produce. Under the new CAFE regulations, however, this credit is set to expire. It remains to be seen if the automobile manufacturers continue producing FFVs at the current rate in the absence of this credit. (Figure 9)

## EFFECT OF CAFE STANDARDS ON FFV PRODUCTION

Production of FFVs has been encouraged by federal policy. The Alternative Motor Fuels Act of 1988 established the first credit available to vehicle manufacturers for the production of FFVs based upon a specific calculation, with a maximum credit of 1.2 miles per gallon.<sup>12</sup>

The Energy Independence and Security Act of 2007 extended this tax credit through 2019, but at declining rates. The maximum credit of 1.2 miles per gallon was extended through 2014, but then dropped by 0.2 miles per gallon in each subsequent year until it reached 0.0 in 2020.<sup>13</sup> Additional credits are available for vehicles manufactured after 2020, but they are based upon the actual use of E85 in those vehicles.

Forecasts issued by EIA and the Fuels Institute indicate continued increased market penetration of FFVs, even after the expiration of the credit. However, as Figure 9 demonstrates, forecasts expect declining rates of growth in total registered vehicles. By 2023, the rate of growth in both forecasts is around 3% compared with 12%–15% between 2012 and 2013.



A complicating factor in the continuation of offering FFVs to the public is the introduction of advanced powertrain technologies. Some of these, like direct injection and turbo boosted engines, which facilitate compliance with CAFE standards, are expected to increase the cost and complexity of adding FFV technologies to vehicles. In

the absence of CAFE credits, it is uncertain to what extent manufacturers will continue offering these vehicles.

## Vehicle-Station Density

There is plenty of room in the nation to support additional E85 stations. The number of FFVs per station currently selling E85 is significantly higher than the national average of total LDVs per retail fueling location. This means there may be opportunities for retailers to satisfy an underserved market. It is also a contributing factor to the limited volume of E85 consumed by FFV drivers.

Understanding how many stations sell E85 and how many vehicles can run on it is only part of the equation. Another key factor in determining the potential market for E85 is to evaluate how many FFVs operate near those stations selling E85. This relationship between vehicles and stations—Vehicle-Station Density—is defined as:

**Station Density = Number Vehicles / Number of Fueling Stations**

Vehicle-Station Density is a critical consideration in determining the potential success of a product. The smaller the number, the more saturated the market is for fuel retailers and the more competition there is to support the consumer. This would provide more opportunities for consumers to purchase E85, but would also introduce stronger competition amongst E85 retailers, thereby enhancing the competitive market for E85 pricing. As a baseline, using EIA numbers for the vehicle population and NPN numbers for total fueling station, the LDVs for all light duty vehicles in 2013 was 1,466:

**Station Density = 225.6 million LDVs / 153,900 stations = 1,466**

By comparison, FFV Vehicle-Station Density in 2014 can vary depending on which numbers are employed. Here is the range:

**EIA and AFDC = 14.2 million FFVs / 2,685 E85 stations = 5,289**

**Growth Energy = 16.0 million FFVs / 2,804 E85 stations = 5,706**

**RFA = 16.0 million FFVs / 3,349 E85 stations = 4,778**

<sup>12</sup> P.L. 100-494, Section 513(g)(1)(A) (repealed, previously codified at 15 U.S.C. 2013(g)(1)(A)).

<sup>13</sup> P.L. 110-140, Section 109(a) (49 U.S.C. 32906(a)).

Regardless which numbers are used to calculate FFV Vehicle-Station Density, it is clear that there is plenty of room in the market to accommodate additional E85 stations (Figure 10). It can be inferred that the FFV population is being underserved by the retail market. An analysis of the ten states with the most E85 retail facilities supports this assertion.

Figure 11 shows the E85 Vehicle-Station Density for the top states with E85 retail facilities using the EIA-AFDC data. From this data, it would seem that Minnesota, Iowa and Indiana have station densities that are most closely in line with the national density for all vehicles and stations. Meanwhile, Texas and California<sup>14</sup> are far from achieving a comparable station density and the other states also have station densities in excess of the national LDV density.

While the data demonstrates there is room in the market to support additional E85 retail facilities, it is important to remember when evaluating E85 Vehicle-Station Density that there is a critical difference between FFVs and other vehicles. Drivers of FFVs are not required to purchase E85—their vehicles can operate on blends containing 0% ethanol to those containing 83% ethanol. Consequently, the siting of E85 stations is not essential to the operation of the vehicles, which undermines the market signal that FFV registrations

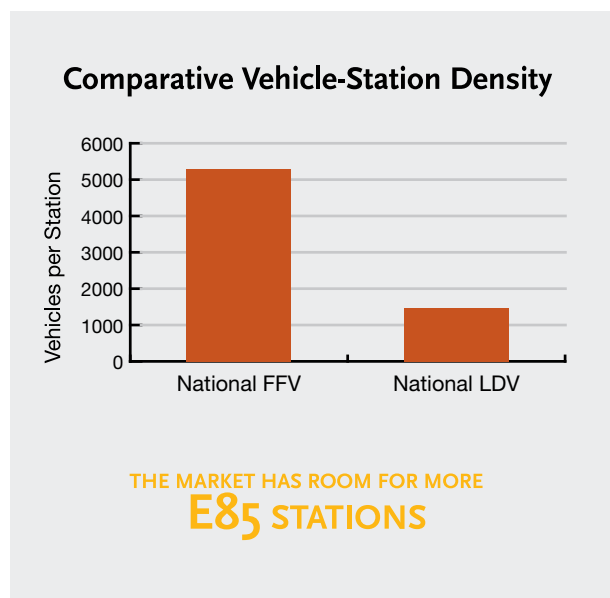
might otherwise send to retail operators. In translation, this could mean that the optimal Vehicle-Station Density for E85 is larger than the 1,466 that currently exists for the overall LDV market. There may not need to be as many E85 retail locations to effectively service the demand of the FFV market for E85 fuel.

Regardless what the optimum Vehicle-Station Density might be for FFVs and E85, market opportunities for E85 might be better realized if E85 stations were installed more frequently in locations with heavy FFV inventories.

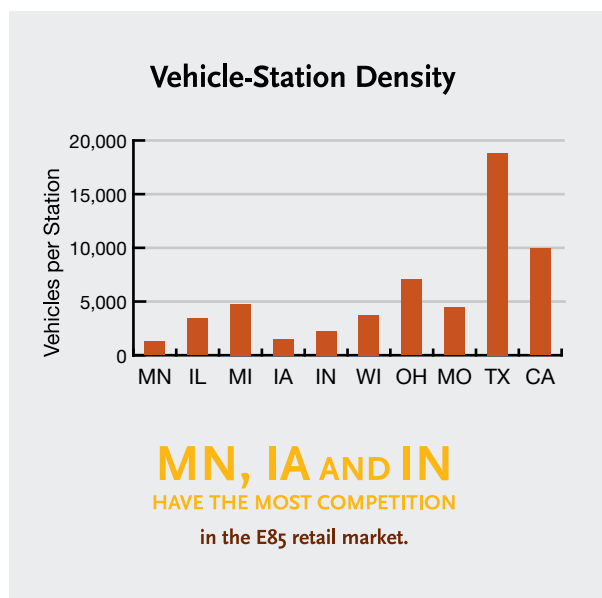
## E85 Energy Efficiency

When evaluating the E85 market, it is important to understand the energy efficiency and performance of E85 as a motor fuel, which is a critical element to understanding the relationship between E85 prices and those for unleaded gasoline.

ASTM International fuel specification standard D5798 applies to fuel blends containing 51%–83%, with the balance made up of gasoline. For this report, such fuels are referred to as E85.<sup>15</sup> Ethanol and gasoline contain different amounts of energy, which means there could be tremendous



**Figure 10:** Comparative Vehicle-Station Density  
(Source: AFDC, National Petroleum News)



**Figure 11:** Vehicle-Station Density  
(Source: AFDC, National Petroleum News)

<sup>14</sup> High FFV registration numbers for California and Texas are likely the result of the large populations in those states and the resulting large number of total registered LDVs.

<sup>15</sup> <http://www.astm.org/Standards/D5798.htm>

variability in the energy efficiency of E85 sold at retail. The ratio of each fuel component in the final E85 fuel mix can affect the fuel efficiency of vehicles operating on that fuel and ultimately affect the consumer experience and satisfaction with the fuel.

Because the concentration of ethanol can vary between 51%–83%, the energy value of E85 also can vary significantly. To assist with market evaluation, EIA uses an average ethanol concentration of 74%. This level takes into consideration blend ratios that benefit fuel performance in certain weather conditions and provides a valuable bench mark, even though the variability in the fuel can be significant. From information submitted to the Fuels Institute for this study by E85 retailers, the EIA average seems to be a fair approximation of market performance. Retailers reported average ethanol concentrations below 60% and as high as 83% during certain times of the year and given blending economics.

Because the efficiency of each FFV engine can be different, the most conservative way to evaluate the fuel efficiency of FFVs operating on E85 is to base the analysis on the possible energy value of the E85. This would represent the highest mileage loss case with some FFV vehicles performing better. In doing this, one can calculate the relative gasoline gallon equivalent (GGE) value for each E85 concentration, which will assist calculations concerning the potential market for E85. (GGE is used to demonstrate how many gallons of E85 would deliver the same energy as one gallon of gasoline, and by extension propel a vehicle the same distance.) While this is not a precise measurement (the BTU<sup>16</sup> value of each gallon of ethanol and gasoline can vary), it provides a credible benchmark.

Clean Cities reports the following energy values:<sup>17</sup>

**Ethanol:** 75,700 BTU/Gal  
**Gasoline:** 115,400 BTU/Gal  
**E10:** 111,430 BTU/Gal

## Ethanol Concentration

Ethanol Concentration	E85 BTU	E85 Energy % of E10	GGE
51%	95,153	85.39%	1.17
60%	91,580	82.19%	1.22
70%	87,610	78.62%	1.27
74%	86,022	77.20%	1.3
83%	82,449	73.99%	1.35

Figure 12: Ethanol Concentration (Source: Fuels Institute)

Because the vast majority of gasoline sold in the U.S. is blended with 10% ethanol, the energy value of this blend will be used as the baseline for comparison and for calculating GGE. The energy value and the GGE for various ethanol concentrations used in E85 is presented in Figure 12 using the following calculations:

$$(115,400 * \% \text{ gasoline}) + (75,700 * \% \text{ ethanol}) = \text{E85 BTU}$$

$$\text{E85 BTU} / \text{E10 BTU} = \text{E85 Energy as \% of E10}$$

$$1 \text{ Gallon E10} / \text{E85 Energy as \% of E10} = \text{GGE}$$

From these calculations, the EIA average ethanol concentration of 74% in each gallon of E85 results in an average energy deficit relative to unleaded gasoline of approximately 23%.

<sup>16</sup> BTU—British Thermal Units, a standard measure of energy that represents the amount of energy needed to cool or heat one pound of water one degree Fahrenheit.

<sup>17</sup> "Clean Cities Alternative Fuel Price Report," January 2014, page 16. The gasoline BTU value provided by Clean Cities in this report is for unleaded fuel, but it is unclear if the value is indicated for summer or winter blend fuel. The BTU value of the two specifications can vary.

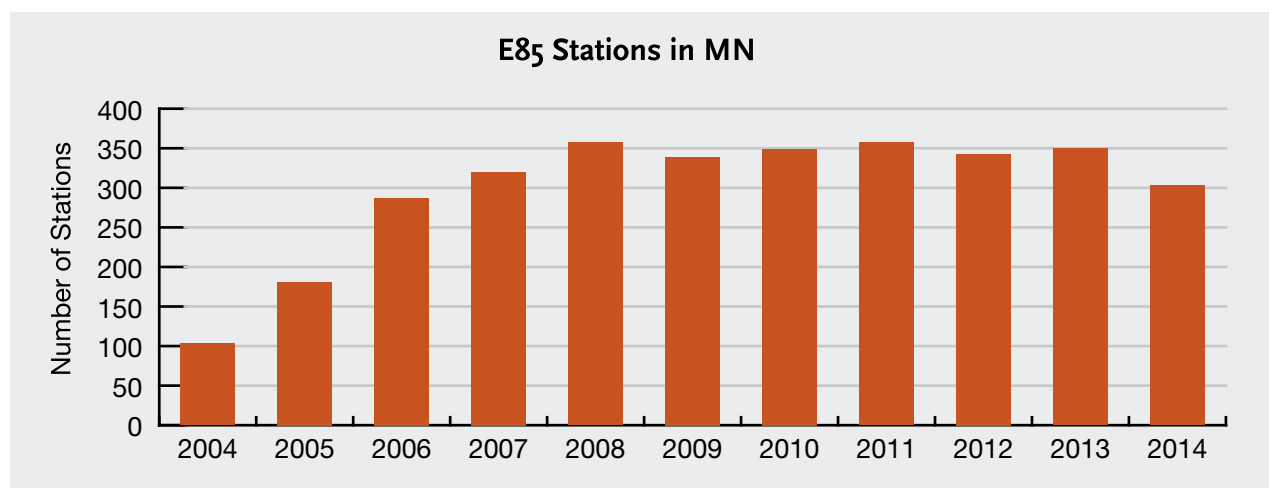
# Market Performance

## The Minnesota Experience

As the national leader in terms of E85 stations, and as the one state with a Vehicle-Station Density that mirrors the national density for LDVs, Minnesota provides a valuable test market to evaluate the potential for E85 sales in the nation. According to data published by the Minnesota Department of Commerce, since 2004 the number of E85 stations has increased 200% from 103 to 303 in 2014. (Station count peaked in 2008 and again in 2011 at 357 sites.)<sup>18</sup> (Figure 13)

Minnesota also tracks and reports monthly E85 sales volumes and reported prices. The number of stations that report data is extrapolated for statewide estimates. For this analysis, however, because understanding how E85 performs at the store level is the key focus, the data presented will be directly related to those stores that actually reported data to the Department of Commerce, not the extrapolated statewide data. Monthly data from January 2009 through April 2014 is included in this analysis, to provide a similar time frame as that evaluated in the next section.

Since January 2009, stores selling E85 have averaged



**Figure 13: E85 Stations in MN** (Source: MN Department of Commerce E85 Station Report <sup>19</sup>)

<sup>18</sup> According to marketer representatives in Minnesota, the decline in E85 station count is due in part to recent enforcement of infrastructure compatibility requirements. Stations that were not using listed equipment were required to cease operations.

<sup>19</sup> <http://mn.gov/commerce/>

4,083 gallons per month, with a range from a low of 2,014 in January 2013 to a high of 6,279 in August 2013. While Minnesota does not report unleaded sales data, if the E85 sales volumes are compared to industry averages as reported in the *NACS State of the Industry Report of 2013 Data*,<sup>20</sup> E85 sales would equal 4.3% of the average unleaded sales per store per month. (Figure 14)

### Station Location Profile Influences Sales Volume

Minnesota data indicates that station location profile can have a significant influence over E85 sales. The state reports monthly station sales volumes according to three location profiles: Metro, Rural and Government/University. The data demonstrates that Metro located stations report higher sales volumes than the other categories. Without analyzing the actual station reports to compare E85 sales versus regular unleaded sales, it is impossible to determine if Metro consumers are more likely to buy E85 or if Metro stations simply report higher E85 volumes because they generate higher fuel volumes overall. But one can assume that the Metro locations do enjoy a higher throughput because they serve a larger customer base. Similar to the Vehicle-Station Density discussion, a station will sell more fuel if there are more consumers in the location. Metropolitan markets by definition have a greater population density and would statis-

tically be expected to generate greater volume per station for all products sold. (Figure 15)

### Role of Price in E85 Sales

Market availability, both in Minnesota and nationally, has significant influence over the ability of a FFV driver to purchase E85. But the decision to buy E85, if given the opportunity, is largely driven by the price of the fuel compared to other alternatives. To help demonstrate the role of price in E85 consumption, Minnesota tracks E85 and regular unleaded prices on a monthly basis.

As explained in detail in the “Basics” section of this report, E85 contains fewer BTUs and delivers fewer miles per gallon than regular unleaded (i.e., E10). When blended at the EIA average rate of 74% ethanol, the fuel delivers 22.8% fewer BTUs. The mileage efficiency of FFVs could be up to 22.8% lower when running on E85 rather than gasoline, although individual vehicle performance could mitigate some of this energy deficit.

The volume of ethanol in each gallon of E85 can vary seasonally and between retail locations. To establish a baseline for analysis, the EIA average 74% ethanol concentration is used in this report. This would infer an economics-calculated price discount of up to 23% to inspire a FFV driver to purchase E85 instead of regular unleaded.

The data available through Minnesota does not answer

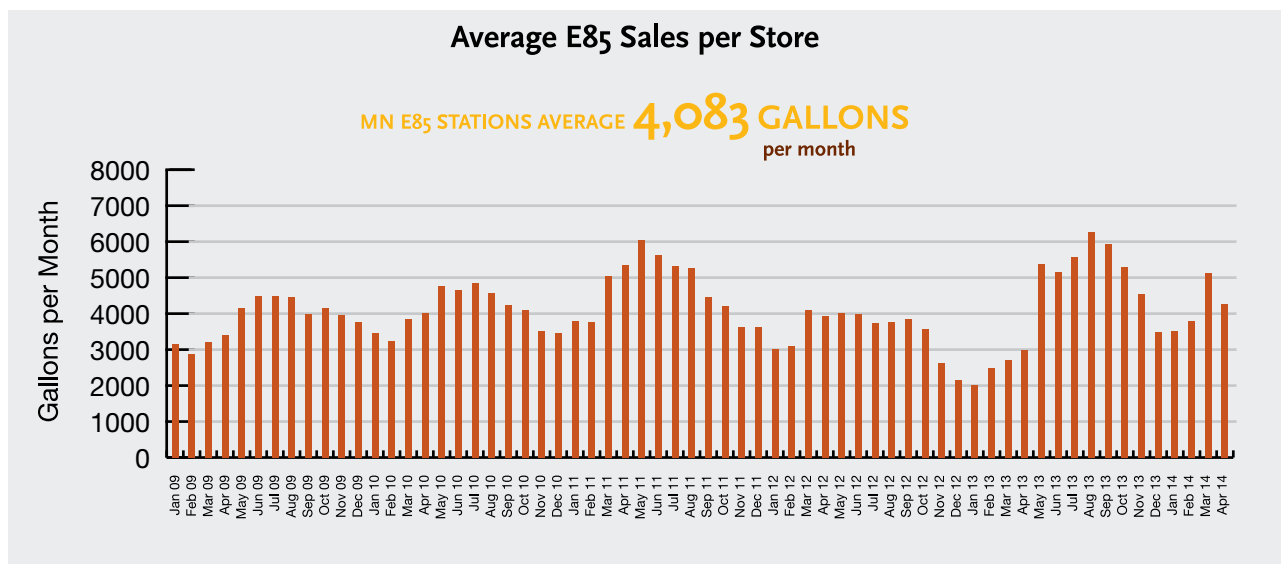


Figure 14: Average E85 Sales per Store (Source: MN Department of Commerce E85 Station Report)

<sup>20</sup> <http://www.nacsonline.com/soi>



whether this is a true inference because it is not a controlled study between multiple retailers and the same consumers and it does not provide volumes for unleaded sales, preventing a direct comparison of consumer conversions. However, it does provide helpful insight into the relationship between price and overall E85 gallons sold.

Store-level data since January 2009 indicates that E85 pricing has averaged 16.5% below unleaded, with an average price differential of \$0.51 per gallon. Discounts over the

time period have ranged from \$0.17–\$0.91 per gallon, or 5.5%–26.1%. As Figure 16 shows, sales volume seems to track closely with variation in the E85 price discount relative to gasoline.

While evaluating the percent differential between prices is informative and allows observers to evaluate the relative value of E85 compared to its expected energy density, consumers see dollars and cents—not percentages—when they pull into a retail fuel facility. Therefore, the actual price

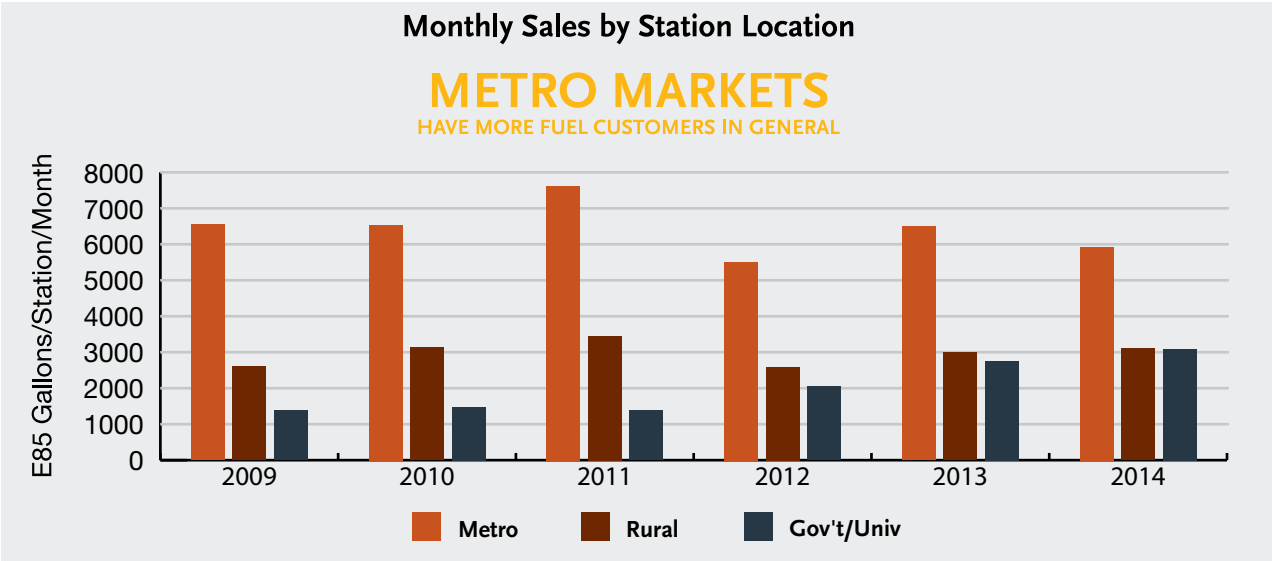


Figure 15: Monthly Sales by Station Location (Source: MN Department of Commerce E85 Station Report)

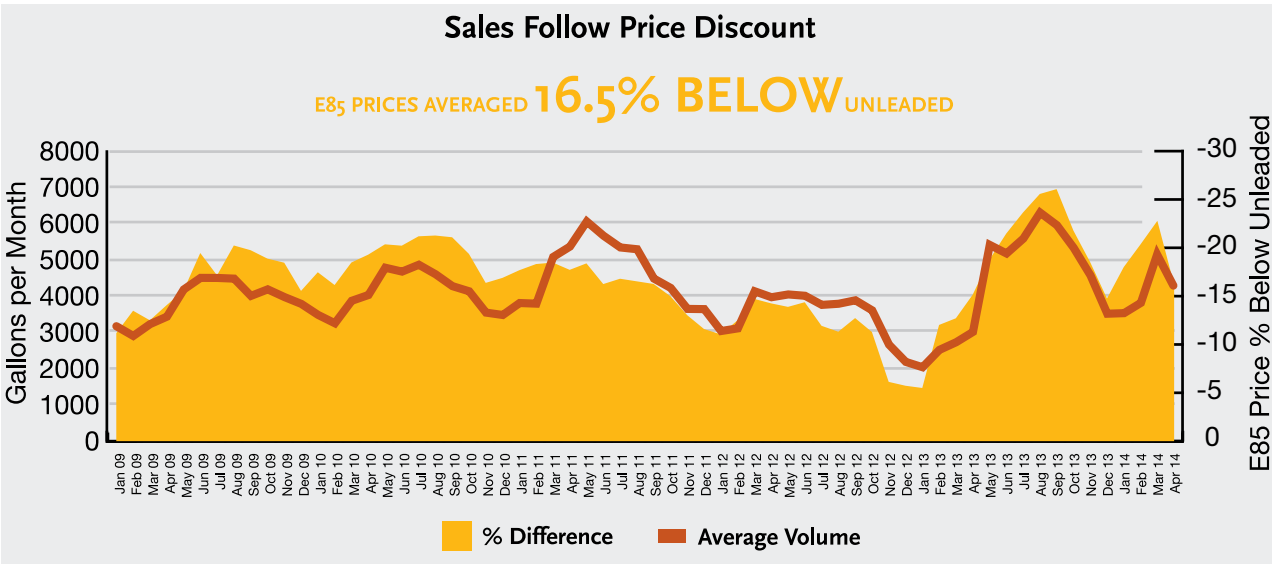


Figure 16: Sales Follow Price Discount (Source: MN Department of Commerce E85 Station Report)

discount might have more of an impact on their decision.

Figure 17 reflects the same data as Figure 16, but plots the cents per gallon discount rather than the percentage. From this data, it appears that posting a discount of greater than \$0.50 per gallon has generated stronger E85 sales, averaging 4,600 gallons per month compared to 3,374 gallons when the discount is less than \$0.50.

Another way to evaluate the effect of pricing on volumes is presented in Figure 18. In this chart, average monthly

sales volumes are shown for each price point at which E85 was sold below gasoline. It is clear that as the price discount declines, the volume of E85 sold also declines—although this is not necessarily a linear experience. However, with only three exceptions (May, July and October 2009), Minnesota stores did not report more than 4,000 gallons in E85 sales when the discount was less than \$0.50 per gallon. When the price discount was at least \$0.50 per gallon, the discount equaled an average of 18.8% below gasoline.

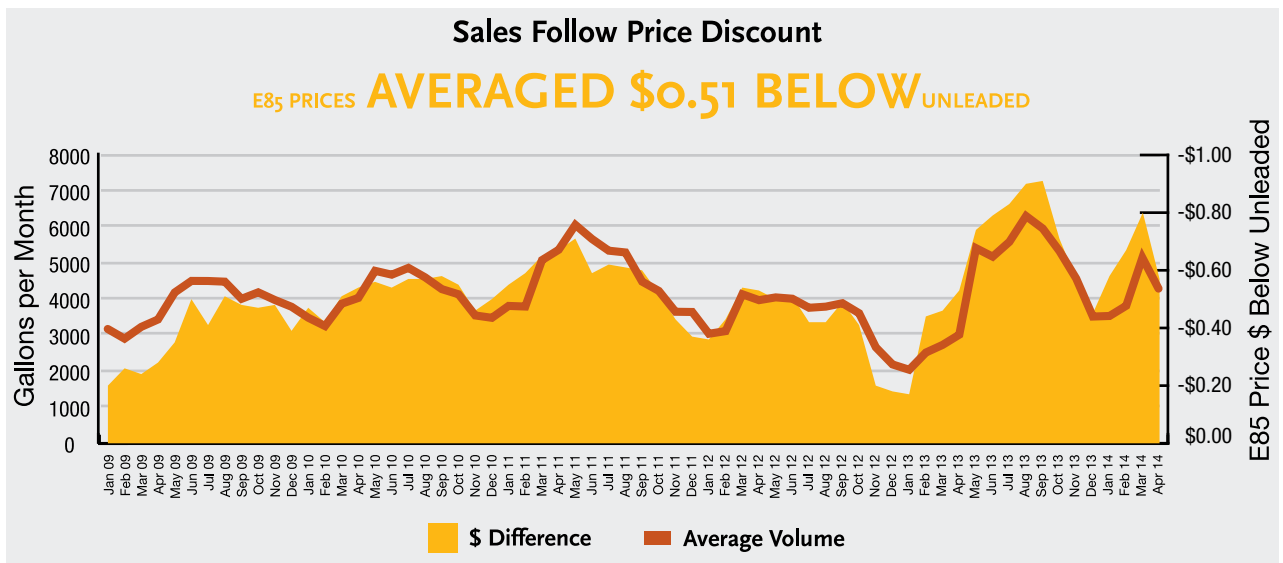


Figure 17: Sales Follow Price Discount (Source: MN Department of Commerce E85 Station Report)

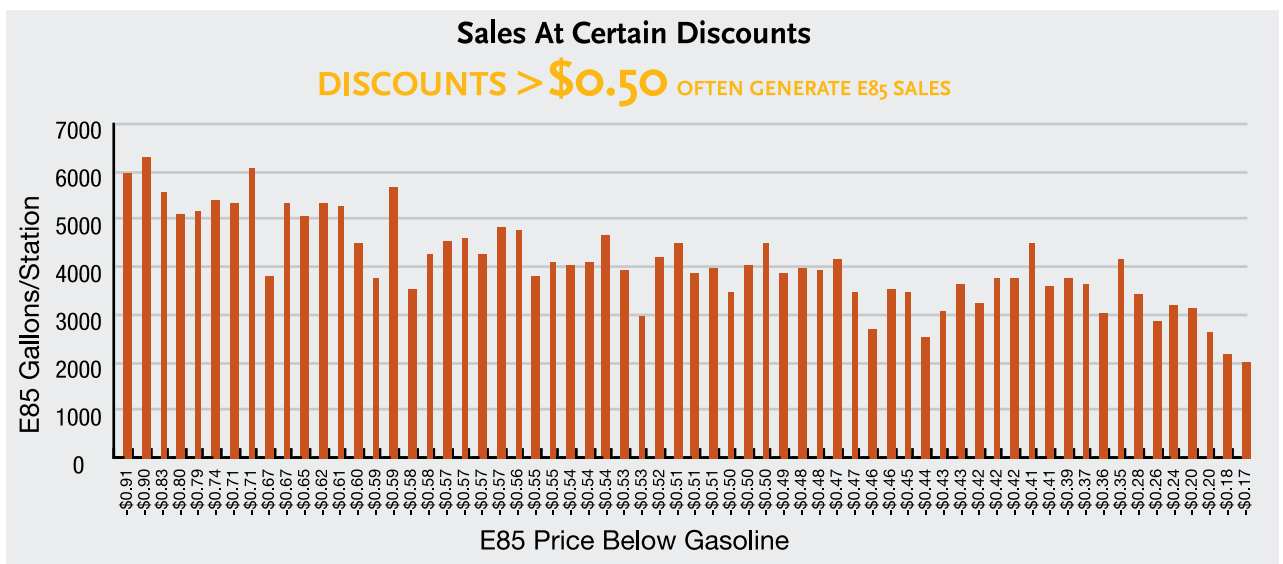


Figure 18: Sales At Certain Discounts (Source: MN Department of Commerce E85 Station Report)

## NACS-CSX Data

While the Minnesota data is informative, it is a regionally limited sample and may not be reflective of national performance. Further, the data reported in the Minnesota survey can only go so far to explain the market value of E85 because it does not provide data on unleaded volumes, a key metric for evaluating the popularity of E85 at a given station. That said, the state has taken great steps to promote the consumption of these products and could serve as a model for other states interested in promoting biofuels.

To provide greater clarity to the performance of E85 at the station level, the Fuels Institute received store-level data from NACS and its affiliate CSX, an online financial benchmarking application for the convenience and fuel retailing industry. This database enables analysis of sales data submitted monthly from thousands of convenience and fuel retailers across the nation.

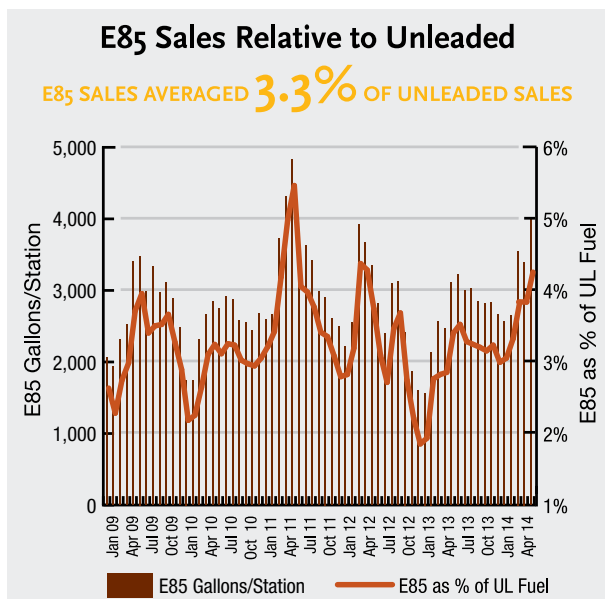
NACS-CSX contributed to the Fuels Institute monthly sales data reaching back to January 2009. The number of stations reporting E85 monthly sales data throughout the data set ranged from 101 sites to 121. While not a robust number of sites, data was collected from stores operating in all regions of the country and represents actual point of sale

transactional data from these stores, which enables valuable analyses. The stations that reported E85 sales represent an average of 4.2%–6.4% of the national E85 station count, as reported by AFDC.

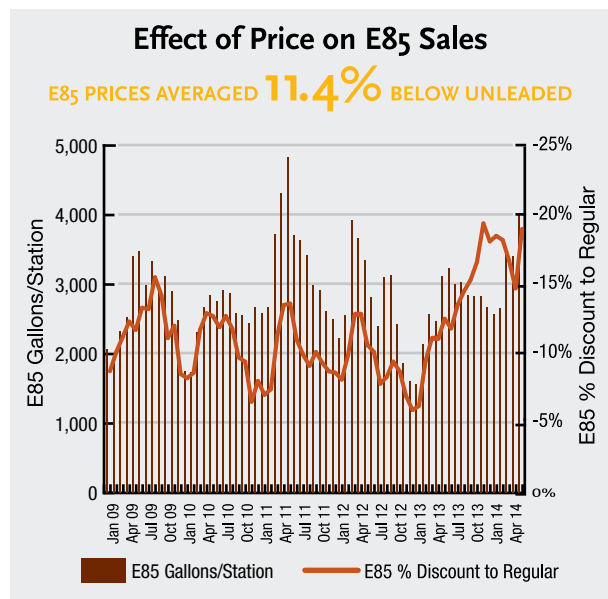
According to NACS-CSX, E85 sales from these stores are a relatively small percentage of the average fuel gallons reported on a monthly basis. In the sample, E85 averaged 3.3% of regular unleaded volume with a monthly average volume of 2,845 gallons. This data set underperformed stores in Minnesota, which averaged 4.3% when compared with NACS State of the Industry unleaded average. (Figure 19)

Over the time period examined, E85 prices in the NACS-CSX sample set averaged 11.4% lower than gasoline. As Figure 20 demonstrates, when the E85 price discount expands the volume of E85 sales historically tends to increase as customers recognized greater value relative to gasoline. But, there is inconsistency here as well.

The strongest month for E85 sales was May 2011, when the average monthly volume was 4,825 gallons at a price discount of 13.6% relative to gasoline. However, the month with the greatest price discount (19.0% in May 2014) experienced an average volume of only 3,992. While this is still the third strongest E85 volume month in the sample period, it is



**Figure 19: E85 Sales Relative to Unleaded**  
(Source: NACS-CSX)



**Figure 20: Effect of Price on E85 Sales**  
(Source: NACS-CSX)

significantly lower than the peak reached in May 2011. This indicates that while the price differential is critical, there must be other factors at play as well.

As noted in the examination of Minnesota data, it is possible that the percent differential in price, while intellectually an appropriate method for comparison, is not utilized by the consumer. Rather, they might look at the cents per gallon differential. Figure 21 presents the posted price for gasoline and E85 and the price difference in dollars, which

averaged \$0.347. Note, similar to the Minnesota data, the strongest months for E85 sales were achieved when the price differential was approximately \$0.50 per gallon or greater and the posted retail price for gasoline was near \$3.50. This combination of higher prices for regular unleaded and a greater discount for E85 on a cents per gallon basis seems to drive some degree of consumer behavior.

Another way to evaluate the relative price of E85 compared with regular gasoline is to calculate the GGE.

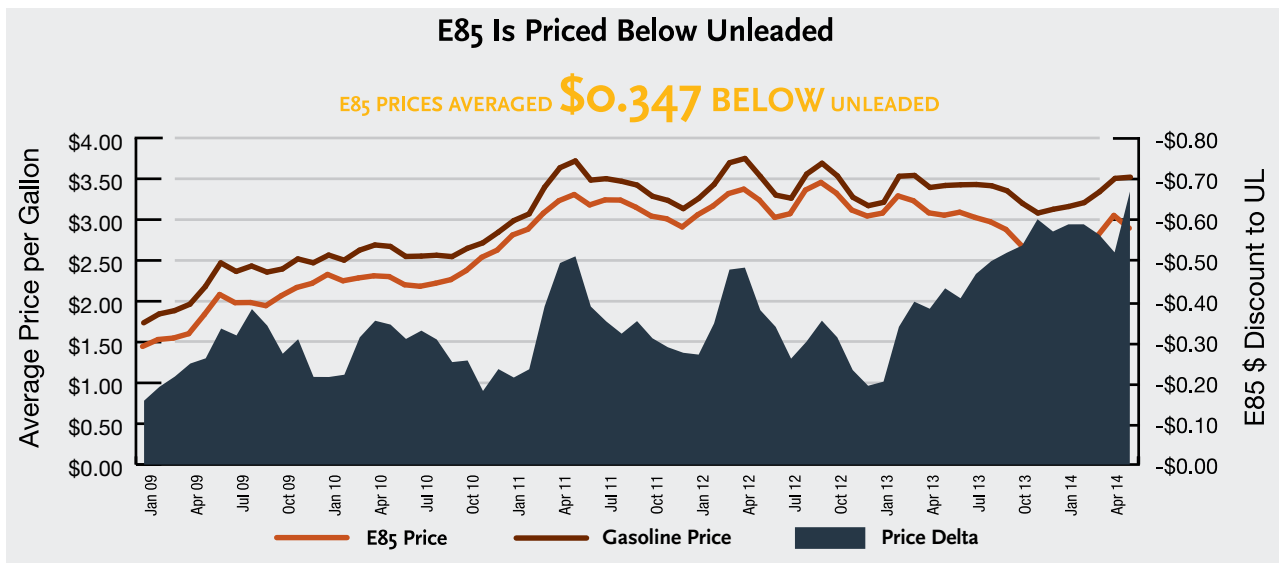


Figure 21: SE85 Is Priced Below Unleaded (Source: NACS-CSX)

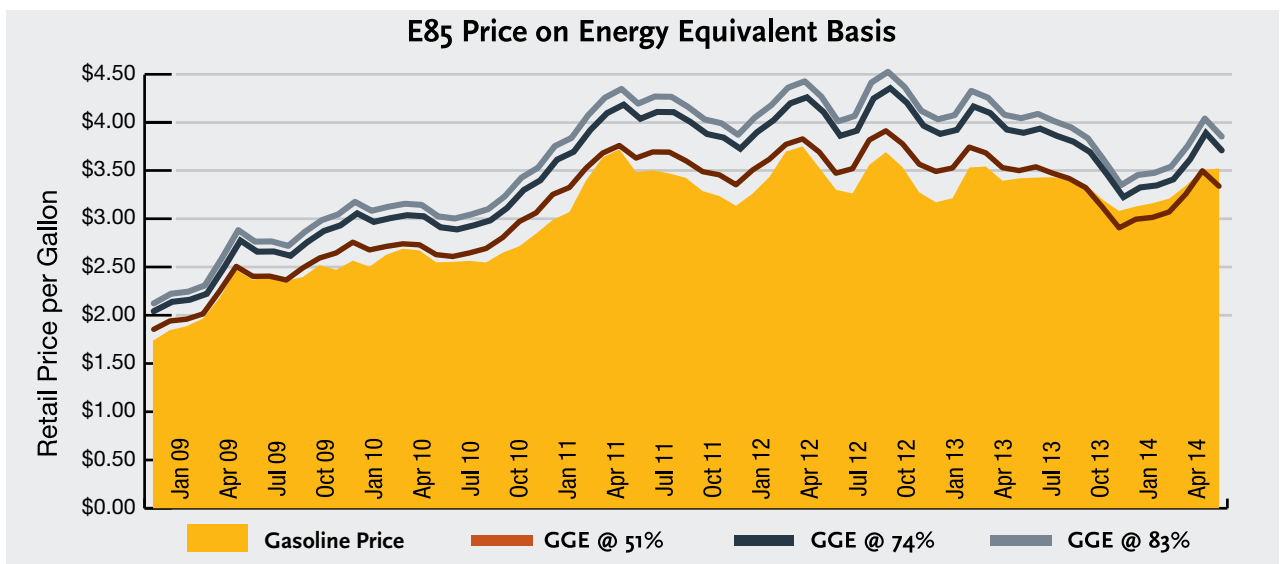


Figure 22: E85 Price on Energy Equivalent Basis (Source: NACS-CSX, Fuels Institute)

Although the ethanol concentration of the E85 sales reported is unknown, we can evaluate the range of E85's GGE for the time period in question. Figure 22 shows E85's GGE for fuel containing 51%, 74% and 83% ethanol. The chart also plots the reported retail price for regular unleaded. The GGE calculated here represents a straight BTU-adjusted value and does not take into consideration efficiency improvements within a given FFV that might offset the energy deficit of the fuel—it can be considered a “worst-case” scenario for fuel efficiency. From the chart, it appears that the GGE for E85 rarely matches the posted price of gasoline, indicating that the efficiency of an FFV operating on E85 is critical to delivering economic value to the consumer.

Another way to evaluate the NACS-CSX data is to measure the volume of E85 sales as a percent of unleaded sales at particular price discount levels. If E85 sales begin to take volume from the unleaded pumps at a particular price discount, that could infer a turning point in consumer acceptance.

In the NACS-CSX sample, the most common average monthly discount was \$0.30–\$0.39 cents per gallon and this generated sales of E85 that totaled 3.4% of total unleaded sales. The data shows a steady increase in E85 sales with increasing price discounts, which is informative and

consistent with the Minnesota data. It also shows that additional E85 sales might be achieved if the retailers were to offer E85 at a greater discount. (Figure 23)

## Profitability of E85

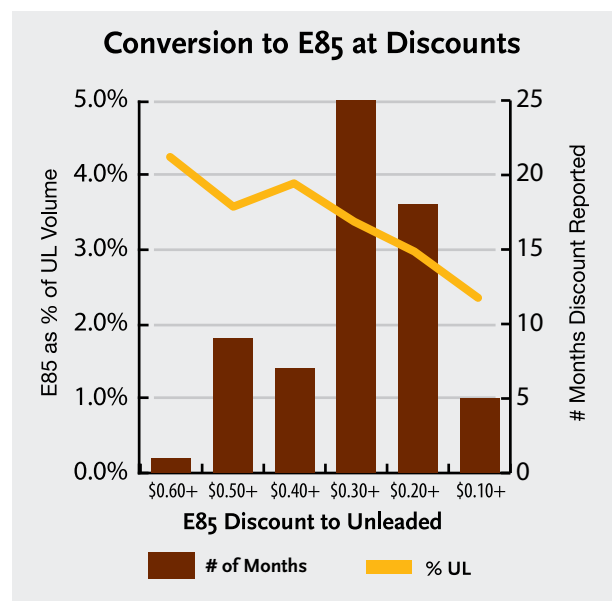
Overall profitability is an important consideration for retailers when considering which fuel blends to offer and can affect a retailer's ability to offer E85 at a more aggressive discount relative to unleaded.

Ethanol has historically cost retailers less than gasoline, with few exceptions. Since January 2009, wholesale ethanol has averaged \$0.28 lower than gasoline. This lower price point enables retailers of E85 to price the fuel more competitively. For example, if E85 is comprised of 74% ethanol, the ethanol volume could enable a price point that is \$0.207 below gasoline. (Figure 24)

For years, fuel blenders received a credit for every gallon of ethanol blended with gasoline. Through 1990, the credit was \$0.60 per gallon then dropped to \$0.51 until 2008. At that time, the credit was reduced to \$0.45, where it stood until Congress let the credit expire at the end of 2012. The ethanol prices in Figure 24 incorporate the available blenders' credit. As the data shows, when the credit expired, there was not a significant shift in the price difference between ethanol and gasoline, indicating that the economics of blending ethanol remained relatively stable even in the absence of the credit.

The lower cost of ethanol enables retailers to sell E85 at a competitive price while generating more beneficial margins per gallon. Since January 2009, E85 margins have been consistently higher than those for regular gasoline. Margins for E85 averaged 43% higher than unleaded at \$0.214 per gallon compared with \$0.149. In the summer 2013, however, E85 delivered significantly higher margins hitting a peak of nearly \$0.94 in July 2013. (See Figure 25)

The profitability of E85 during the summer of 2013 can largely be attributed to the dramatic increase in the value of RINS (renewable identification numbers) that are used to demonstrate compliance with the Renewable Fuel Standard (RFS). (See Figure 26) When the value of RINS increased to a peak of \$1.46 on July 18, 2013, the ability of retailers who were selling E85 to offer a more competitive price and increase overall profitability per gallon likewise increased. Once the RINS values retreated in the fall, E85 margins



**Figure 23: Conversion to E85 at Discounts**  
(Source: NACS-CSX)

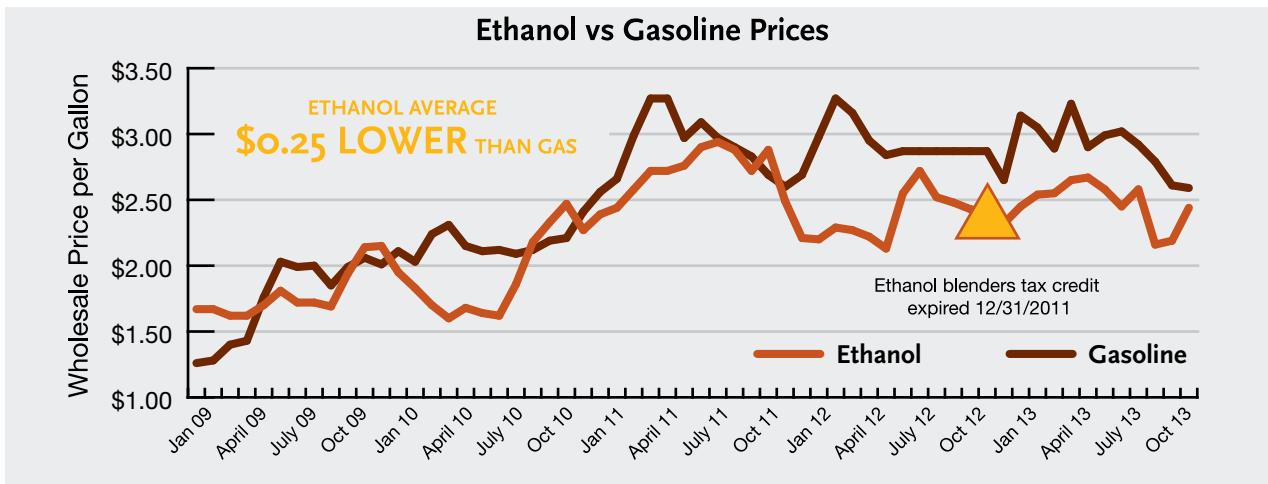


Figure 24: Ethanol vs Gasoline Prices (Source: U.S. Department of Agriculture)

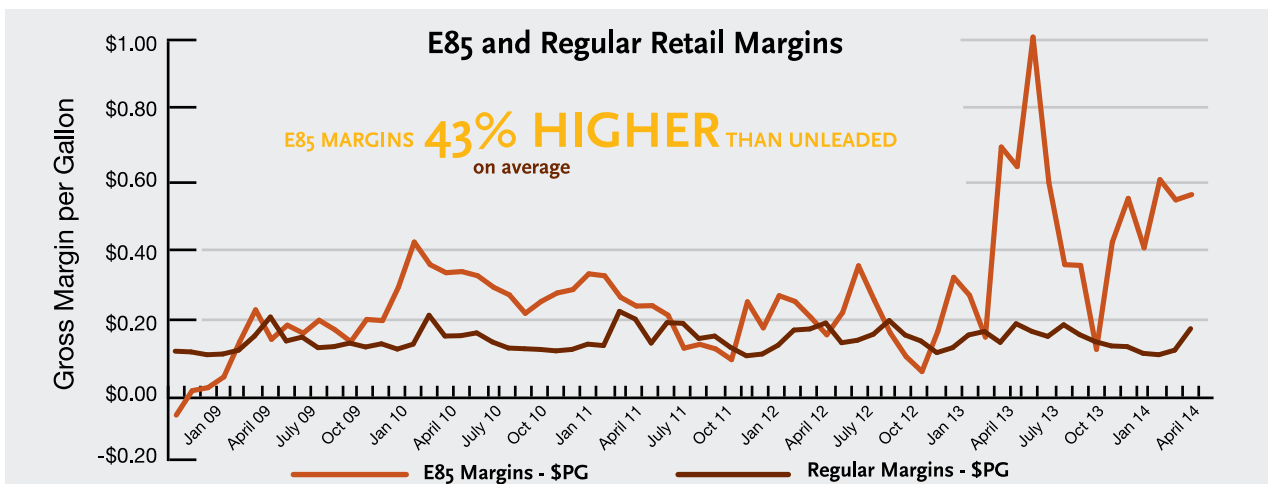


Figure 25: E85 and Regular Retail Margins (Source: NACS-CSX)

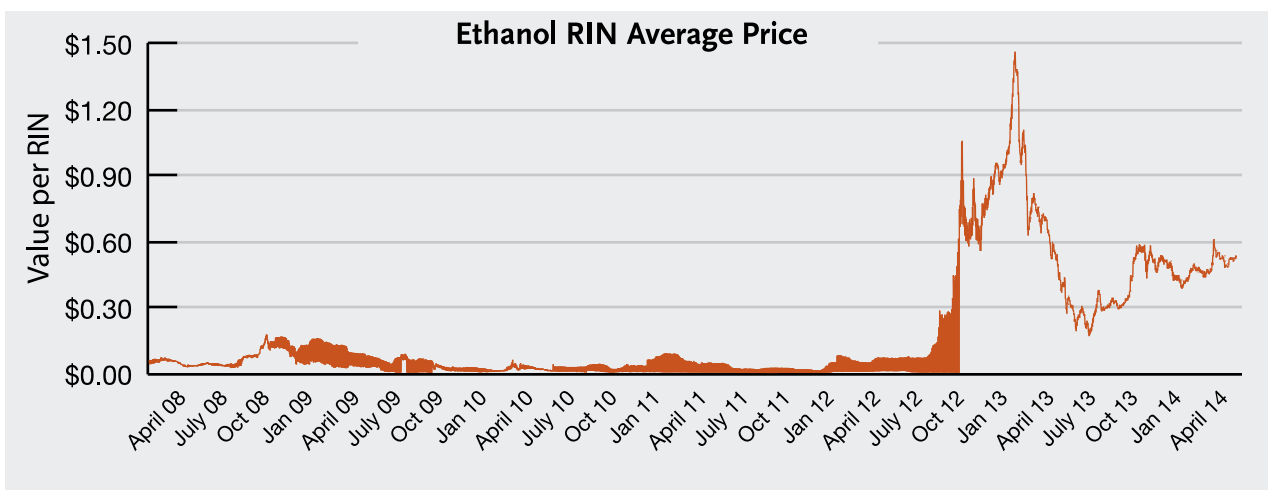


Figure 26: Ethanol RIN Average Price (Source: Oil Price Information Service)

<sup>21</sup> [www.ers.usda.gov](http://www.ers.usda.gov); The reported ethanol price includes application of the available blenders' tax credit.

followed suit and then returned as RINS values climbed in early 2014. Since RINS values increased in the spring of 2013, the NACS-CSX data indicates E85 has delivered an average margin of \$0.497 compared with \$0.144 for regular unleaded.

## Optimal Pricing

Given these margin differentials, one could ask if it would be possible to offer E85 at a lower price and generate more demand. If a lower price point would generate additional sales, this could be a desirable outcome for the retailer. To evaluate this potential, it is possible to compare an adjusted E85 price with actual regular gasoline prices. The adjusted E85 price in this example is generated by setting a price that would deliver to the retailer the same margin as generated by regular gasoline in the same month.

For example, in May 2014, the average retail price for E85 was \$2.852 with a retail margin of \$0.526 per gallon. The retail price for gasoline was \$3.520 and the margin was \$0.175. The average price difference was \$0.668 per gallon, or 19.0%. (This represents a very positive month for E85 pricing.) If E85 was priced at a level that would deliver a retail margin of just \$0.175, the posted E85 price would have been \$2.502 and the price discount relative to gasoline would have been \$1.02, or 28.9%. This could have compelled drivers of FFVs to opt to fuel with E85 more frequently, resulting in stronger sales volumes for those locations and deliver unto the retailer a margin equal to that of gasoline.

## VALUE OF RINS AND E85 PRICING

For retailers who blend ethanol into gasoline (rather than obtaining pre-blended product), the relative value of the RINS they generate can be a strong motivator to increasing overall biofuel sales. According to the data, when RINS reached their peak in summer 2013, retail profitability for E85 also reached its peak. It can be argued that if retailers were to factor the value of RINS into their pricing strategy, E85 would be much more competitively priced than has been witnessed in the market. In this scenario, a higher value RINS market could conceivably contribute to a stronger E85 market.



Theoretically, this argument makes sense. However it is unclear how retailers are accounting for their RINS. Some might be factoring the relative value into the price of E85, while others may be applying it to their overall bottom line. Further complicating the analysis is the fact that RINS are not sold at the same time as E85. Rather, RINS are generated and then sold to an obligated party at a later time. Because RINS are traded on the commodities market, the value of each RIN changes every day. This makes it more difficult for the retailer to factor the value of a RIN into the price of the fuel without knowing what the value of that RIN will be once it is sold.

Looking at historical RINS values, it is difficult to anticipate how the market may behave in the future. Further, there is uncertainty concerning the reaction of policymakers to the movement of the RINS market. There are very few commodities markets that are as heavily influenced by Washington, D.C., as is the RINS market. This lack of certainty and predictability further complicates the ability of retailers to incorporate RINS values into their pricing strategies.

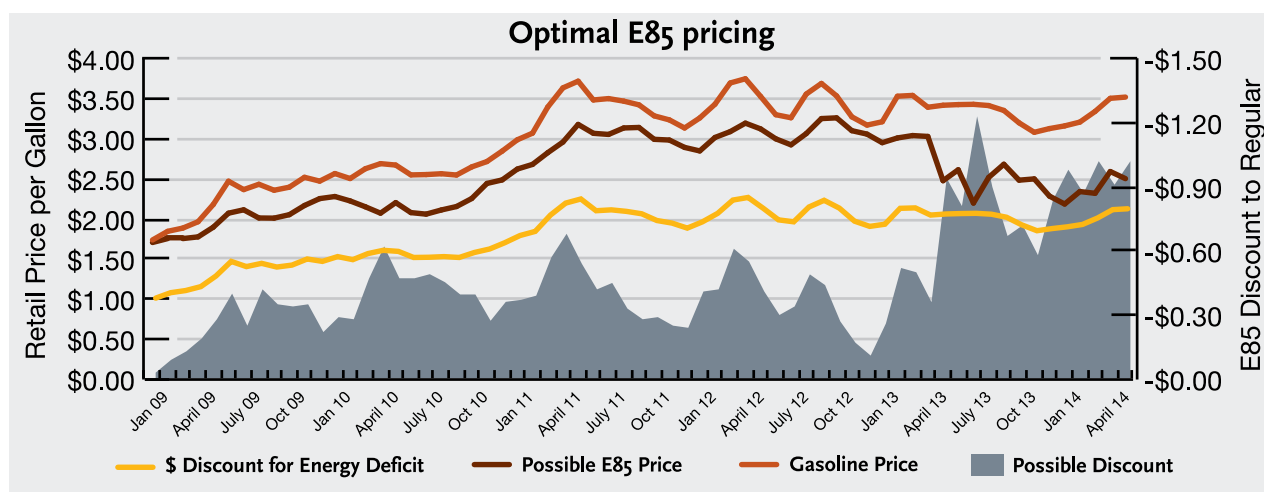


Figure 27: Optimal E85 Pricing (Source: NACS-CSX, Fuels Institute)

Such a discount may have been a possibility in May 2014 because of the relatively healthy margins delivered by E85, but conditions do not always provide opportunity for such a dramatic discount. Figure 27 plots the relationship between the actual retail price for gasoline and the adjusted potential E85 price if matching the reported gasoline margin. The chart also features a line indicating the price discount necessary to compensate for the lower energy density of E85 (when blended with 74% ethanol). In this scenario, the adjusted price differential would have not compensated for the estimated energy deficit of E85 until spring 2013 when RIN prices increased.

## Fuels Institute Store Performance Reports

The NACS-CSX aggregate data is very valuable to obtain an overview of what might be happening in the market and how elements of the business can affect a retailer's decision concerning E85. However, to fully understand what is happening at retail it is necessary also to look at detailed store level data.

### About the Data

To facilitate this analysis, the Fuels Institute obtained store-level data from 304 stores that sell E85. Of these, 197

stores provided daily information pertaining to E85 and unleaded volume, price and margins. Another 107 stores provided subsets of this data, sometimes on a weekly or monthly basis, sometimes daily but without all elements of detail. Most of the data begins in January 2013 and ends in the summer of 2014.

In reviewing this data, it is important to note that the firms who submitted the store level data are typically considered by NACS to represent the higher quality of operators within the retail fueling industry. In addition, each firm is privately branded, meaning they do not sell fuel under the brand of a refiner, and they operate a chain of retail locations. These factors provide them with greater flexibility to take advantage of market opportunities presented by E85 than the "typical" fuel retailer. For comparison, approximately half of the fuel retailers in the nation are subject to branded contractual obligations associated with their sale of fuel under the brand of their supplying refiner.<sup>22</sup> In addition, according to NACS, 58% of convenience stores that sell fuel are one-store operations.

These distinctions are important—the data provided by this sample set represents some of the most capable and flexible retailers in the country. Consequently, the data should be viewed to represent what is possible in a highly efficient and capable retail operation. It is also important to note that in the analysis concerning top quartile and bottom quartile

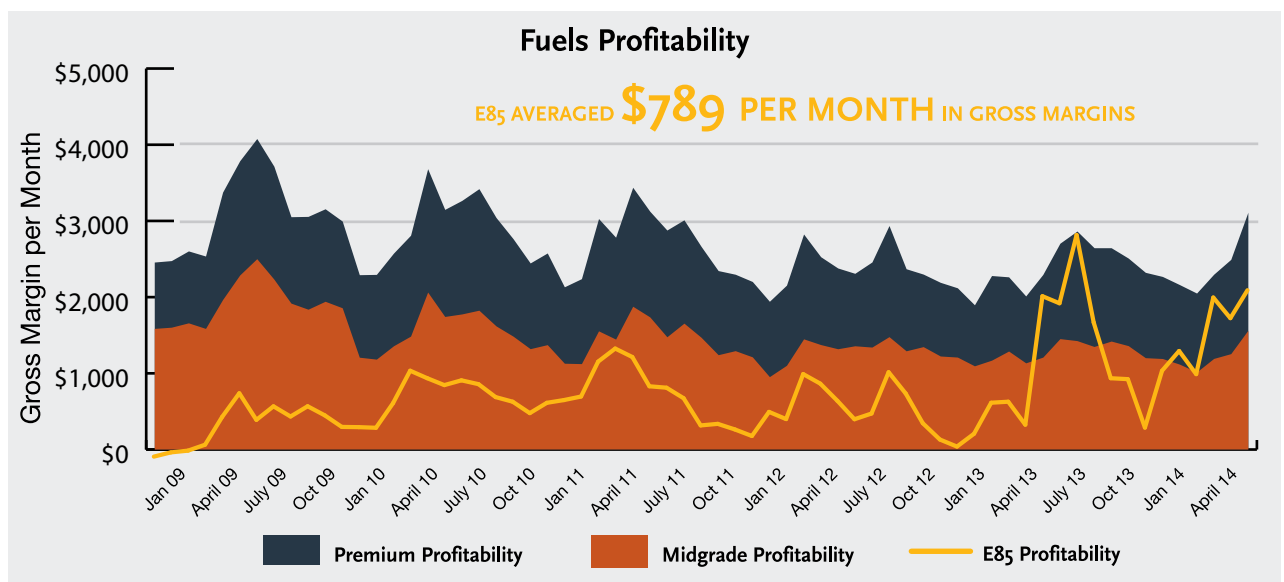


Figure 28: Fuels Profitability (Source: NACS-CSX)



## MAKING THE DECISION TO OFFER E85

Deciding to offer a new fuel product is not a simple decision. Unlike many other products at a retail location, fuel cannot be offered on a trial basis and then easily transitioned to another product if it does not produce the target revenues envisioned. Rather, retailers must invest capital to ensure their equipment is suitable and ready to accommodate the new fuel. In many cases, the introduction of a new fuel product requires the elimination of another.

There are 152,900 retail fueling outlets in the United States. Many of these fuel retailers only operate two underground storage tanks, one containing regular unleaded and the other premium. In these situations, midgrade is offered to consumers by blending product from each tank at the dispenser. To convert one of these facilities to offer E85 (without installing a third tank or replacing an existing tank with one that is manifolded to accommodate two different fuels), a retailer would have to replace a traditional petroleum product. This decision would likely involve the conversion of the premium tank to E85 and the elimination of both premium and midgrade fuel. To make this decision, a retailer would need to evaluate the relative value of E85 compared with the other two products.<sup>23</sup>

Other retail locations may operate more than two tanks, providing the opportunity to convert a tank to accommodate E85. In some situations, the tanks currently contain only gasoline—perhaps a third tank contains midgrade or is a second container for regular unleaded. Some other stores may store diesel in one of the additional tanks. In any situation, the retailer would have to consider where to place E85, i.e. replace the midgrade or diesel tank, or change the volume configuration of regular unleaded. In making this decision, the retailer must consider anticipated sales volume and fuel margins.

Retailers who have been able to add E85 often have found opportunities by also offering E15 and mid-level ethanol blends. The cost to expand the product offering in this way can be incremental and the additional fuels can provide more options and price points to consumers.

According to the NACS-CSX data, E85 has underperformed both midgrade and premium in terms of gallons sold, selling 38.2% and 46.8% fewer gallons, respectively. While the small sample size makes it difficult to extrapolate this performance to all stores in the nation, the results are consistent with those reported by the *NACS State of the Industry Report of 2013 Data*. This report collected data from 26,978 stores and reported that E85 sales tracked 36.4% and 45.1% below midgrade and premium.

In terms of margins, however, E85 has strongly outperformed, generating margins that were 36% and 34%

higher than the margins contributed by midgrade and premium. Again, this is consistent with data reported in the NACS SOI Report.

The combination of margins and volume demonstrate that, over the time period being evaluated, E85 generated an average monthly profit of \$789. This is less profitable than either premium (\$1,193/month) or midgrade (\$1,466/month).

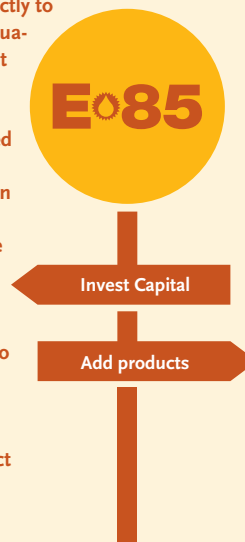
This calculation, of course, could be flipped if margins or volume for E85 were to improve. In fact, since E85 margins improved in May 2013, profitability has increased to \$1,538 per store per month. This exceeds the profitability for either premium (\$1,201) or midgrade (\$1,285). However, if a retailer was required to replace both premium and midgrade to accommodate E85, the combined profitability of the gasoline blends would exceed that of E85. (See Figure 28)

Retailers who have the ability to add E85 without eliminating a full slate of gasoline products could strongly contribute to their bottom line, provided the change in tank configuration did not compromise their ability to maintain adequate fuel supplies to satisfy demand.

For those who might consider replacing a diesel tank with E85, the economic consideration is different. The NACS-CSX data reports that diesel volumes averaged 19,793 gallons per month with an average margin of \$0.214 per gallon, resulting in an average monthly gross profit of \$4,235. This data also is consistent with NACS SOI data.

The decision to offer E85 will be contingent upon the anticipated volume of E85 sales and the effect that offering E85 will have on the store's ability to sell other items. In some situations, E85 represents an additional choice to consumers and will contribute directly to the store's bottom line. In other situations, it will require decisions about overall product offerings.

An opportunity not often recognized when considering E85 is the ability to communicate a value proposition to consumers. E85, and other ethanol-blended fuels, often enable the retailer to post lower-priced fuel options on the street. Given the price sensitivity of consumers, lower-posted prices send a signal to consumers that the retailer offers a value alternative, even for those who cannot purchase lower-price fuels. This can have a positive effect on overall consumer throughput.



<sup>22</sup> [http://www.nacsonline.com/YourBusiness/FuelsReports/GasPrices\\_2014/Retail-Operations/Pages/How-Branded-Stations-Operate.aspx](http://www.nacsonline.com/YourBusiness/FuelsReports/GasPrices_2014/Retail-Operations/Pages/How-Branded-Stations-Operate.aspx)

<sup>23</sup> There are some models in which E85 could be blended with regular unleaded to deliver the octane of a midgrade fuel, but this would likely require the resulting fuel to contain greater than 10% ethanol. Any fuel product containing greater than 10% ethanol has restrictions on its use. In this section, we assume a retailer would add E85 and offer other gasoline products that are suitable and approved for all engines.

## BRANDED VS. UNBRANDED RETAIL FACILITIES

There are 152,900 retail fueling stations in the United States, according to the latest data available from the now defunct *National Petroleum News*. The publication also indicates that approximately 50% of these sell fuel under a branded supply contract—i.e., they sell fuel under the brand of their refiner supplier. The other half of the retail stations are referred to as unbranded—i.e., they sell fuel under a private brand established by the store chain. How a retail station's supply arrangement is structured will affect its ability to sell E85.

**50%** of fuel retail locations are subject to branded contractual obligations.

Unbranded retailers encounter no contractual restrictions concerning the fuel products they decide to sell. They are free to purchase fuel from any supplier and offer whatever fuel blends they believe will satisfy the demands of their customers.

Branded retailers are beholden to the terms of their contract. A branded retailer will typically sign a contract that could be as long as 20 years. Within this contract, the retailer agrees to abide by the image standards established by the supplier, to sell only fuel provided by the supplier and to comply with all requirements of the contract. In return, the retailer receives a guaranteed supply of fuel (even during periods of disruption, although the volume provided might be allocated at a reduced level depending on market conditions), a possible financial allowance for creating and maintaining the store image and assistance marketing the brand to consumers. For these benefits, the retailer pays an additional fee for each gallon provided.

In the Energy Independence and Security Act of 2007, Congress sought to address concerns identified in the market that branded supply contracts created a barrier to entry for E85. This legislation amended the Petroleum Marketing Practices Act to ensure that branded retailers were permitted to sell E85 at their branded locations provided they clearly identified the fuel as not being a product of the supplying and branded refiner. In addition, the legislation ensured that, in the event a branded supply contract requires the retailer to sell three grades of gasoline (typically regular, midgrade and unleaded), E85 could be used to satisfy one of these fuel grade requirements. And the legislation ensured branded retailers could obtain E85 from a supplier other than their contracted branded supplier.<sup>25</sup>

The changes enacted by Congress in 2007, however, only apply to contracts entered into after enactment. The legislation did nothing to change the conditions of existing contracts, which could remain in place for years following enactment of this legislation.

performing retail locations, a single firm could have stores represented in both groupings.

## How the Stores Performed

According to the Fuels Institute sample, 237 stores averaged 185 gallons of E85 per day, compared to 6,633 gallons per day of unleaded. (Assuming a 30 day month, E85 sales averaged 5,550 gallons compared with 198,990 gallons of unleaded.) On average, E85 was offered for sale at a price \$0.436 cents below unleaded, for a percent discount of 12.6%. For the 197 stores that included unleaded sales data, E85 sales totaled 2.8% of their unleaded volume.

Compared with the previously analyzed data sets obtained from NACS-CSX and the Minnesota Department of Commerce data, the stores represented in the Fuels Institute data set represent the strongest performers in terms of E85 sales. (Figure 29)

## E85 Sales Volumes

The volume of E85 sold per store is an important metric to measure. Of the 247 stores that provided E85 volume data, the average amount of E85 sold on a daily basis ranged from 15 to 751 gallons and averaged 185 gallons. (Figure 30)

From this data, it is possible to evaluate the E85 sales volumes compared with sales of unleaded using data from 197 stores. The stores in the sample reported daily sales of unleaded ranging from 2,067 gallons to 15,339 gallons. Consequently, the ratio of E85 sales to unleaded sales on a store level basis is a very important analysis. Stores reported E85 sales that equaled between 0.23% to 10.5% of unleaded sales, with a sample set average of 2.8%. (Figure 31)

## E85 Price Discount

Evaluating E85 sales compared with unleaded sales is instructive, especially when the influence of pricing strategies is incorporated. E85 prices ranged from 6.1%–41.7% below unleaded, with an average of 12.6%. On a cents per gallon basis, the E85 discount ranged from \$0.194 to \$1.46 per gallon, with an average discount of \$0.436. (Figure 32)

On a store by store basis, however, the price discount relative to the volume of E85 as a percentage of unleaded volumes can help examine the ability of a retailer to convert a consumer from unleaded to E85. Figure 33 plots the E85 discount to unleaded compared with the E85 sales expressed

<sup>24</sup> [http://www.nacsonline.com/YourBusiness/FuelsReports/GasPrices\\_2014/Retail-Operations/Pages/Who-Sells-Americas-Fuel.aspx](http://www.nacsonline.com/YourBusiness/FuelsReports/GasPrices_2014/Retail-Operations/Pages/Who-Sells-Americas-Fuel.aspx)

<sup>25</sup> P.P.L. 110-140, Section 241 (15 U.S.C. 2807).

## How the Stores Performed

Data Set	Monthly E85 Gallons	Average E85 Discount	Margins (E85/Unleaded)	E85 as % Unleaded Volume
<b>Fuels Institute</b> (197–304 stores)	5,490	43.6 cents (12.6%)	13.4 cents / 16.8 cents	2.80%
<b>NACS-CSX</b> (101–121 stores)	2,845	34.7 cents (11.4%)	26.5 cents / 14.3 cents	3.30%
<b>Minnesota</b> (150–239 stores)	4,083	51.0 cents (16.5%)	N/A	N/A

Figure 29: How the Stores Performed

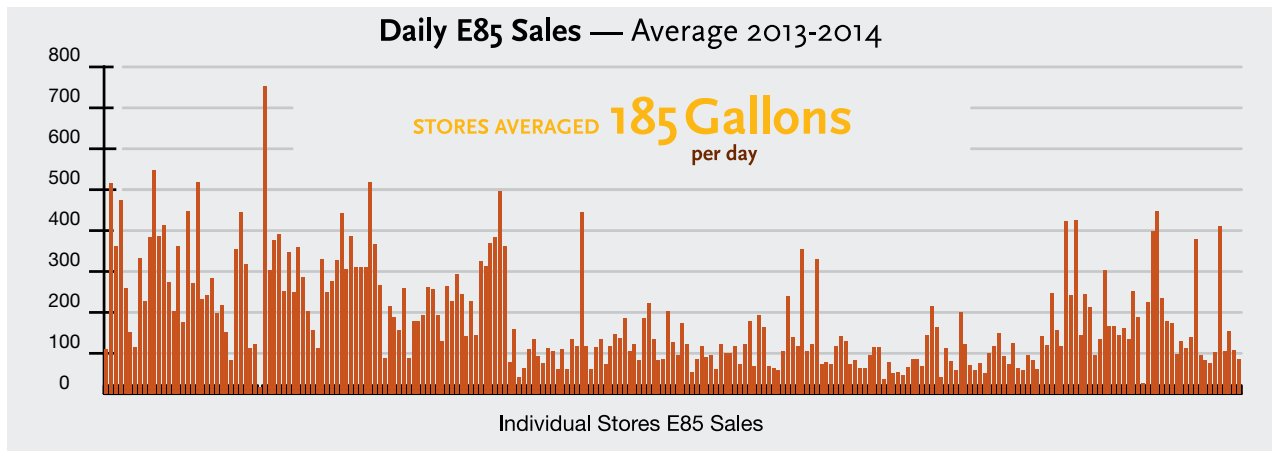


Figure 30: Daily E85 Sales (Source: Fuels Institute)

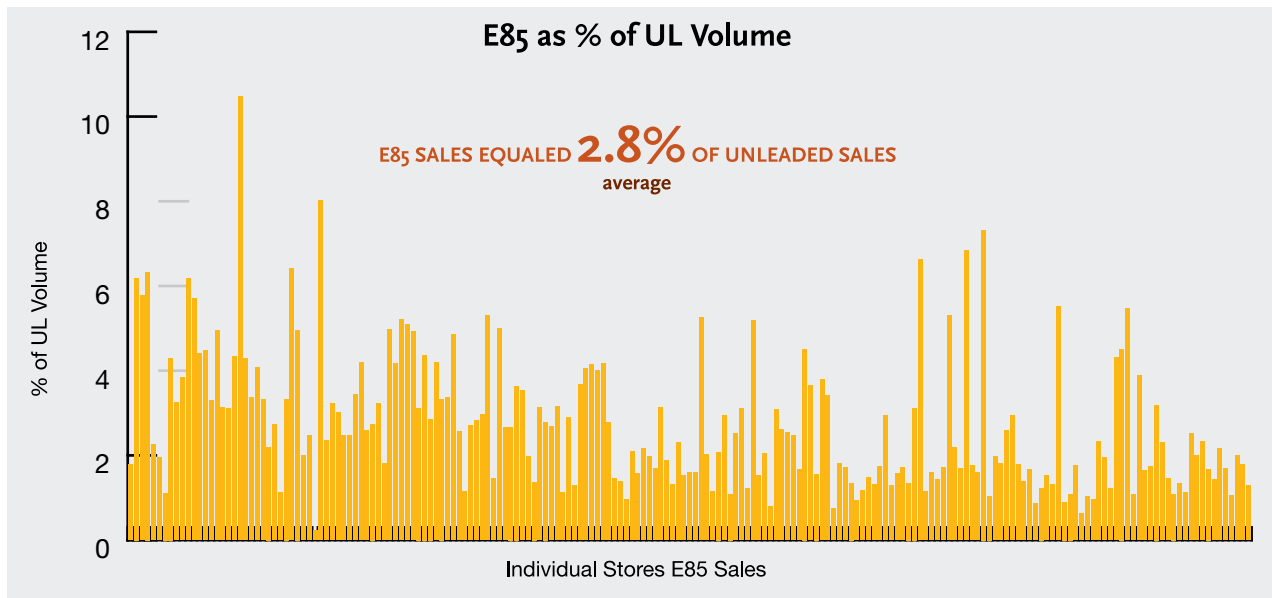


Figure 31: E85 as % of UL Volume (Source: Fuels Institute)

as a percent of unleaded sales. If there was a significant correlation, one would expect to see reciprocal spikes on either side of the chart—this does not seem to be happening, which means that the stores that offer the greatest E85 discount are not necessarily the stores that sell the most E85.

In the previous section, NACS-CSX data was analyzed to determine at what price E85 might be sold if its margins were equal to those generated from unleaded sales. In that analysis, E85 margins averaged \$0.122 higher than those for unleaded, providing some room for movement. However, in

this data set E85 margins have averaged lower than those for unleaded, leaving no room for further adjustment on an aggregate basis. For these stores, E85 is being priced very aggressively in order to generate sales. (Figure 34)

### Top and Bottom Quartiles

To help identify strategies that might contribute to stronger E85 sales, it is valuable to evaluate the most successful stores compared with those that experience less success. The 237 stores that reported E85 sales volume data were

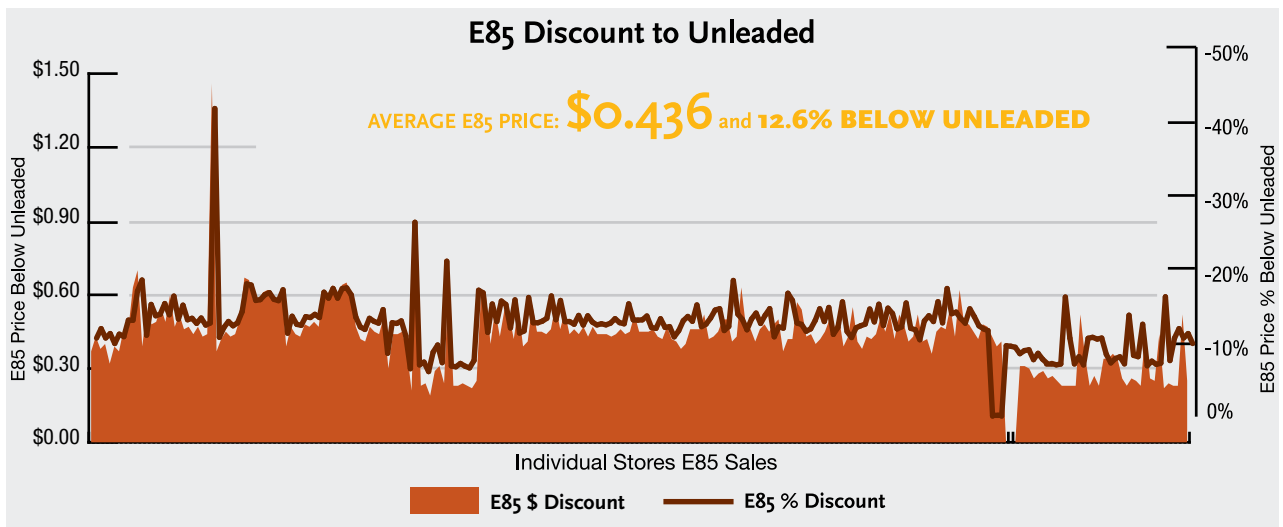


Figure 32: E85 Discount to Unleaded (Source: Fuels Institute)

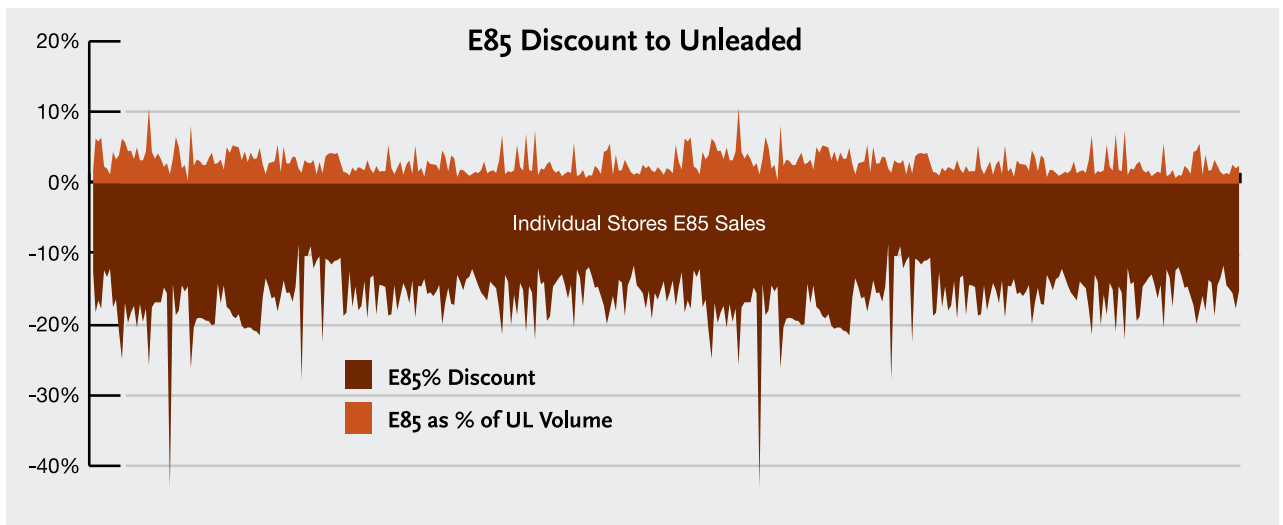


Figure 33: Conversion of Unleaded to E85 (Source: Fuels Institute)

divided into the Top and Bottom quartiles to facilitate best practice comparison.

The Top Quartile of stores is defined as the 60 stores with the highest average daily E85 sales. Among this group, stores averaged 364 gallons per day and ranged from 250–751 gallons. This compared to unleaded sales, which averaged 8,824 gallons and ranged from 4,478 to 15,339. E85 sales equaled an average of 4.4% of unleaded sales and ranged from 2.4% to 10.8%. E85 was priced at an average discount to unleaded of \$0.453, or 12.8%. This discount

ranged from \$0.194 to \$0.698 and from 6.0% to 18.5%.

The Bottom Quartile is defined as the 60 stores with the lowest average daily E85 sales. Among this group, stores averaged 68 gallons per day and ranged from 15–94 gallons. This compared to unleaded sales which average 5,283 gallons and ranged from 4,420 to 10,311. E85 sales equaled an average of 1.47% of unleaded sales and ranged from 0.87%–2.46%. E85 was priced at an average discount to unleaded of \$0.441, or 12.6%. This discount ranged from \$0.245–\$0.631 and from 7.6%–18.4%.

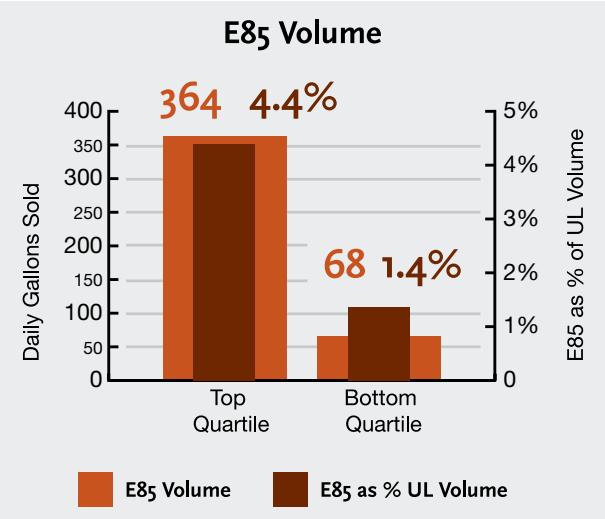


Figure 35: E85 Volume (Source: Fuels Institute)

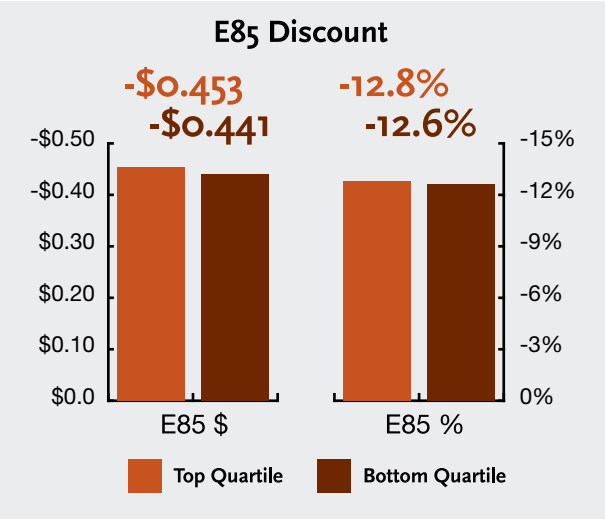


Figure 36: E85 Discount (Source: Fuels Institute)

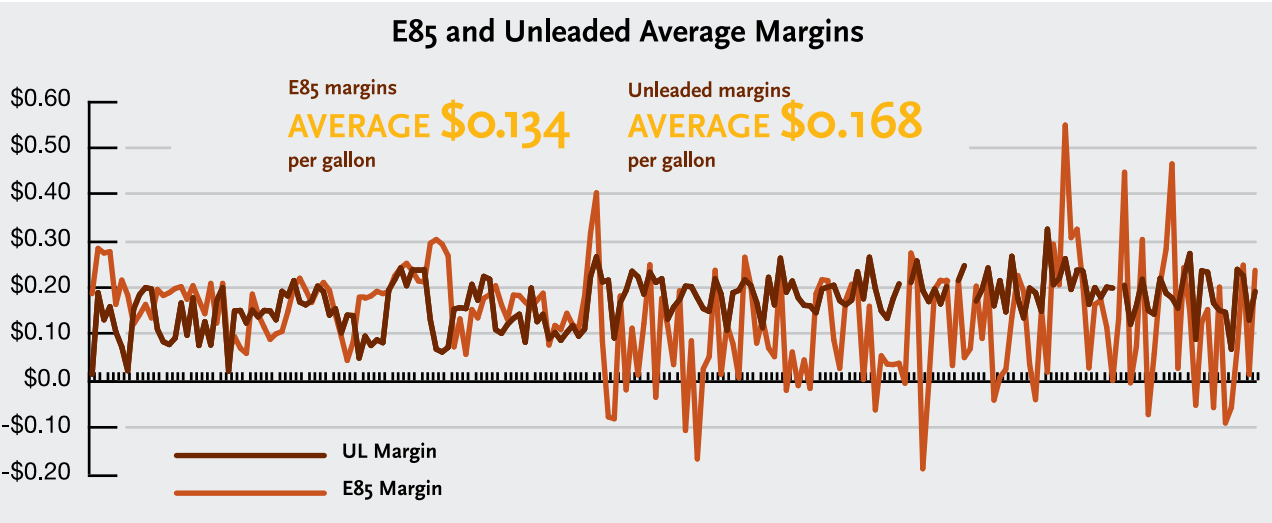


Figure 34: E85 and Unleaded Average Margins (Source: Fuels Institute)

In a head to head comparison, it is clear that the Top Quartile far outperformed the Bottom Quartile, selling six times more E85. However, it is difficult to identify the distinguishing characteristics that might explain the stronger performance.

Top Quartile stores not only sold more E85, they also sold more unleaded but not six times as much. While the additional throughput of customers at the Top Quartile stores provided more opportunity to sell E85, the correlation is not direct. In fact, E85 sales in the Top Quartile equaled a higher percentage of a store's unleaded sales than in the Bottom Quartile. (Figure 35)

What drove the greater success of Top Quartile stores to convert more FFV drivers from unleaded to E85 is uncertain, but price can be ruled out as the determining factor. The E85 discount for each quartile is within a nickel of each other and, on a percent basis, within one percent. This is hardly a sufficient distinction to explain a six-fold difference in E85 volumes. (Figure 36)

Since the analysis of Top and Bottom Quartile performers does not provide great insight into the characteristics that would lead a store to outperform others in terms of E85 sales, it is necessary to dive more deeply.

### Top 10 E85 Volume Stores

The Top 10 stores in terms of E85 sales can provide valuable insight into what will compel drivers of FFVs to purchase E85 rather than unleaded. The average daily values provide additional detail into what makes these stores successful. Figure 37 presents key metrics that characterize the Top 10 stores compared with those for the Top and Bottom Quartiles.

Aside from the differences in overall volume, there is not much difference between these groups of stores to clearly articulate what drives success. By diving into the daily data of the Top 10 stores, however, some trends begin to materialize.

Figure 38 presents average E85 sales in terms of gallons and as a percent of unleaded sales for specific ranges of price discounts. Figure 39 presents the number of days in which the Top 10 stores posted specific E85 discounts.

From the data in Figure 39, it is clear that the most common discount offered by the Top 10 stores throughout

the period was \$0.40 per gallon, followed closely by \$0.50. The price discount at which E85 sales exceeded 7% of unleaded sales for the first time, however, was \$0.60. At discounts of at least \$0.60, E85 volumes averaged 727 gallons per day compared with an average of 422 when the discount is less than \$0.60.<sup>26</sup> At discounts of \$0.60 per gallon or more, these retail locations generated \$0.157 per gallon margins on E85 compared to \$0.222 margins for unleaded. (Figure 40)

### Comparing Against the Industry

To determine how the E85 numbers generated by these Top 10 stores relate to the overall fuel business it is helpful to compare them with overall industry data. *The NACS State of the Industry Report for 2013 Data* reports average volumes by fuel grade. Because regular unleaded outperforms all competing fuel grades, it is instructive to compare E85 with midgrade and premium fuels.

In reviewing this data, it is important to note that the stores included in the Fuels Institute sample for this study reported average fuel volumes that are more than two times higher than those reported by the industry for the NACS SOI Report (198,990 gallons of regular unleaded vs 93,948), and the Top 10 E85 stores exceeded even this level. For this reason, fuel gallons sold may not be the most valuable comparison. It might be more valuable to simply compare the fuel volumes expressed as a percent of regular unleaded.

This data indicates that the Top 10 E85 stores might generate average monthly volumes of E85 that are slightly lower than the industry average for premium and midgrade when considered as a percent of total regular unleaded sales, but considerably higher than the industry average for E85. This might represent opportunities for retailers who operate stores in markets with strong FFV inventories. (Figure 41)

<sup>26</sup> Reported E85 prices that were higher than the same store same day reported price for unleaded were not included in this specific analysis.

### Comparison of Average Daily Performance

Category	Top 10	Top Quartile	Bottom Quartile
E85 Volume	520	364	68
Unleaded Volume	9,501	8,824	5,245
E85 as % of Unleaded Volume	6.18%	4.40%	1.38%
E85 Price	\$3.21	\$3.04	\$3.04
Unleaded Price	\$3.61	\$3.50	\$3.48
E85 \$ Discount	(\$0.50)	(\$0.45)	(\$0.44)
E85 % Discount	-13.58%	-12.82%	-12.64%
E85 Margin	\$0.20	\$0.17	\$0.16
Unleaded Margin	\$0.17	\$0.15	\$0.20

Figure 37: Comparison of Average Daily Performance (Source: Fuels Institute)

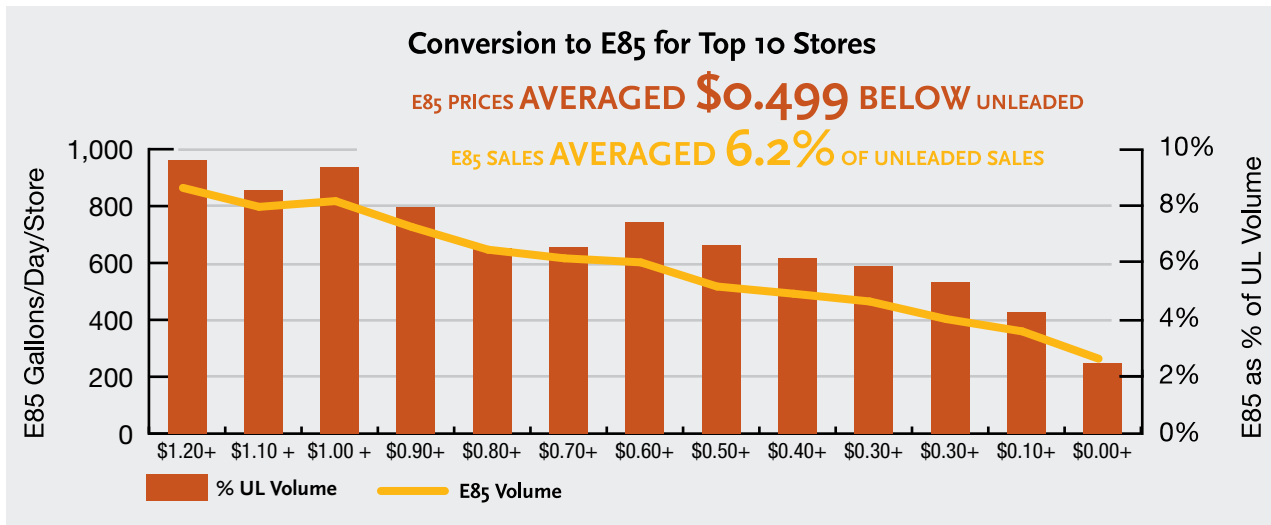


Figure 38: Conversion to E85 (Source: Fuels Institute)

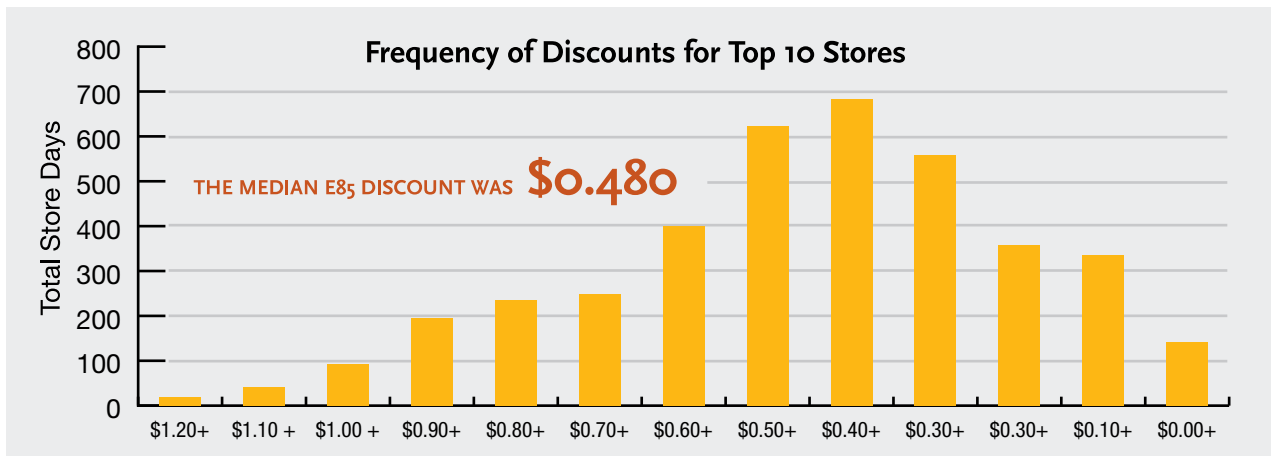


Figure 39: Frequency of Discounts (Source: Fuels Institute)

### Key Metrics for Top 10 E85 Stores

Discount	Stores Reporting	E85 Margin	E85 Price	E85 Volume	UL Margin	UL Price	UL Volume	CPG Discount	% Discount	% UL Volume
<b>\$1.20+</b>	19	\$0.177	\$2.834	865	\$0.253	\$4.106	10013	(\$1.27)	-31.02%	9.62%
<b>\$1.10 +</b>	41	\$0.159	\$2.884	799	\$0.251	\$4.022	10765	(\$1.14)	-28.33%	8.56%
<b>\$1.00 +</b>	92	\$0.095	\$2.882	819	\$0.220	\$3.922	10134	(\$1.04)	-26.56%	9.38%
<b>\$0.90+</b>	195	\$0.118	\$2.971	729	\$0.231	\$3.915	10780	(\$0.94)	-24.19%	7.98%
<b>\$0.80+</b>	236	\$0.157	\$3.088	650	\$0.223	\$3.931	11501	(\$0.84)	-21.51%	6.51%
<b>\$0.70+</b>	249	\$0.175	\$3.070	620	\$0.195	\$3.819	11205	(\$0.75)	-19.64%	6.54%
<b>\$0.60+</b>	401	\$0.217	\$3.084	606	\$0.178	\$3.714	9096	(\$0.63)	-16.98%	7.42%
<b>\$0.50+</b>	622	\$0.256	\$3.087	522	\$0.171	\$3.629	8653	(\$0.54)	-14.96%	6.61%
<b>\$0.40+</b>	682	\$0.231	\$3.061	497	\$0.153	\$3.508	9110	(\$0.45)	-12.75%	6.16%
<b>\$0.30+</b>	558	\$0.216	\$3.132	470	\$0.144	\$3.479	8925	(\$0.35)	-10.02%	5.90%
<b>\$0.30+</b>	357	\$0.198	\$3.204	409	\$0.150	\$3.454	8655	(\$0.25)	-7.26%	5.32%
<b>\$0.10+</b>	336	\$0.159	\$3.265	366	\$0.163	\$3.421	9308	(\$0.16)	-4.56%	4.28%
<b>\$0.00+</b>	142	\$0.098	\$3.264	271	\$0.098	\$3.316	12133	(\$0.05)	-1.59%	2.47%

Figure 40: Key Metrics for Top 10 E85 Stores (Source: Fuels Institute)

### Key Metrics for Top 10 E85 Stores

Fuel	Average Monthly Volume	Average Margin per Gallon	Average Margin per Month	Volume as % of Unleaded
<b>Fuels Institute Top 10 Stores</b>				
E85	15,594	\$0.20	\$3,103	6.18%
Unleaded	285,031	\$0.17	\$48,170	100%
<b>State of the Industry Sample</b>				
E85	3,690	\$0.28	\$1,014	3.93%
Unleaded	93,948	\$0.16	\$15,313	100%
Midgrade	10,124	\$0.20	\$2,014	10.77%
Premium	8,179	\$0.19	\$1,513	8.70%

Figure 41: Key Metrics for Top 10 E85 Stores (Source: Fuels Institute, NACS State of the Industry Report of 2013 Data)



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# The Forecasts

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There are several ways to forecast the market potential for E85.

This section looks at:

- U.S. Energy Information Administration's Annual Energy Outlook
- Vehicle Consumption Models
- Store Performance Scenarios
- Ethanol Sold as E85
- Summary of Forecasts

## U.S. Energy Information Administration's Annual Energy Outlook

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EIA's Annual Energy Outlook 2014 Early Release forecast E85 sales will increase from 151.4 million in 2012 to 3.4 billion by 2023. Although EIA's forecast is considered low by many in the biofuels industry, it serves as a credible basis for this analysis.(Figure 42)

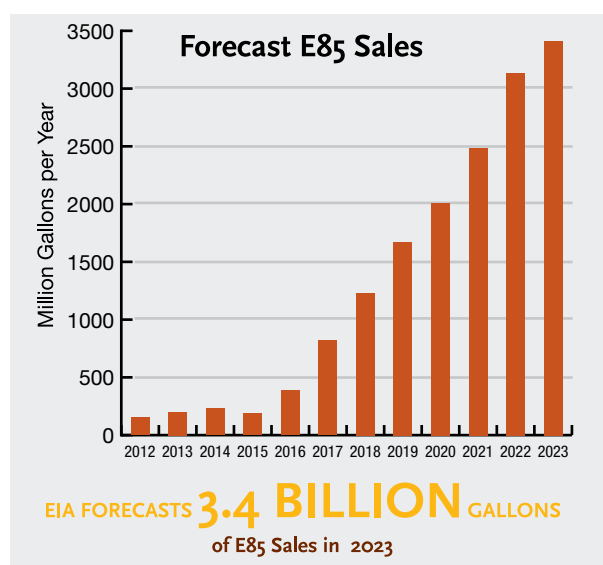


Figure 42: Forecast E85 Sales (Source: EIA)

## Vehicle Consumption Models

Vehicle Consumption Models seek to identify the maximum potential for E85 sales based upon potential refueling practices of FFV drivers. In EIA's Annual Energy Outlook, the agency reported total E85 sales of 201.39 million gallons through 12.8 million FFVs in 2013. This translates into an average of 15.7 gallons of E85 consumed by each FFV. By increasing the frequency with which FFV drivers refuel with E85, it is possible to calculate potential increases in E85 demand.

Using EIA's forecast, it is possible to calculate how much E85 would be required to transport FFV drivers throughout the year. EIA reports gasoline-powered vehicles will consume on average 1,085 gallons in 2014. Using EIA's average ethanol concentration of 74% per gallon of E85 as a baseline, and applying the gasoline gallon equivalent (GGE) standard calculated previously (1.30 gallons of E85 = 1 gallon of unleaded with 10% ethanol),<sup>27</sup> an FFV would need to consume 1,410 gallons of E85 to travel the same distance:

$$1,085 \text{ gallons/LDV} \times 1.30 \text{ (E85 GGE @ 74\% ethanol)} = 1,410 \text{ gallons E85/FFV/Year}$$

The models use the following formula to calculate the amount of E85 that would be consumed if each FFV refueled with E85 more frequently:

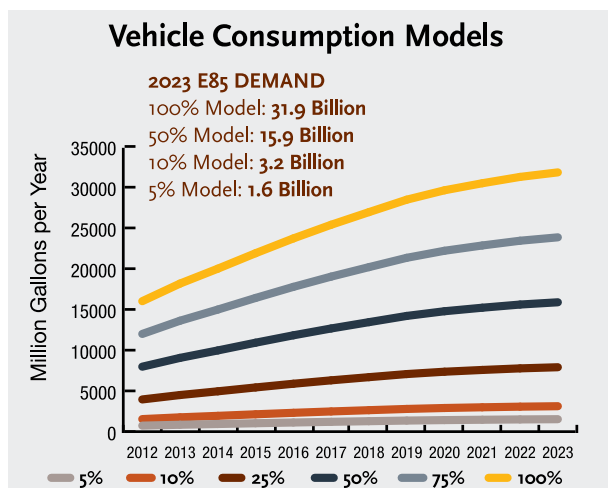
$$\text{EIA FFV Inventory} \times \text{E85 GGE for 74\% concentration} \times \text{Refuel Rate} = \text{Potential E85 Sales}$$

Figure 43 demonstrates the potential increase in E85 consumption assuming every FFV were to refuel with E85 more frequently than they currently do. The model evaluates what demand would be if FFVs refueled with E85 100% of the time, 50%, 10% and 5% of the time. The result is a potential demand for E85 in 2023 from a low of 1.6 billion gallons to a high of 31.9 billion gallons.

If the ethanol concentration in E85 did not average 74%, then the GGE factor in the above calculation would be incorrect. Figure 44 presents recalculations of the above Vehicle Consumption Models to account for different ethanol concentrations assuming a 5% and 100% rate of refueling.

## Store Performance Scenarios

The following Store Performance Scenarios used the NACS-CSX and the Fuels Institute sample sets of store-level data to present five different market forecasts for E85 based upon the total number of E85 stations and varying levels of retail E85 performance. First, however, the total number of stores selling E85 and the number of FFVs that will be in the market must be forecast.



**Figure 43: Vehicle Consumption Models**  
(Source: Fuels Institute)

**Range of Potential E85 Sales**

	5% Refuel		100% Refuel	
E85 Type	2014	2023	2014	2023
51% Ethanol	0.903	1.436	18.068	28.71
60% Ethanol	0.942	1.497	18.84	29.936
70% Ethanol	0.981	1.558	19.612	31.163
74% Ethanol	1.004	1.595	20.075	31.899
83% Ethanol	1.042	1.656	20.847	33.126

**Figure 44: Range of Potential E85 Sales (Billion Gallons)**  
(Source: Fuels Institute)

<sup>27</sup> It is important to remember that this BTU-calculated GGE does not take into consideration vehicle efficiency improvements and could be considered to represent the lowest efficiency for FFVs operating on E85.

## E85 Station Count

As discussed in the “Basics” section, there are between 2,600–3,400 stations selling E85 in 2014. AFDC and Growth Energy report historic growth rates that average 12.9% and 15.6%, respectively. Applying the average of these growth rates (14.3%), it is possible to forecast how many stations might sell E85 in 2023. The number of stations selling E85 could range between 8,907 and 11,151, with a forecast average of 9,798. This average forecast station count will be used in this analysis. (Figure 45)

## FFV Forecast

EIA and the Fuels Institute forecast the number of FFVs through 2023 increasing at annualized growth rates of

6.02% and 6.14%, respectively. Starting with an FFV inventory in 2014 of 15.2 million<sup>28</sup> and applying an average growth rate of 6.08% delivers a forecast of up to 25.9 million FFVs in 2023. (Figure 46)

## Store Performance Scenarios

The Store Performance Scenarios leverage the performance reported by NACS-CSX and the Fuels Institute sample sets to forecast E85 demand through 2023. Data reported in this sample set was for 2013–2014. To accurately predict potential demand, it is assumed that demand will grow at the same rate as the number of FFVs on the road. Therefore, an annual growth rate of 6.08% is factored into the demand forecasts.

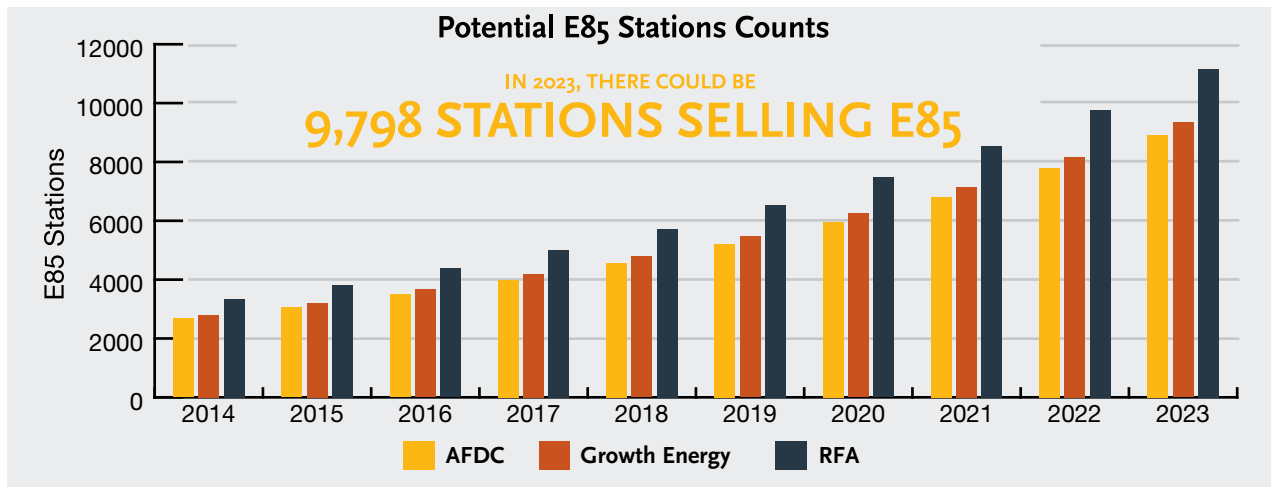


Figure 45: Potential E85 Stations Counts (Source: Fuels Institute)

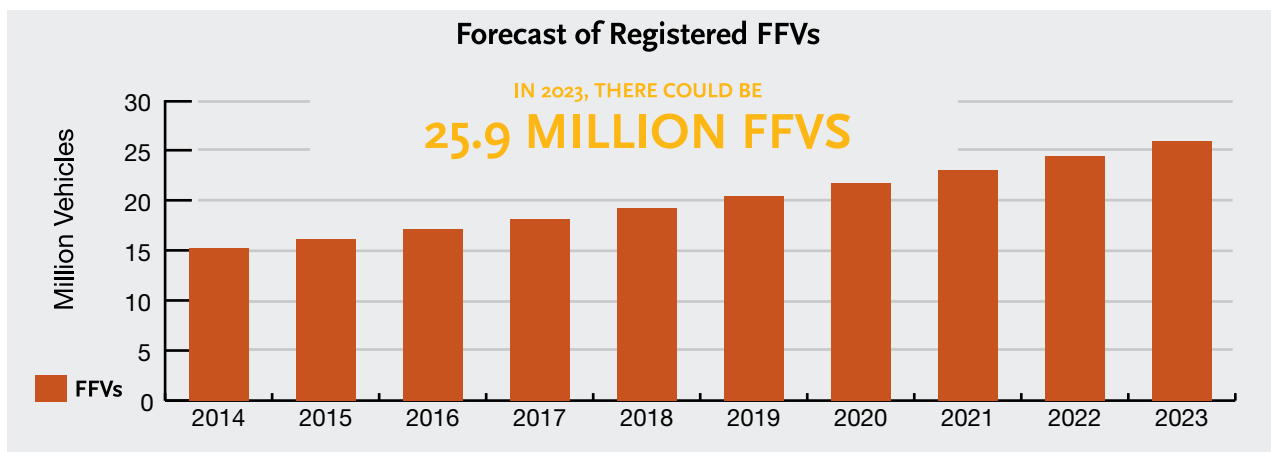


Figure 46: Forecast of Registered FFVs (Source: Fuels Institute)

<sup>28</sup> This represents an average of the estimated registered FFVs in 2014 as reported by EIA, the Fuels Institute, Growth Energy and RFA.

## NACS-CSX Scenario

This scenario assumes every E85 retail station has the ability to match the performance of the NACS-CSX sample. These stores sold on average 2,848 gallons of E85 per month. The model forecasts potential monthly E85 volume of 4,839 gallons per store by 2023. Applying this per store E85 daily sales forecast to the total number of E85 stores, the model forecasts that by 2023, such a market could generate 569 million gallons of E85 sales.

## Top 10 Store Scenario

This scenario assumes every E85 retail station has the ability to match the performance of the Top 10 stations when performing at their most successful, i.e., selling E85 at \$0.60 or more below unleaded. At this price, these stores sold on average 727 gallons of E85 per day. The model forecasts potential daily E85 volume of 1,237 gallons per store by 2023. Applying this per store E85 daily sales forecast to the total number of E85 stores, the model forecasts that by 2023, such a market could generate 4.4 billion gallons of E85 sales.

## Top Quartile Store Scenario

This scenario assumes every E85 retail station has the ability to match the performance of the Top Quartile of stores reported in the Fuels Institute sample. These stores sold on average 364 gallons of E85 per day. The model forecasts potential daily E85 volume of 619 gallons per store by 2023. Applying this per store E85 daily sales forecast to the total number of E85 stores, the model forecasts that by 2023, such a market could generate 2.2 billion gallons of E85 sales.

## Average Store Scenario

This scenario assumes every E85 retail station has the ability to match the performance of the average of all stores reported in the Fuels Institute sample. These stores sold on average 185 gallons of E85 per day. The model forecasts potential daily E85 volume of 315 gallons per store by 2023. Applying this per store E85 daily sales forecast to the total number of E85 stores, the model forecasts that by 2023, such a market could generate 1.1 billion gallons of E85 sales.

## Bottom Quartile Store Scenario

This scenario assumes every E85 retail station has the ability to match the performance of the Bottom Quartile of stores reported in the Fuels Institute sample. These stores sold on average 66 gallons of E85 per day. The model forecasts potential daily E85 volume of 112 gallons per store by 2023. Applying this per store E85 daily sales forecast to the total number of E85 stores, the model forecasts that by 2023, such a market could generate 401 million gallons of E85 sales.(Figure 47)

## Summary of Forecasts

Figure 48 summarizes the conclusions of the above forecasts. To put the forecasts into perspective, however, an additional column is provided expressing the forecast E85 volume in terms of the forecast gasoline market. Similar to the NACS-CSX and Fuels Institute sample analyses above, understanding how E85 demand measures up against gasoline demand can be instructive.

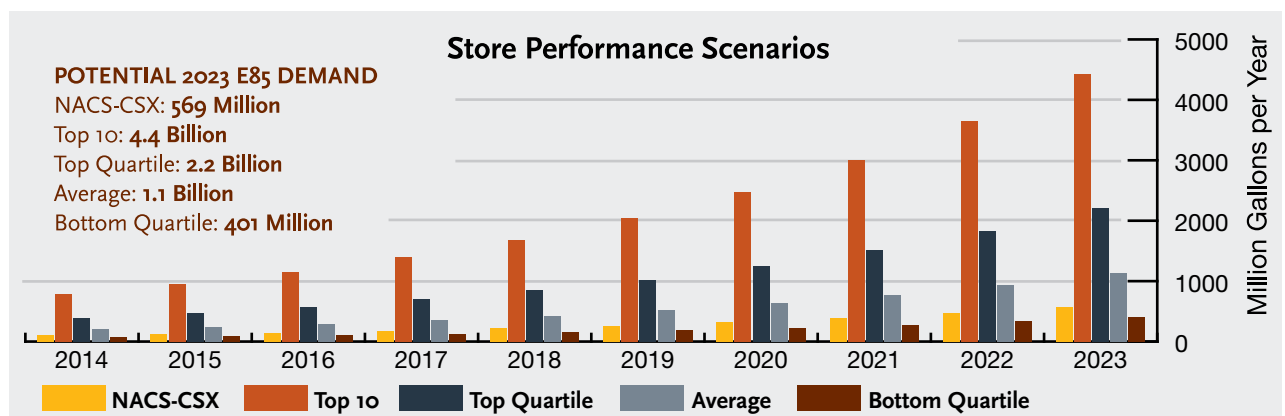


Figure 47: Store Performance Scenarios (Source: NACS-CSX, Fuels Institute)

To calculate how E85 volumes relate to gasoline volumes, the table uses EIA's Annual Energy Outlook 2014 Early Release forecast of motor gasoline demand—118.6 billion gallons in 2023. This forecast volume does not incorporate recent increases in EIA's short term projected demand, but official forecasts through 2023 are not yet available. The market share numbers presented in this table, therefore, should be viewed as a high estimate and the Fuels Institute suspects when the revised 2023 forecasts are released by EIA that the market share percentages reflected here will be revised downward.

## Ethanol Sold as E85

Given the variability in ethanol volumes that can be used to produce E85, to understand how much ethanol could be sold via E85 it is necessary to adjust the E85 forecasts according to certain ethanol blend rates. Figure 49 presents the volume of ethanol that would be sold under the various forecasts based upon three different average concentration ratios.

### Summary of Forecast

Forecast	2023 E85 Market	% of Forecast Gasoline Demand
<b>EIA Annual Energy Outlook</b>	3,412 Billion	2.87%
<b>Vehicle Consumption Model – 100% Refuel</b>	31,899 Billion	26.90%
<b>Vehicle Consumption Model – 5% Refuel</b>	1,595 Billion	1.34%
<b>NACS-CSX</b>	569.0 Million	0.48%
<b>Top 10 Store Scenario</b>	4,422 Billion	3.73%
<b>Top Quartile Store Scenario</b>	2,214 Billion	1.87%
<b>Average Performing Store Scenario</b>	1,125 Billion	0.95%
<b>Bottom Quartile Store Scenario</b>	401.5 Million	0.34%

Figure 48: Summary of Forecasts (Source: Fuels Institute)

### Forecast Ethanol Volumes

Forecast	51%	74%	83%
<b>EIA Annual Energy Outlook</b>	1,740 Billion	2,525 Billion	2,832 Billion
<b>Vehicle Consumption Model – 100% Refuel</b>	16,268 Billion	23,605 Billion	26,476 Billion
<b>Vehicle Consumption Model – 5% Refuel</b>	0,813 Billion	1,180 Billion	1,324 Billion
<b>NACS-CSX</b>	290.2 Million	421.1 Million	472.3 Million
<b>Top 10 Store Scenario</b>	2,255 Billion	3,272 Billion	3,670 Billion
<b>Top Quartile Store Scenario</b>	1,129 Billion	1,638 Billion	1,838 Billion
<b>Average Performing Store Scenario</b>	573.8 Million	832.5 Million	933.8 Million
<b>Bottom Quartile Store Scenario</b>	204.8 Million	297.1 Million	333.2 Million

Figure 49: Forecast Ethanol Volumes (Source: Fuels Institute)

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## Conclusion

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There are opportunities and challenges facing the E85 market.

- There is room to accommodate additional E85 retail stations. With 5,289 registered FFVs for every station selling E85, there clearly are opportunities for new entrants. But because drivers of FFVs are not required to purchase E85, it will be essential for retailers to optimize their pricing strategies to convince consumers to substitute their unleaded purchases with E85.
- The price E85 is sold relative to gasoline is not contingent upon the energy density of the fuel. E85 does not need to be sold 23% below gasoline to compensate for its lower energy value. Consumers are focused on the absolute price differential, not the percent change, and that price discount need not be equal to the energy differential.
- Retailers who have had the greatest success generating E85 sales have done so by pricing E85 at \$0.60 below unleaded. This generated 727 gallons of E85 sales per day (21,810 gallons per month), which equaled 8.0% of unleaded sales.
- Based upon reported store performance, it is possible that annual E85 sales could increase to 4.4 billion gallons in 2023 if every E85 retailer matched the best performance of the top reporting stores. However, if stores matched the average performance of the stores that submitted daily information to the Fuels Institute, E85 sales in 2023 would reach 1.125 billion gallons.
- The forecasts for E85 sales could improve if the automobile industry continued to increase FFV production at historic rates, thereby generating additional potential demand. However, absent government incentive and give increasing complications associated with advanced fuel efficient designs, consumers will have to demonstrate their demand for FFVs to convince manufacturers to sustain or increase production levels. Without a change in production intent, FFVs will not account for more than 10% of the light duty market.
- FFV demand for E85 could be supported at retail if ethanol prices remain far enough below gasoline to create favorable blending economics that could result in aggressive E85 pricing at retail. The uncertainty surrounding the future of the RFS and the future value of RINS makes it difficult for retailers to incorporate anticipated RINS revenues into their pricing strategies, and thereby compromises their ability to effectively reduce the price of E85 to a required level to generate increased sales.

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# About the Fuels Institute

The Fuels Institute, founded by NACS in 2013, is a non-profit research-oriented think tank dedicated to evaluating the market issues related to consumer vehicles and the fuels that power them. Led by a diverse Board of Directors and driven by a Board of Advisors, the Fuels Institute incorporates the perspective of interested stakeholders affected by this market.

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## Financial Support

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This report was funded by the Fuels Institute. The Fuels Institute is supported financially by the following organizations:

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Fuels Institute  
(703) 518-7970  
[FuelsInstitute.org](http://FuelsInstitute.org)  
[@FuelsInstitute](https://twitter.com/FuelsInstitute)

1600 Duke Street  
Suite 700  
Alexandria, VA 22314