



# DOE Bioenergy Technologies Office (BETO) 2023 Project Peer Review Biofuels Information Center

April 3, 2023  
Data, Modeling, and Analysis  
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NREL

# Project Overview

## HISTORY

- Title II, Sect. 229 of the Energy Independence and Security Act of 2007 requires DOE to develop a “Biofuels and Biorefinery Information Center.”
- Historical work included creating biofuels content on AFDC, static data and maps, State Bioenergy Assessment Tool, and the Bioenergy Atlas tools.

## GOALS

- The Biofuels Information Center (BIC) task provides essential bioenergy data, information, and reports to educate stakeholders on all aspects on biofuels.
  - This was accomplished through the Alternative Fuels Data Center (AFDC); analysis of USDA Biofuels Infrastructure Partnership (BIP) data; data and analysis via the Bioenergy Atlas Tools; and participation in industry groups. .

# 1. Approach-Management

## Prioritize

tasks based on stakeholder needs and data availability.

## Engage

stakeholders on what is useful and what is missing.

## Review

with BETO quarterly budget and deliverable status.

## Communicate

During the review process and when work is complete. Address issues quickly

## Outreach

through multiple communication methods to reach stakeholder audience.

## Risk

Reduction by working with all data sources to identify timeline issues.

# 1. Approach-Technical

## Gather

unbiased, relevant industry data primarily from federal sources.

## Protect

data using federally approved secure data transfer services.

## Review

data for quality and work with sources on issues. Ensure consistent content.

## Deploy

information and data updates to websites and tools. Publish reports.

## Influence

industry-funded projects by leading and participating in stakeholder groups.

## Serve

as a technical fuel infrastructure expert for all stakeholders.

## Leverage

funding from AFDC platform and shared GIS tool platforms. Coordinate with KDF task.

# 1. Approach—Data Sources

The majority of data and information are sourced from federal agencies supplemented with vetted industry data when federal data is unavailable.



# 1. Approach-Data Review Example

Table 6: General BIP Station Information (Part 2)						
Grant Agreement No.	123456					
Worksheet Completion Date	3/20/20					
State Name	Florida					
Station Name	ABC Store					
Station Address (line 1)						
Station Address (line 2)	Tampa, FL 33605					
Location (GPS)						
Date of Installation	7/21/18					

Table 8: 2017 Sales						
Type of Fuel	January		February		March	
	Avg Retail Sales Price	Gallons Sold	Avg Retail Sales Price	Gallons Sold	Avg Retail Sales Price	Gallons Sold
E10	\$1.890	97,367.9	\$1.720	81,857.4	\$2.040	113,624.8
E15					\$1.950	3,634.6
E85		3,543.3		2,368.4		4,368.5
Diesel	\$1.850	69,156.1	\$1.790	70,948.8	\$2.000	76,211.4

Table 9: 2018 Sales						
Type of Fuel	January		February		March	
	Avg Retail Sales Price	Gallons Sold	Avg Retail Sales Price	Gallons Sold	Avg Retail Sales Price	Gallons Sold
E10	\$2.319	105,382.2	\$2.241	99,572.7	\$219.200	32,000.0
E15	\$2.221	6,782.4	\$2.146	6,931.9	\$2.099	9,503.6
E85	\$1.763	3,858.2	\$1.796	3,795.8	\$1.875	4,364.5
Diesel	\$2.441	66,132.4	\$2.399	68,524.0	\$2.392	86,576.6

Table 10: 2019 Sales						
Type of Fuel	January		February		March	
	Avg Retail Sales Price	Gallons Sold	Avg Retail Sales Price	Gallons Sold	Avg Retail Sales Price	Gallons Sold
E10						
E15	\$2.368	3,572.9	\$2.544	3,155.0	\$2.445	4,697.8
E85	\$1.891	2,747.6	\$1.895	2,819.5	\$1.896	3,452.3
Diesel	\$2.860	89,677.7	\$2.906	76,849.0	\$2.832	106,979.9

Missing E85 \$

Wrong i

Out of ng volume

Missing data for

## USDA BIP Data Example

- Review ~1,700 spreadsheets submitted by ~850 stations
- Review data 2015-2021
- Identify missing or suspected incorrect data
- Contact USDA to ask stations for missing data
- Vastly out of range data not included in analysis

# 1. Approach-Challenges & Go/No-Go

## CHALLENGES

Ensuring USDA BIP timeliness of data and quality.

- Achieved by reviewing data quality to identify obvious and easy to fix errors.
- Communicating to USDA and industry partners where data quality or omissions are impacting the overall dataset.
- Data timeliness and relevance for AFDC and Bioenergy Atlas tools.
  - All tasks rely on updates from multiple sources with whom NREL regularly communicates.
  - Identify new or alternate data sets and engage with BETO and stakeholders to determine their usefulness as an addition or replacement for the data, information, reports, and tools.

## GO/NO-GO

- Based on use of AFDC as monitored by Google Analytics. If there is a decline in use, funding will be reevaluated.

## 2. Progress and Outcomes-AFDC

- BIC's 3 main tasks the past 2 fiscal years:
  - AFDC biofuels pages
  - Bioenergy Atlas tools data updates and maintenance
  - USDA BIP data collection, analysis, and reporting

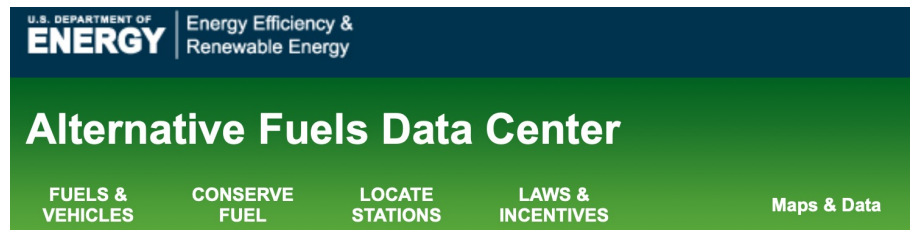




## 2. Progress and Outcomes-AFDC

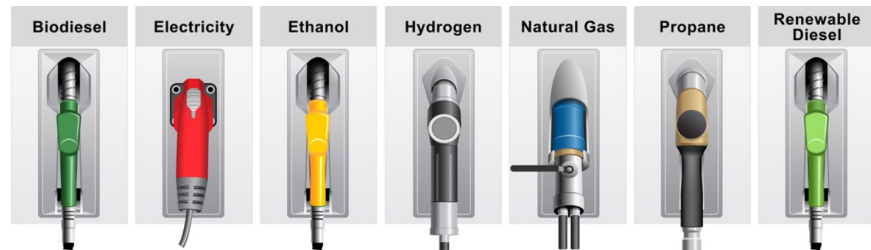
### AFDC pages are reviewed, updated, and edited annually.

- Extensive reviews by NREL, Clean Cities leads, and communications edits.
- Completed by March each year.
- Ethanol (21 pages).
- Biodiesel (13 pages).
- Renewable Diesel (1 page).
- Sustainable Aviation Fuel (1 page).
- Emerging (5 pages).
- Maps, data, and publications are updated and added as they are available.



EERE » AFDC

#### Fuels & Vehicles ▶



<https://afdc.energy.gov>

## 2. Progress and Outcomes-AFDC

### Mature and non-drop-in fuels have more content.

- As a fuel matures, more content is added.
- General topics are feedstocks, production, distribution, fuel quality specs, fuel properties, station infrastructure details, vehicles and associated emissions.

The screenshot shows the Alternative Fuels Data Center website. At the top, there is a green navigation bar with the title "Alternative Fuels Data Center" and five menu items: "FUELS & VEHICLES" (highlighted in yellow), "CONSERVE FUEL", "LOCATE STATIONS", "LAWS & INCENTIVES", and "MORE...". Below the navigation bar is a breadcrumb trail: "EERE » AFDC » Fuels & Vehicles » Ethanol". On the left side, there is a vertical menu with five items: "Ethanol Basics", "Benefits & Considerations" (highlighted in grey), "Stations", "Vehicles", and "Laws & Incentives". The main content area features the heading "Ethanol Benefits and Considerations" followed by a paragraph: "Ethanol is a renewable, domestically produced transportation fuel. Whether used in low-level blends, such as E10 (10% ethanol, 90% gasoline), E15 (10.5% to 15% ethanol), or E85 (flex fuel)—a gasoline-ethanol blend containing 51% to 83% ethanol, depending on geography and season—ethanol helps reduce emissions. Like any alternative fuel, the use of ethanol involves several considerations." Below this is the heading "Energy Security" followed by another paragraph: "The United States became a net exporter of petroleum in 2020 with exports surpassing imports, although imports of 6.11 million barrels per day remained an important part of balancing supply and demand for domestic and international markets. Overall, the transportation sector accounts for approximately 30% of total U.S." On the right side, there is a sidebar with three items: "+ Maps & Data", "- Case Studies" (expanded), and three case study entries: "Municipality with a Mission: Georgia Fleet Commits to Alternative Fuels for the Long Haul", "Green Fueling Station Powers Fleets in Upstate New York", and "Idaho County Employs FFVs and Idle Reduction".

### Alternative Fuels Data Center

EERE » AFDC » Fuels & Vehicles » Ethanol

Ethanol Basics  
Benefits & Considerations  
Stations  
Vehicles  
Laws & Incentives

#### Ethanol Benefits and Considerations

Ethanol is a renewable, domestically produced transportation fuel. Whether used in low-level **blends**, such as E10 (10% ethanol, 90% gasoline), E15 (10.5% to 15% ethanol), or **E85** (flex fuel)—a gasoline-ethanol blend containing 51% to 83% ethanol, depending on geography and season—ethanol helps reduce emissions. Like any alternative fuel, the use of ethanol involves several considerations.

#### Energy Security

The United States became a **net exporter of petroleum in 2020** with exports surpassing imports, although imports of 6.11 million barrels per day remained an important part of balancing supply and demand for domestic and international markets. Overall, the transportation sector accounts for approximately 30% of total U.S.

+ Maps & Data

- Case Studies

- Municipality with a Mission: Georgia Fleet Commits to Alternative Fuels for the Long Haul
- Green Fueling Station Powers Fleets in Upstate New York
- Idaho County Employs FFVs and Idle Reduction

<https://afdc.energy.gov>

## 2. Progress and Outcomes-AFDC

Renewable diesel and sustainable aviation fuels pages were developed in FY22. Previously, limited information was available on an emerging fuel page.

### Renewable Diesel

Renewable diesel is a fuel made from fats and oils, such as soybean oil or canola oil, and is processed to be chemically the same as petroleum diesel. It meets the [ASTM D975](#) specification for petroleum in the United States and EN 590 in Europe. Renewable diesel can be used as a replacement fuel or blended with any amount of petroleum diesel. Nearly all domestically produced and imported renewable diesel is used in California due to economic benefits under the Low Carbon Fuel Standard.

Renewable diesel and [biodiesel](#) are not the same fuel. Renewable diesel, previously known as green diesel, is a hydrocarbon produced most often by hydrotreating and also via gasification, pyrolysis, and other biochemical and thermochemical technologies. It meets ASTM D975 specification for petroleum diesel. Biodiesel is a mono-alkyl ester produced via [transesterification](#). Biodiesel meets ASTM D6751 and is approved for blending with petroleum diesel.

### Production

Renewable diesel can be produced by several different technology pathways. Currently, commercial production facilities are using the hydrotreating pathway and fats, oils, and greases are the most common feedstocks. There are several technology pathways to produce renewable diesel including:

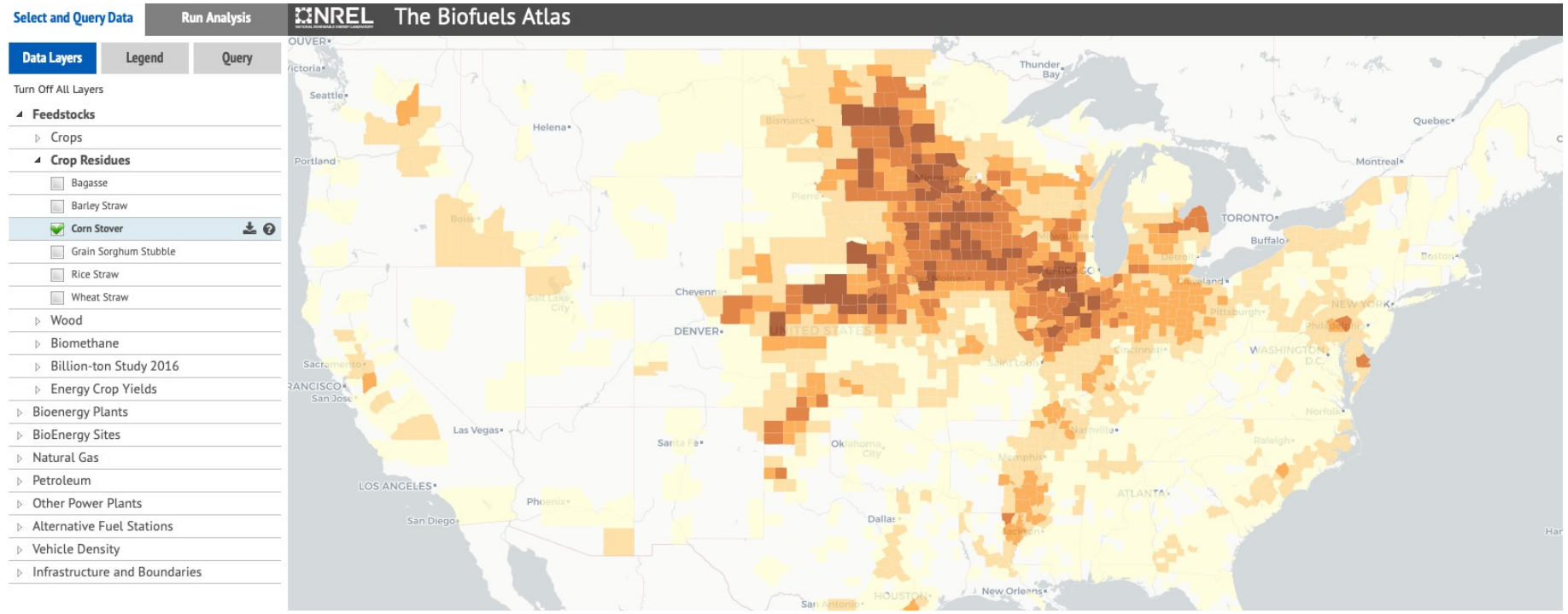
#### Fuel Prices ▶

Find renewable diesel fuel prices and trends.



## 2. Progress and Outcomes-Bioenergy Atlas Tools

Bioenergy Atlas data layers were updated annually where new data was available.

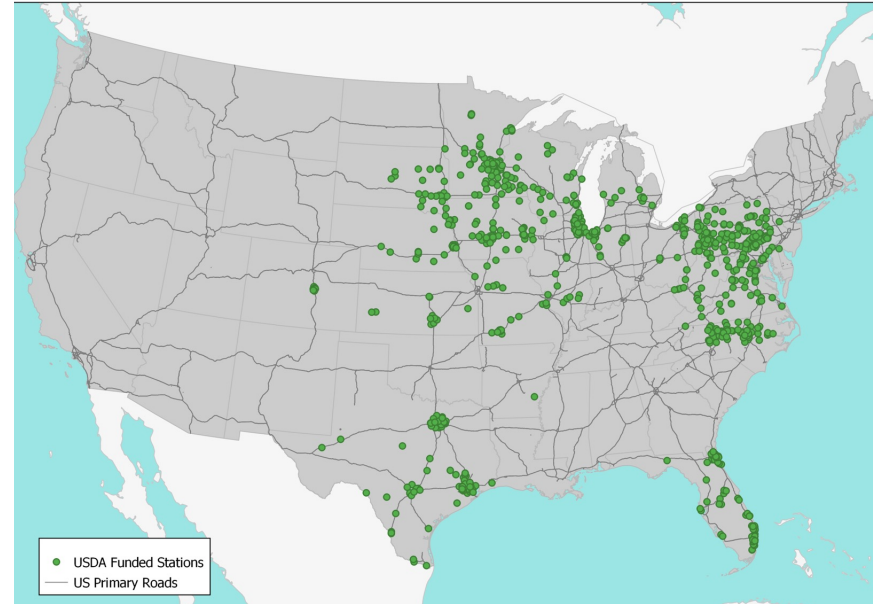


Bioenergy Atlas tools were archived in July 2022. Security protocols required a new platform. The data layers and functionality could be migrated to the new platform.

## 2. Progress and Outcomes-USDA BIP

### Review & Analyze BIP data and prepare a national summary report.

- USDA and state/industry partners invested approximately \$186 million in grants to gas stations to purchase refueling equipment to extend the availability of E15 and E85.
- DOE and USDA have a memorandum of agreement to share station data
- NREL reviewed data from ~850 stations, loads it to a database, and prepares graphics and a report from the data.
- NREL prepared has prepared a detailed and summary reports in FY18, FY19, FY20, FY21, and FY22.
- Plan to publish the final summary report with all years of data

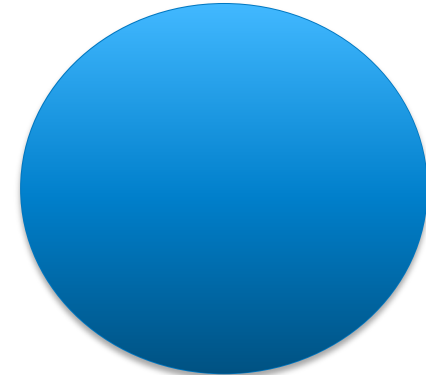
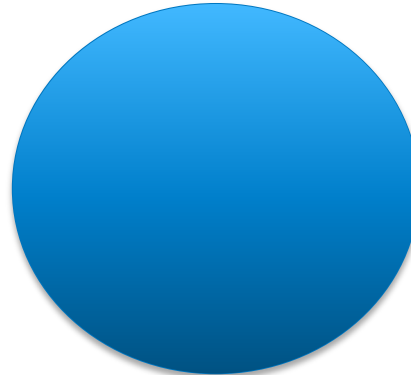
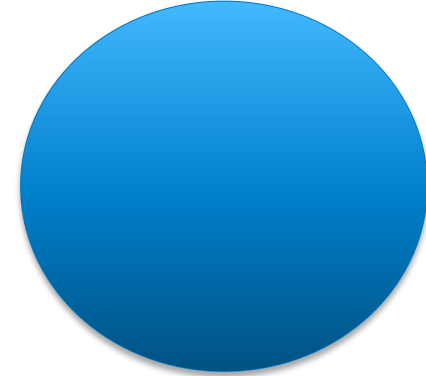
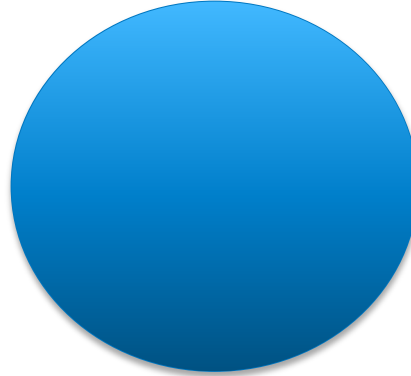


## 2. Progress and Outcomes-USDA BIP

The BIP provides insights on costs to upgrade or replace infrastructure to accommodate biofuels.



Dispenser



## 2. Progress and Outcomes-USDA BIP

**BIP sales data allows for comparison of sales prices and sales volume for E10, E15, and E85.**

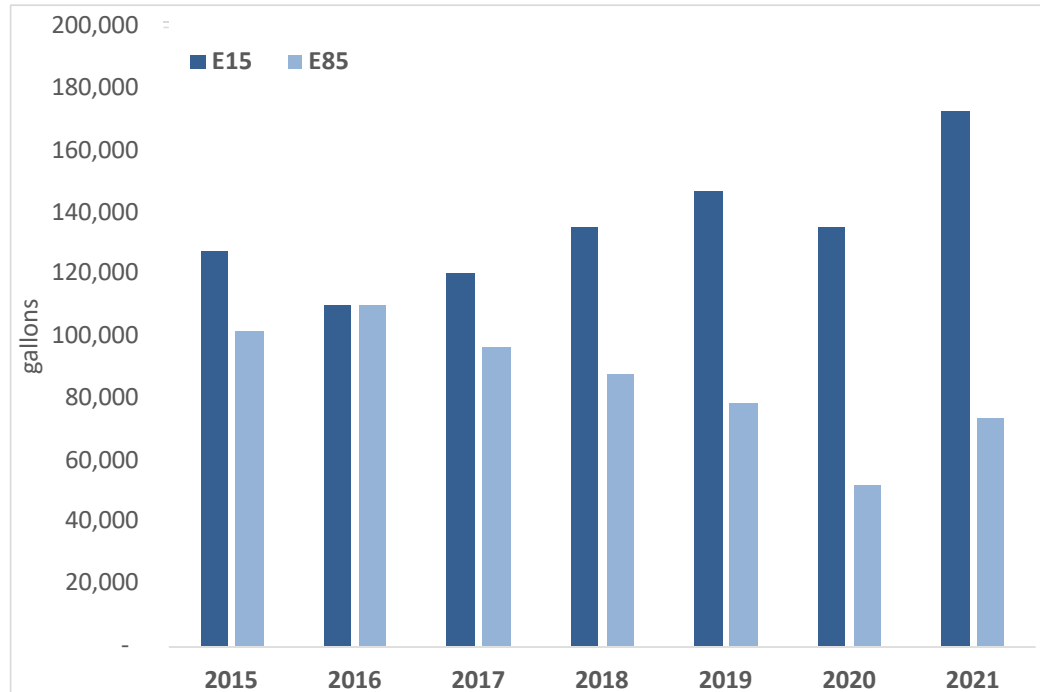
### *Average Annual Fuel Prices*

Fuel	2015	2016	2017	2018	2019	2020	2021
	per gallon						
E10	\$2.41	\$2.13	\$2.37	\$2.63	\$2.50	\$2.17	\$2.91
E15	\$2.01	\$2.01	\$2.29	\$2.56	\$2.43	\$2.08	\$2.78
E85	\$1.97	\$1.69	\$1.92	\$2.19	\$2.16	\$2.01	\$2.48

## 2. Progress and Outcomes-USDA BIP

Average and total E15 sales grew each year while E85 did not.

### *Average E15 & E85 Annual Sales per Station*



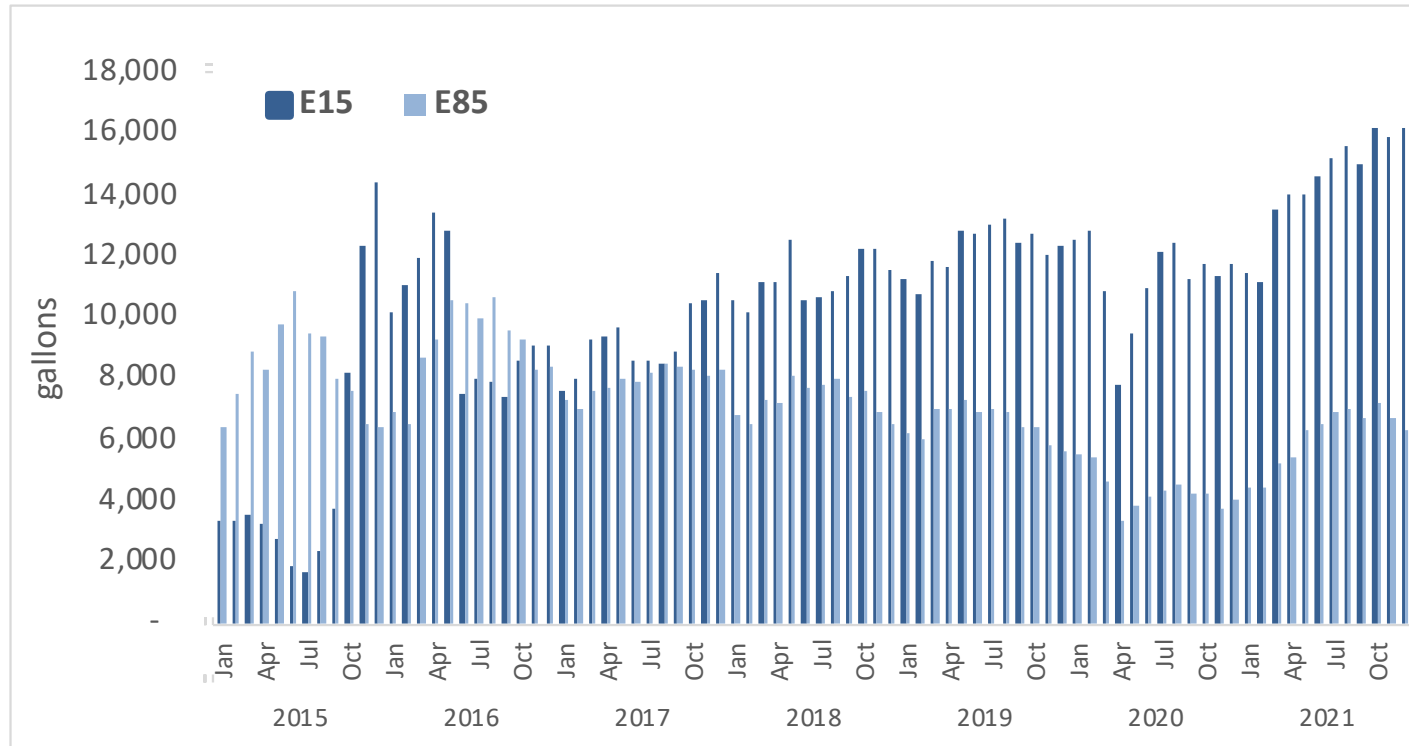
- **E15 can be used in ~95% of existing light duty vehicles**
- **E85 can be used solely in flexible fuel vehicles (FFVs)**
  - Changes to federal Corporate Average Fuel Economy credits resulted in lower FFV sales



## 2. Progress and Outcomes-USDA BIP

Sales trended higher throughout 2021.

### *Average E15 & E85 Monthly Sales per Station*



## 2. Progress and Outcomes-USDA BIP

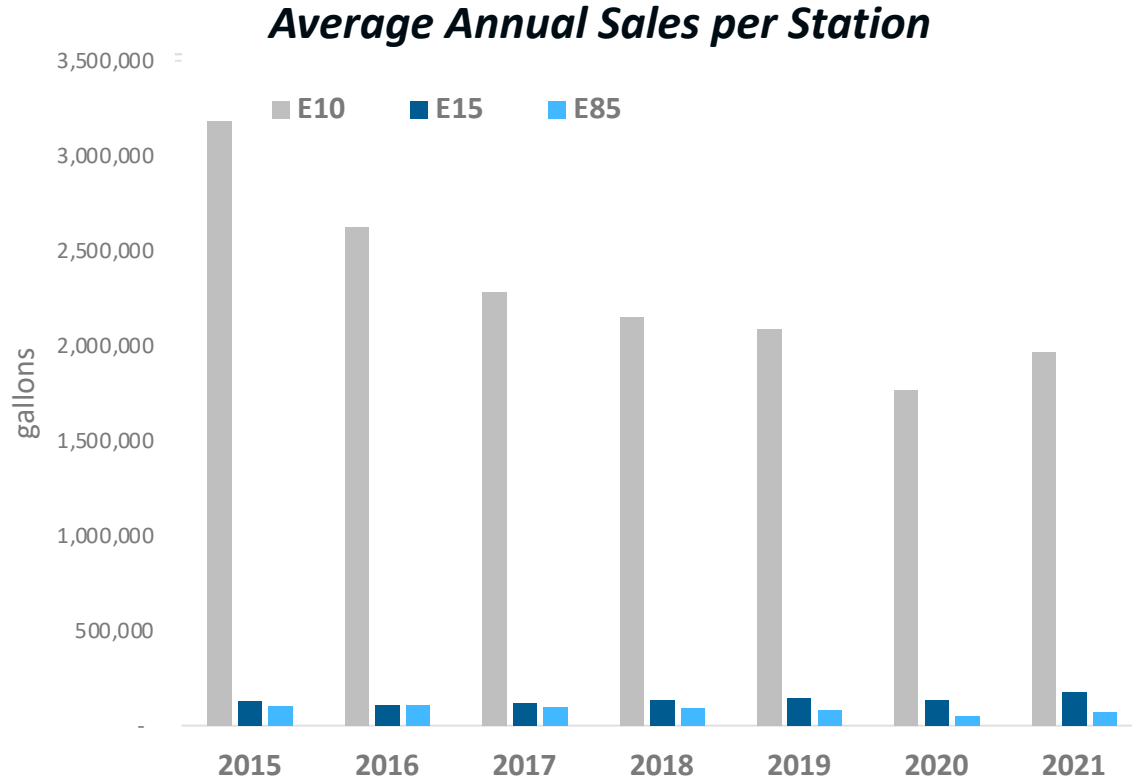
On average, E15 is priced lower than E10.

### *Average E15 Discount Compared to E10*

Fuel	2015	2016	2017	2018	2019	2020	2021
	per gallon						
E15 Discount	\$0.39	\$0.12	\$0.08	\$0.07	\$0.07	\$0.08	\$0.13

## 2. Progress and Outcomes-USDA BIP

Despite E15 discount, sales of E10 remain much higher.

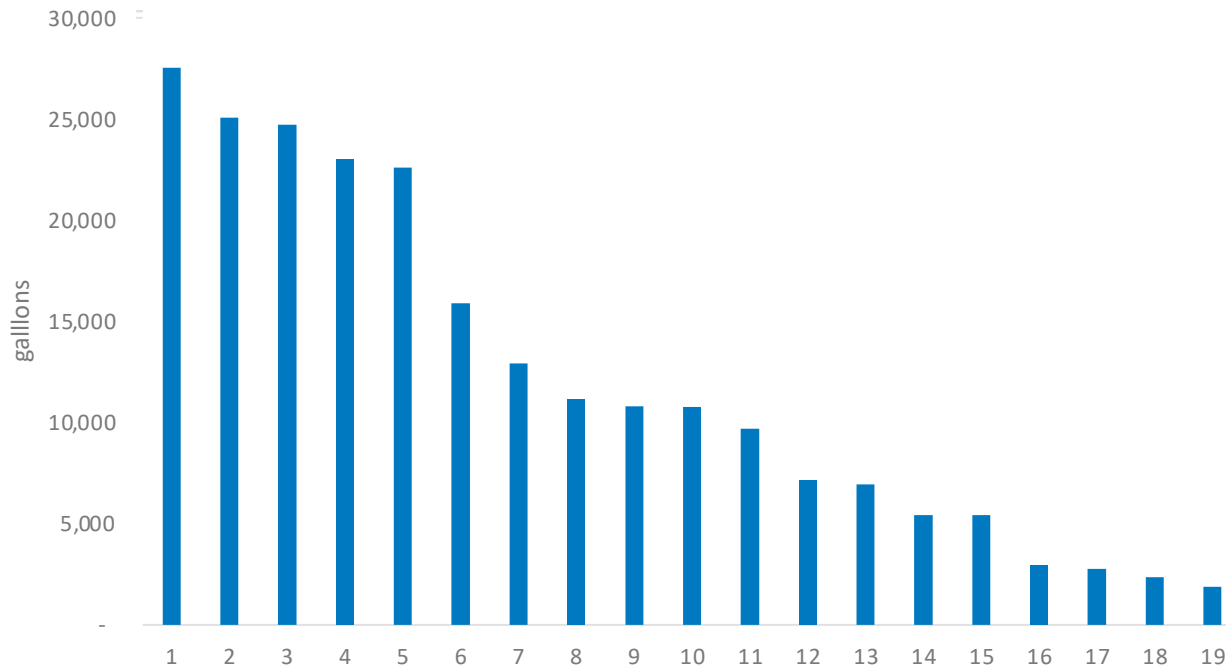


Beyond the Renewable Fuel Standard, E10's strong market is due in part to pipelines shipping suboctane (84) fuel. Ethanol is a low cost octane enhancer. A 10% blend results in 87 octane fuel.

## 2. Progress and Outcomes-USDA BIP

Some states had much better performance of E15 sales.

### *Average E15 Sales per Station per Month*



- Average fuel sales in states varied widely.
- Some retailers/states had higher sales compared with others.
- State data anonymous to protect business sensitive data

## 2. Progress and Outcomes-Summary

- **Update AFDC biofuels pages annually.**
  - PI completes on 3/31 each year. Followed by a Clean Cities review, NREL manager review, NREL communications review, and DOE review.
- **USDA BIP Report.**
  - A few graphic edits are needed to finalize the national summary report for publication.
- **Update Bioenergy Atlas tool data were updated annually.**
  - Review all data for any available updates.
  - Routine platform maintenance.
  - Tool and data currently archived and can be moved to new platform.
- **Go/no-go for future funding is based on consistent use of AFDC biofuels pages and Bioenergy Atlas tools which is tracked using Google Analytics. Usage continues to increase each year.**

### 3. Impact-Stakeholders

Many types of stakeholders use the BIC deliverables and provide feedback on what is missing. Stakeholders include:

- **Bioenergy companies** and their industry groups.
- **Other government agencies**, including DOD, DOI, DOT, EPA, State, and USDA.
- **State offices** including agriculture, economic development, energy, environment, and transportation. State corn and soybean boards.
- **Refueling equipment manufacturers** and their industry groups.
- **Retail station owners** and their industry groups.
- **Oil and refining companies** and the American Petroleum Institute.
- **Vehicle and engine manufacturers** and their industry groups.
- **Others** include ASTM, Coordinating Research Council, Fuels Institute, institutions, investment firms, and universities.

### 3. Impact-Google Analytics

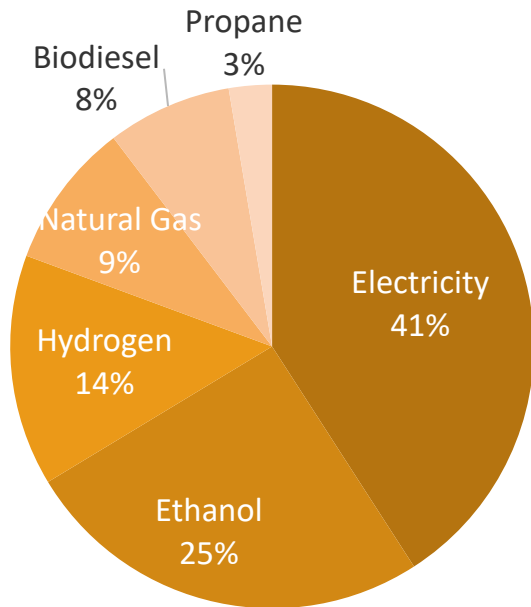
- BIC helps BETO meet its goals and objectives of expanding the domestic bioenergy market by providing current and relevant bioenergy data and tools to a wide group of stakeholders.
- In FY22, AFDC usage exceeded 1.7 million pageviews (an instance of an internet user visiting a web page) with a budget of \$220,000.
- Go/No-Go is based on AFDC usage.

Google Analytics	FY16	FY17	FY18	FY19	FY20	FY21	FY22
	<i>Pageviews</i>						
AFDC Ethanol Pages	405,355	410,166	477,951	601,338	753,390	895,887	1,296,598
AFDC Biodiesel Pages	193,951	199,995	209,380	171,495	219,865	282,520	391,719
AFDC Emerging Fuels Pages	44,818	50,134	43,969	43,425	50,960	86,628	111,499
<b>Total</b>	<b>644,124</b>	<b>660,295</b>	<b>731,300</b>	<b>816,258</b>	<b>1,024,215</b>	<b>1,265,035</b>	<b>1,799,816</b>

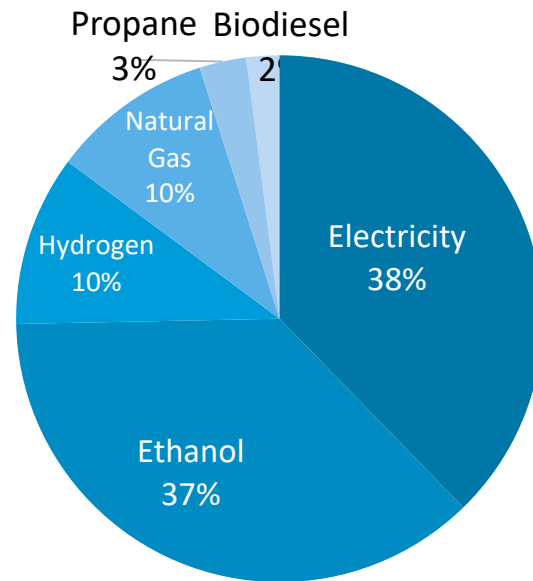
### 3. Impact-Google Analytics

In FY22, pageviews of AFDC biofuels content was significant.

#### FUELS & VEHICLES



#### STATIONS



FY22 AFDC Google Analytic use data. Fuels & vehicles: 9 million pageviews; Stations: 8 million pageviews.



### 3. Impact-BIP Gas Station Data Set

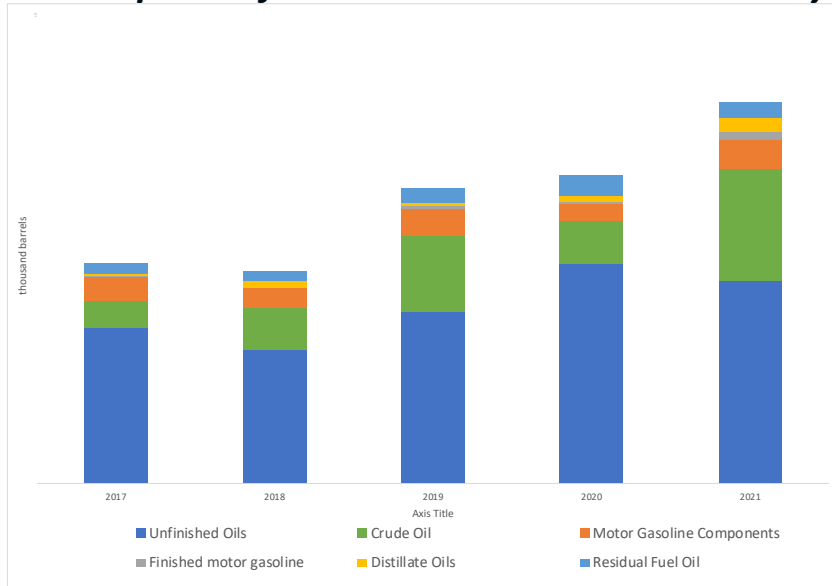
The BIP task provides a valuable and previously unavailable data set (gas stations are privately owned). Data collected from ~850 stations includes:

- E10, E15, and E85 monthly sales price and volume data allows for analysis and comparison.
- Costs of dispensers (pumps) and underground storage tank systems provides insight into infrastructure costs for a non-fungible fuel.
- Market data include % of ethanol in E85 (varies 51%-83%), source of E85, number of refueling positions (spots where a car can pull up and buy a particular fuel), number/material of tanks, if E15 and E85 are on the price sign, if station is branded by oil company.

### 3. Impact-Data Requests

**BIC data and information was used to inform the federal government on the ability of domestic biofuels to offset Russian imports and on barriers to quick implementation such as E15 limits with Reid Vapor Pressure.**

*U.S. Imports of Russian Petroleum Products by Year*



Administration

APRIL 12, 2022

**FACT SHEET: Using Homegrown Biofuels to Address Putin's Price Hike at the Pump and Lower Costs for American Families**

# Summary

- **MANAGEMENT:** Identify quality data sources, ask industry for input, communicate timelines/approach to BETO, outreach project output to industry.
- **APPROACH:** Gather unbiased data, review data and content for quality, prepare and deploy deliverables, determine funding based on content usage statistics.
- **IMPACT:**
  - Over 1.7 million pageviews for AFDC in FY22.
  - Providing previously unavailable gas station infrastructure data and E10, E15, and E85 sales volume and price data.
- **OUTCOME:**
  - USDA BIP National Summary of station data to be published.
  - AFDC biofuels pages information and data updated annually.
  - Bioenergy Atlas tools annual data updates (tools discontinued and archived).
  - Industry support for biofuels infrastructure.

# Quad Chart Overview

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	FY22 Costed	Total Award
DOE Funding		

TRL at Project Start: 8  
TRL at Project End: 8  
This is a data and information project focused on deployment.

## Project Goal

The goal of this project is to provide relevant data, information, and tools via the AFDC, Bioenergy Atlas websites, and Bioenergy Industry Status Report to enable stakeholders to make bioenergy decisions. Publish biofuel infrastructure data and costs as well as biofuel sales data for comparison to conventional fuel sales.

## End of Project Milestone

- Publish USDA BIP report.
- Provide current and relevant information and data on the AFDC and Bioenergy Atlas tools.
- Provide infrastructure support to industry.

## Funding Mechanism

Annual Operating Plan (AOP).

## Project Partners\*

- USDA

\*Only fill out if applicable.

# Q&A

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[www.nrel.gov](http://www.nrel.gov)

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**Additional Slides**

# Responses to Previous Reviewers' Comments

- Past reviewers wanted to understand similarities/differences and coordination with ORNL's KDF project.
- Reviewer response: the intended audience for BIC deliverables are industry stakeholders. The intended audience for KDF are bioenergy researchers. NREL and ORNL discuss deliverables and focus for both tools as they change overtime. There was some overlap ~10 years ago but not any longer.