

## **Economic Impact of Nationwide E15 Use**

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### **Executive Summary**

One of the most significant challenges and opportunities for the ethanol industry lies in expanding demand by increasing use of higher blend levels. Most of the motor gasoline used in the U.S. contains 10 percent ethanol (E10). The USEPA approved the year-around sale of 15 percent ethanol blends (E15) for use in model year 2001 and newer vehicles and the number of retail stations selling E15 has been increasing.

Increasing the blend level of ethanol from E10 to E15 nationwide will increase ethanol use by nearly 6.2 billion gallons over baseline 2016-2020 average levels and will generate substantial economic benefits for the U.S. economy. Implementing nationwide E15 use will require an increase in production that will be reflected in higher demand for feedstocks (mostly corn) and other inputs and will necessitate an expansion of industry capacity.

The economic impact of expanding ethanol use results from the spending on goods and services to produce ethanol and build the new capacity required to support a larger industry. This study estimates the impact for the U.S. economy and consumers of expanding E15 use to the nation's entire motor gasoline supply.

The combination of producing an additional 6.2 billion gallons of ethanol and building the 3.3 billion gallons of new capacity will:

- Generate an additional \$17.8 billion of value-added output (GDP) to the U.S. economy
- Support more than 182,600 jobs in all sectors of the economy with agriculture and construction leading the contribution.

- Put an additional \$10.5 billion of income into the pockets of American households and save each household nearly \$100 in lower gasoline prices at the pump.
- Generate an additional \$1.8 billion in tax revenue for the Federal Treasury and \$1.6 billion for State and local governments.

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### **Introduction**

One of the most significant challenges and opportunities for the ethanol industry lies in expanding demand by increasing use of higher blend levels. Most of the motor gasoline used in the U.S. contains 10 percent ethanol (E10). In 2011 the U.S. EPA approved E15 for use in model year 2001 and newer cars, light-duty trucks, medium-duty passenger vehicles (SUVs), and all flex-fuel vehicles (FFVs). In May 2019 the EPA issued a final rule that allows the year-round sale of E15. Reflecting this the number of retail stations selling E15 increased 18 percent in 2020 to nearly 2,200 nationwide.

ABF Economics was asked by Growth Energy to examine the economic implications of expanding E15 use on a nationwide basis. The objective of this study is to estimate the impact for the U.S. economy and consumers of expanding E15 use to the nation's entire motor gasoline supply.

### **Methodology**

#### Gasoline and E15 Use

Increasing the blend level of ethanol from E10 to E15 will increase ethanol use. This will require an increase in production that will be reflected in higher demand for feedstocks (mostly corn) and other inputs and will necessitate an expansion of industry capacity. The economic impact of expanding ethanol use results from the spending on goods and services to produce ethanol and build the new capacity required to support a larger industry. The first step in this process is to estimate the amount of E15 that would be needed to supply the nation's motor gasoline supply.

The Energy Information Administration (EIA) reported in 2005 that more than 95 percent of the nation's motor fuel supply contained at least 10 percent ethanol (E10). EIA does not track the use of E15 or other higher blends of ethanol and currently only two states – Iowa and Minnesota and Iowa report sales of E15 and other higher ethanol blends. A close examination of EIA data for motor gasoline and ethanol use suggests that ethanol is present in about 97 percent of U.S. gasoline.

We estimated the amount of E15 that would be required to replace E10 in the nation's motor gasoline supply by using data for the domestic use of finished motor gasoline and ethanol imputed from production, ending stocks, imports and exports published by EIA. Simply, domestic use is imputed when exports plus ending stocks are subtracted from total supply (beginning stocks plus production and imports).

Since ethanol is an additive to motor gasoline the demand for fuel ethanol is determined by the quantity of gasoline used and the ethanol blend level. The baseline for our analysis was a five-year average of domestic finished motor gasoline and ethanol demand. Our analysis also uses five-year averages for prices of industry inputs (corn, natural gas and electricity) and outputs (ethanol, DDGS and Distiller's corn oil).

EIA data indicate that American consumers used an average of 139.3 billion gallons of finished motor gasoline over the past five years. Over this same period total domestic fuel ethanol use averaged 14.1 billion gallons.<sup>1</sup> On the assumption that 97 percent of the nation's fuel supply currently contains 10 percent ethanol, E10 demand is estimated at 13.5 billion gallons (139.3 billion gallons times 97 percent (0.97) and then by 10 percent (0.1). As pointed out above while E15 currently is available in more than 2,000 stations in 31 states, EIA does not track sales. We estimate the amount of E15 (and other higher ethanol blends) by subtracting estimated E10 demand from total domestic ethanol use. This amounts to 578 million gallons

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<sup>1</sup> Imputed domestic use of finished motor gasoline and ethanol was calculated by constructing a supply and demand balance for each using production, imports, exports, and ending stock data taken from online EIA databases. In any year beginning stocks are the previous year ending stocks. Total supply is beginning stocks plus production and imports. Domestic demand is imputed by subtracting exports and ending stocks from total supply.

(14,089 million gallons less 13,511 million gallons of E10). Making E15 the standard ethanol blend in the nation’s motor gasoline supply would require nearly 20.3 billion gallons of ethanol, 6.2 billion more than is currently being used. EIA reports that ethanol capacity reached 16.9 billion gallons on January 1, 2020. Meeting the 20.3 billion gallons of ethanol demand represented by nationwide E15 would necessitate adding 3.3 billion gallons of new production capacity and would boost corn demand by an additional 2.1 billion bushels. The amount of E15 needed to meet nationwide demand, new capacity, and corn requirements are detailed in Table 1.

Table 1  
 Calculation of E15 Nationwide Demand

	Ave 2016-20 (Mil Gal)
Imputed Gasoline Use	139,289
Imputed Domestic Ethanol Use	14,089
E10	13,511
Current E15	578
E15 Needed to Replace E10	20,267
Addl Ethanol to produce E15	6,178
Current (Jan 1, 2000) Ethanol Capacity <sup>2</sup>	16,924
New Capacity Required	3,343

### **Economic Impact**

The use of E15 nationwide will increase demand for and production of ethanol. To evaluate this, we calculated the economic impact of the producing the additional ethanol required to meet an E15 standard and compared that to a baseline that represents a realistic view of the current situation where virtually all motor gasoline used in the U.S. contains at least 10 percent ethanol (E10). As our base for comparison, we chose to use a five-year average (20116-2020) of

<sup>2</sup> [https://www.ers.usda.gov/data-products/us-bioenergy-statistics/Table 11-- Fuel ethanol production facilities capacity and utilization rates, by State, January 2020](https://www.ers.usda.gov/data-products/us-bioenergy-statistics/Table-11--Fuel-ethanol-production-facilities-capacity-and-utilization-rates,-by-State,-January-2020)

ethanol production, use and prices rather than an individual year to avoid selecting an unusually “good” or “bad” year. The best example of this is 2020 when the economywide shutdowns prompted by the COVID-19 pandemic sharply curtailed driving. EIA data indicates that motor gasoline and ethanol demand fell 13.1 percent in 2020 to the lowest level in two decades.

The impact of the ethanol industry on the American economy was estimated by applying expenditures by supplying industries to the industry-level final demand multipliers for value added output, earnings, and employment.

To understand how the economy is affected by changes to output in an industry such as ethanol, it is necessary to understand how different sectors or industries in the economy are linked. For example, ethanol producers buy corn grown by farmers who in turn, buy inputs such as fertilizer and crop protection products whose producers purchase inputs and services from a range of other industries. Similarly, the construction sector purchases materials and equipment from suppliers who, in turn, purchase intermediate materials needed to produce the inputs. Finally, all sectors employ workers (labor) that are supplied by households who in turn spend wages and salaries throughout the economy. Industry earnings for ethanol producers are treated as an addition to the household sector since corporate income is paid to owners and shareholders of operating ethanol plants.

This analysis used the IMPLAN (Impact Analysis for Planning) multiplier database to develop a model of the national economy. This model describes the industry sectors that support and supply the ethanol industry. IMPLAN is a commonly used economic input-output (I-O) model. These models are constructed based on the concept that all industries in an economy are linked together; and the output of one industry becomes the input of another industry until all final goods and services are produced.

Multipliers typically measure three types of impacts: direct, indirect, and induced:

- Direct effects are the known changes in the economy from an activity such as ethanol production.
- Indirect effects are the business-to-business transactions required to produce direct effects (i.e., increased output from businesses providing intermediate inputs to ethanol producers such as feedstocks).
- Induced effects are derived from spending on goods and services by people working to satisfy direct and indirect effects (i.e., increased household spending resulting from higher income).

Economic impact models provide three economic measures that describe the economy: value added, income, and employment.

- Value added is the total value of the goods and services produced by businesses in the country and is generally referred to as GDP.
- Labor income reflects employee compensation (payroll and benefits). An important component of this is the income that is generated by increased demand for corn and other feedstocks used to produce ethanol. This supports farm income through higher crop receipts than would be the case without ethanol production.
- Employment represents the annual average number of employees, whether full or part-time, of businesses producing output and is expressed in full-time equivalent jobs.

It is important to note that the economic impacts of increased ethanol production and use are total estimates viewed at a point in time. That is, this includes the impacts of investing in 3.3 billion gallons of new capacity to produce the additional 6.2 billion gallons of ethanol needed to supply the nation's entire motor gasoline supply with E15. In reality the actual impacts will be spread over the number of years it will take to ramp up capacity and production. For example, it took seven years (2014 to 2020) for the industry to add 3.2



billion gallons of capacity. It is also important to note while the impacts from increased ethanol production are permanent and will continue to contribute with ongoing production, the construction impacts are temporary and will expire when new biorefineries and completed and become active.

**Baseline: 2016-2020**

Over the five-year 2016 to 2020 period the ethanol industry operated 196 biorefineries that spent an annual average of \$24.5 billion on feedstocks and other inputs to produce an annual average of 15.4 billion gallons of ethanol. This level of activity provided the economic baseline against which implementing a nationwide 15 percent ethanol (E15) standard will be measured. The average annual economic contribution to national economic activity of producing 15.4 billion gallons is summarized in Table 2.

Table 2  
Economic Impacts of Baseline E10 Ethanol Production (2016-2020)

	<b>GDP (Mil 2020\$)</b>	<b>Employment FTEs</b>	<b>Income (Mil 2020\$)</b>
<b>Ethanol Production</b>	<b>\$11,587</b>	<b>86,979</b>	<b>\$6,203</b>
Direct	\$3,711	9,797	\$1,617
Indirect	\$4,129	28,670	\$2,140
Induced	\$3,747	48,511	\$2,445
<b>Construction</b>	<b>\$880</b>	<b>9,298</b>	<b>\$586</b>
Direct	\$326	4,067	\$264
Indirect	\$224	1,844	\$135
Induced	\$330	3,387	\$187
<b>Agriculture</b>	<b>\$21,262</b>	<b>242,046</b>	<b>\$11,398</b>
Direct	\$3,670	58,866	\$1,766
Indirect	\$11,107	111,404	\$5,972
Induced	\$6,486	71,775	\$3,659
<b>R&amp;D</b>	<b>\$1,506</b>	<b>12,778</b>	<b>\$966</b>
<b>Exports (Total)</b>	<b>\$5,898</b>	<b>15,150</b>	<b>\$3,126</b>
<b>Total Ethanol</b>	<b>\$41,133</b>	<b>366,251</b>	<b>\$22,279</b>
Direct	\$8,266	76,161	\$4,040
Indirect	\$21,759	160,837	\$11,639
Induced	\$11,108	129,252	\$6,600

## E15 Analysis

The ethanol industry will spend nearly \$32.2 billion on feedstocks and other inputs and \$5.8 billion of additional capital expenditures to produce 20.3 billion gallons of ethanol represented by nationwide E15 use. This is nearly 6.2 billion gallons more than was produced on average over the past five years. As these dollars circulate through the economy, they generate value added output (GDP), income, and support employment in all sectors of the economy. The impacts of nationwide E15 use are summarized in Table 3. These represent the effects on major supplying industries and the entire national economy of producing the ethanol that would be required if E15 replaced E10 in the nations motor gasoline supply. The impact on GDP, employment, and income over and above current levels of ethanol use are simply the difference between Tables 2 and 3.

Table 3  
Economic Impact of Nationwide E15 Use

	<b>GDP (Mil 2020\$)</b>	<b>Employment FTEs</b>	<b>Income (Mil 2020\$)</b>
<b>Ethanol Production</b>	<b>\$15,220</b>	<b>114,250</b>	<b>\$8,148</b>
Direct	\$4,874	12,869	\$2,124
Indirect	\$5,424	37,659	\$2,811
Induced	\$4,922	63,721	\$3,212
<b>Construction</b>	<b>\$8,404</b>	<b>88,796</b>	<b>\$5,598</b>
Direct	\$3,113	38,841	\$2,525
Indirect	\$2,138	17,607	\$1,287
Induced	\$3,153	32,348	\$1,786
<b>Agriculture</b>	<b>\$27,929</b>	<b>317,937</b>	<b>\$14,972</b>
Direct	\$4,820	77,323	\$2,320
Indirect	\$14,589	146,334	\$7,844
Induced	\$8,520	94,280	\$4,807
<b>R&amp;D</b>	<b>\$1,506</b>	<b>12,778</b>	<b>\$966</b>
<b>Exports (Total)</b>	<b>\$5,898</b>	<b>15,150</b>	<b>\$3,126</b>
<b>Total Ethanol</b>	<b>\$58,956</b>	<b>548,911</b>	<b>\$32,809</b>
Direct	\$13,367	132,464	\$7,362
Indirect	\$28,450	220,519	\$15,334
Induced	\$17,139	195,928	\$10,113

## **Value-Added**

The full impact of the spending for ethanol and co-product output, production of agricultural feedstocks, and construction of new capacity is projected to contribute an additional \$17.8 billion to GDP over what the ethanol industry has provided over the past five years under an E10 standard. The economic activity of moving to an E15 standard will account for a total of nearly \$59 billion of GDP. Implementing an E15 standard will increase the size of the economy by \$17.8 billion compared to the E10 baseline. The direct effect of ethanol production accounts for about a quarter of the GDP generated from E15. The largest contributor to the additional GDP will be the agriculture sector. The importance of agriculture reflects the fact that corn and other feedstocks account for more than 70 percent of the direct costs of producing ethanol. Most of this contribution will come from indirect and induced impacts as the dollars spent to produce ethanol circulate throughout the entire economy.

## **Employment**

Jobs are created from the economic activity supported by ethanol output, additional agricultural output for feedstock production and construction activity for new capacity. Ethanol production is not a labor-intensive industry (accounting for fewer than 13,000 full time equivalent direct jobs nation-wide)<sup>3</sup>. However, the economic activity of supporting industries supports a substantially larger number of jobs in all other sectors of the national economy.

Over the five-year E10 baseline period the full impact of ethanol industry supported more than 366,000 jobs in all sectors of the economy. Moving to an E15 standard would support nearly 182,700 additional jobs. These represent not just the direct jobs associated with ethanol production but also the indirect and induced jobs supported by the economic activity created by additional ethanol demand and production.

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<sup>3</sup> The Census Bureau does not report employment in ethanol production. This analysis conservatively assumes the average ethanol plant employs approximately 50 full-time equivalent employees.

## **Income**

Economic activity and associated jobs produce income for American households. Moreover, the profitable operation of ethanol production will generate corporate income that will be paid to shareholders of public companies and owners of locally owned ethanol plants. The economic activities associated with E15 will put \$10.5 billion of additional income into the pockets of American households and an estimated \$1 billion in corporate income. As is the case with employment, the direct impact on income provided by the ethanol industry is largely concentrated in agriculture, manufacturing, and services.

The impact of increased ethanol production will be compounded by the benefits consumers will experience from lower prices at the pump. Blending ethanol into motor gasoline lowers retail gasoline prices. Recent reporting of average pump prices of gasoline with no ethanol, E10 and E15 suggests that E15 enjoys a 9 cents per gallon discount relative to E10. EIA statistics indicate that the average U.S. household spends nearly \$2,800 on gasoline annually. Adopting an E15 standard nationwide will save consumers \$12.2 billion annually or nearly \$96 per household.

## **Economic Impact by Sector**

- Ethanol Biorefining (Manufacturing)

Ethanol plants are essentially biorefineries that are a component of the manufacturing sector. Ethanol manufacturing is projected to contribute about a quarter of the increase in GDP, or \$11.6 billion more than the E10 baseline. Two-thirds of this impact will come from induced and indirect activities. That is, the impact of larger demand for supplying industries and the spending of employees and their families for the full range of goods and services provided by the economy will have a greater impact on the economy than manufacturing alone.

Ethanol production is not a labor-intensive industry. The average ethanol biorefinery employs an average of 50 full-time employees. The direct employment impact of producing the additional ethanol needed to supply the nation with E15 is fewer than 13,000 jobs, about 3,000 more than the E10 baseline. The induced and indirect impacts are significantly larger so that E15 production is expected to support an additional 24,200 jobs for a total impact of 114,250 jobs in all sectors of the economy.

- Agriculture

Agriculture will provide the most significant source of economic impact from implementing an E15 standard. This reflects the importance of ethanol demand to total corn utilization. Feedstocks, notably corn, account for more than three-quarters of operating costs of producing ethanol. Over the past five years ethanol has accounted for about 37 percent of total corn utilization. The increase in ethanol demand will increase corn prices which, in turn, can be expected to provide a significant incentive for farmers to increase area planted to corn. The aggregate value of crop production, and crop receipts to farm income. The \$27.9 billion of GDP generated by producing an additional 2.8 billion bushels of corn will account for nearly half the impact of E15 on GDP.

Agriculture is projected to support nearly 318,000 jobs in the entire economy under nationwide E15 use, nearly 76,000 jobs more than the E10 Baseline. The direct employment in production agriculture resulting from economy wide E15 is about 77,000. Most agriculture jobs supported by the ethanol industry are those in support activities related to crop production, ranging from farm advisors, producers and distributors of crop protection products, fertilizer, and farm equipment, and other service providers. The jobs supported by income generated and spent by employees supports a significant number of jobs in seemingly unrelated sectors such as retailers and service sectors. In general, as the impact of the direct spending by the ethanol

industry expands throughout the economy, the employment impact expands significantly and is spread over many sectors.

- Construction

The third major impact of expanded E15 use will be provided by the spending associated with adding 3.2 billion gallons of new ethanol production capacity. At an estimates cost of \$1.75 per gallon of new conventional ethanol capacity this amounts to about \$5.8 billion in spending for plant and equipment.<sup>4</sup> Some of this will come from expanding current capacity and increasing utilization. However, a significant share is expected to come from new plant and equipment. Construction is a more labor-intensive industry than ethanol manufacturing and the new capacity needed to produce the additional ethanol for E15 is expected to support more than 28,700 direct jobs in construction related industries and nearly 37,000 additional jobs in other sectors of the economy. The relatively large marginal impact of E15 on construction is explained by the substantial increase in capacity that will be needed to produce ethanol for E15.

As pointed out earlier this is likely to take time so the impact will be spread out over several years. The economic impact from construction is not permanent and will last until the capacity comes online. The full impact of the estimated \$5.8 billion in capital expenditures to build 3.2 billion gallons of new industry capacity will generate an additional \$7.5 billion of GDP, support nearly 89,000 jobs and \$5.6 billion in household income.

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<sup>4</sup> We are assuming conventional starch-based ethanol capacity. The expenditure for cellulosic and other new technologies is considerably higher.

- Exports and R&D

Exports of ethanol and the principal co-product Distillers dried grains with solubles (DDGS) have grown in importance over the past decade and are providing a noticeable economic contribution. We have assumed no change in the volume or value of exports, or the expenditures associated with Research and Development. R&D activities have largely been directed at the development of new production technologies and feedstocks. It is likely that additional demand for ethanol will at a minimum maintain R&D spending at E10 Baseline levels. Exports, particularly of DDGS, are likely to grow as supplies increase with additional ethanol production.

- Tax revenue

The combination of GDP, household, and corporate income supported by E15 will contribute an additional \$1.8 billion in Federal tax revenue and \$1.6 billion more for State and local governments relative to the E10 Baseline. Combined, E15 will increase revenue to Federal and State coffers by more than \$11 billion.

## **Conclusion**

Nationwide use of E15 will expand ethanol production and require a substantial increase in new production capacity relative to current E10 use. This expansion also will stimulate demand for agricultural feedstocks that will directly benefit farm income. The economic benefits from nationwide E15 use are significant increases in GDP, jobs supported in all sectors of the economy, household income and tax revenue.