



# Union Jobs in Ethanol & Biodiesel Industries: An American Success Story

## **Study and Analysis**

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## Executive Summary

**A**MERICA'S ETHANOL AND BIODIESEL<sup>1</sup> industries are **growing union jobs** and helping rebuild America's middle class. The percentage of American workers who are union members in the ethanol and biodiesel industries continues to grow. This is good for America. Numerous studies show that union membership in the U.S. results in higher wages and greater equality.<sup>2</sup>

Using U.S. Department of Labor's Bureau of Labor Statistics (BLS) data on union membership,<sup>3</sup> and building on a 2014 report on employment in the ethanol and biodiesel industries prepared by Guerrilla Economics for Fuels America, we estimate that there are **over 30,000 union members** working directly for and in supplier industries to the ethanol and biodiesel sectors. Perhaps most striking is that **union gains are found in farm country and among agricultural workers, both areas where union membership has historically lagged.** The ethanol and biodiesel industries are growing union jobs and helping rebuild America's middle class.

The ethanol and biodiesel industry's positive impact on union density runs counter to national trends. The percentage of American workers who are union members has declined steadily since its peak at

This report finds that America's ethanol and biodiesel industries are creating union jobs for middle-skill American workers both directly and indirectly, and thereby helping to re-build the American middle class.

around 30 percent in 1954. In 2020, according to the BLS, only 10.8 percent of American wage and salary employees were union members, including only 6.3 percent of private-sector employees. This decline in "union density" has paralleled two other important economic trends that are damaging to American workers: a decline in the percentage of middle-wage, middle-skills jobs in America, and decades-long stagnation in real wages. The perilous result for our country has been a **shrinking middle class.**

Our findings are consistent with analyses performed by the Energy Futures Initiative (EFI) in its U.S. Energy and Employment Report for 2019<sup>4</sup> and the U.S. Department

<sup>1</sup> Ethanol is renewable fuel from grains such as corn, sorghum, and barley. Biodiesel is renewable fuel primarily from soybean oil, but also waste grease, *available at* <https://afdc.energy.gov/fuels/biodiesel.html>

<sup>2</sup> Tom Van Heuvelen and David Brady, "Labor Unions and American Poverty," *ILR Review* (2021): 00197939211014855, citing Kalleberg, Wallace, and Althaus 1981; Freeman and Medoff 1984; Card 1996;

Rosenfeld and Kleykamp 2012; Rosenfeld 2014; Rosenfeld, Denice, and Laird 2016; Kristal and Cohen 2017.

<sup>3</sup> U.S. Bureau of Labor Statistics, Union Members 2020 (Jan. 22, 2021) available at <https://www.bls.gov/news.release/union2.nr0.html>

<sup>4</sup> Energy Futures Initiative and National Association of State Energy Officials, U.S. Energy and Employment Report (Mar 2020), *available at* <https://www.usenergyjobs.org/s/USEER-2020-0615.pdf>.

of Energy in its U.S. Energy and Employment Report for 2017.<sup>5</sup>

The Energy Futures Initiative found a **union density rate of 7 percent in the ethanol and biodiesel industries in 2019, above the estimated national workforce average of 6 percent.** From the first iteration of the EFI reports, the percentage of union members in the ethanol and biodiesel industries has consistently been higher than the national average.

Higher union density rates in the ethanol and biodiesel industries contrasts favorably with conventional agriculture, where most agricultural workers do not have rights to organize and bargain collectively protected by federal or state law. Also, self-employment is significantly more common in agriculture, which makes union organizing less likely. As a result, conventional agriculture is an industry with a union density rate well below the national average.

The innovation in this report is that we have analyzed union membership rates at the industry level rather than the national level. Outside of the agriculture sector, which creates some complications when analyzing union density, we estimate that **union members in the ethanol and biodiesel industries are concentrated in manufacturing, transportation and utilities, construction, and professional and business services.** Together, these four sectors employ two-thirds of all union members working in the ethanol and biodiesel industries.

This is an important supplemental finding because **manufacturing, transportation, and construction jobs, and some business services jobs, are middle-wage, middle-skill jobs that can help employees and their families sustain middle-class lifestyles.** Unions are important contributors to those good outcomes.

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<sup>5</sup> U.S. Department of Energy, U.S. Energy and Employment Report (Jan. 2017), *available at*

<https://www.energy.gov/downloads/2017-us-energy-and-employment-report>.

## About the Authors



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He now provides analysis and research as an author and contributor to reports and studies on the labor market. His most recent report, *America's Workforce and the Self-Driving Future*, with co-authors Erica Groshen et al., analyzed the possible labor market implications of autonomous vehicles.

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## Why Union Membership Matters

**U**NIONS HAVE LONG PLAYED an important role in ensuring that workers secure a fair share of U.S. economic prosperity. At the turn of the 19th Century, union density reached its peak in the U.S. Union density is defined as the percentage of American works who were union members, and at that time nearly 1/3 of American workers were union members. Unemployment was low and real wages were rising for workers at every income level.<sup>6</sup> **America's economy has consistently been fueled in part by union members with middle-class incomes who buy goods and services produced by American workers in a virtuous cycle.** But the virtuous cycle has faded with the decline in union density.

Beginning in the late 1970s and accelerating in the decades to follow, the bargaining power of labor declined, with private-sector union membership now at 6.3 percent. Around the same time, wages and compensation stalled for most workers. **Adjusted for inflation, the average hourly wage of workers is now roughly the same as it was in 1978.**<sup>7</sup>

<sup>6</sup> World Inequality Database, available at <https://wid.world/country/usa/>

<sup>7</sup> Drew Desilver, "For most U.S. workers, real wages have barely budged in decades," Pew Research Center (Aug. 7, 2018), available at <http://www.pewresearch.org/fact-tank/2018/08/07/for-most-us-workers-real-wages-have-barely-budged-for-decades/>

<sup>8</sup> Colin Gordon, "Union decline and rising inequality in two charts," Economic Policy Institute (June 5, 2012), available at <https://www.epi.org/blog/union-decline-rising-inequality-charts/>

This study finds that the ethanol and biodiesel industries are growing union jobs and helping rebuild America's middle class.

As a result of slow wage growth among middle-income jobs, the U.S. is currently experiencing record levels of inequality with wealth concentration among top income earners not seen since the 1920s. According to researchers at the Economic Policy Institute (EPI), the decline in union representation directly accounts for a third of the increase in income inequality.<sup>8</sup>

The benefits of unions have long been studied and understood. **There is extensive literature linking union membership to higher wages and greater equality.**<sup>9</sup> Unions also increase the likelihood that workers will receive various forms of non-cash benefits, like health insurance and retirement plans, and reduce wage disparity.<sup>10</sup> Unionized workers are significantly more satisfied with their jobs than their nonunionized counterparts in the

<sup>9</sup> Tom VanHeuvelen, David Brady, "Labor Unions and American Poverty." ILR Review (2021), citing Kalleberg, Wallace, and Althaus 1981; Freeman and Medoff 1984; Card 1996; Rosenfeld and Kleykamp 2012; Rosenfeld 2014; Rosenfeld, Denice, and Laird 2016; Kristal and Cohen 2017.

<sup>10</sup> See e.g., Unions Help Reduce Disparities and Strengthen our Democracy, Economic Policy Institute (Apr. 23, 2021), available at <https://www.epi.org/publication/unions-help-reduce-disparities-and-strengthen-our-democracy/>

post-Great Recession period.<sup>11</sup> Unions also protect their members, and others working alongside their members, against dismissals and discipline without good cause, and ensure workers will have a voice in their workplaces, with a result that union members tend to have longer job tenures than non-union workers.<sup>12</sup>

All these benefits that flow from unions in American workplaces help to define what it is to be a member of the middle class in our country. For this reason, supporters of the American union movement, and those committed to restoring the American middle class, should welcome the growth of industries that employ a sizable number of unionized workers, particularly in industries that have declined over the last few decades. **This study's results indicate that the ethanol and biodiesel industries are growing union jobs and helping rebuild America's middle class.**

## By the Numbers

We find that of the 313,371 employees directly employed in ethanol production, an estimated **8,776 are union members**. Additionally, supplier industries to ethanol production employ 355,206 employees, **18,686 of which are union members**.

In the biodiesel sector, of the 16,802 employees directly employed in biodiesel production, we estimate that **774 are union members**. Of the estimated 48,798 employees working in supplier industries to biodiesel production, **2,472 are union members**.

Impressively, considering both direct and induced employment, we estimate that there are **over 30,000 employees who are union members in the ethanol and biodiesel industries**.

Because of the sizable percentage of ethanol and biodiesel workers concentrated in agriculture, these high results tend to surprise readers. The union density rate in agriculture is substantially below the national private-sector average (1.7% vs. 6.2%). One reason that union density in agriculture is a fraction of the national rate is that agricultural workers are excluded from the coverage of the National Labor Relations Act (NLRA), the law defining and protecting employees' rights to union organizing and collective bargaining in the U.S. private sector and establishing an administrative agency and system to vindicate those rights. Agricultural workers can organize and bargain collectively pursuant to state law, but only ten states have laws (or judicial decisions) safeguarding those rights and establishing systems like the NLRA model.<sup>13</sup>

<sup>11</sup> Benjamin Artz, David G. Blanchflower, and Alex Bryson, "Unions Increase Job Satisfaction in the United States," No. w28717. National Bureau of Economic Research, 2021.

<sup>12</sup> Katharine G. Abraham and James L. Medoff, "Length of Service and Layoffs in Union and Nonunion Work Groups," *ILR Review*, Vol. 38, No. 1 (Oct. 1984), pp. 87-97 <https://www.jstor.org/stable/2523802>

<sup>13</sup> Arizona - (Arizona General Laws §§ 23-1381 to 1395); California - (California Code §§ 1152 through 1155); Idaho - (Idaho Code §§ 22-4101 to 22-4113); Kansas - (Kansas General Statutes §§ 44-818 to 44-831); Louisiana - (Louisiana Code §§ 23:881 to 23:889); Maine - (Maine

General Statutes §§ 1321 to 1334); Massachusetts - (Mass. General Laws, Chapter 150A § 5A); Nebraska - (Nebraska revised Statutes §§ 48-901 to 48-911); Oregon - (§§ 662.805 to 662.825, enacted in 1963); and Wisconsin - (Wisconsin Code §§ 111.01(2)(6)(c) and 111.115(3)). In New Jersey, a 1947 amendment to the New Jersey Constitution (article 1, paragraph 19) states "persons in private employment shall have the right to organize and bargain collectively." In a 1989 decision, the state supreme court held that this provision applies to agricultural workers, see *Comite Organizador de Trabajadores Agricolas v. Molinelli*, 552 A.2d 1003 (NJ 1989).

A second potentially important factor affecting the union density rate among agricultural workers is that self-employment is four times more prevalent in agriculture than it is in other industries.<sup>14</sup> Union organizing requires that a workplace have employees, so we would not expect to find union members where we also find self-employment. As such, **many of the union jobs in the ethanol and biodiesel industries are in areas like manufacturing, construction, and transportation that have substantially higher-than-average union density rates.**

For example, the four newest ethanol plants built in California, which are owned by three different companies and collectively constitute more than **\$500 million in investment**, were all built pursuant to “project labor agreements” between the companies and the building trades unions that represent construction workers. Project labor agreements, or PLAs, are pre-hire collective bargaining agreements that govern the terms and conditions of employment for all craft workers on a construction project. PLAs protect companies from added construction costs by eliminating costly delays that might result from labor conflicts or shortages of skilled workers. In addition to PLAs, **all outside maintenance and new construction projects for these California ethanol plants are committed to union shops.**

In another example, World Energy plans to convert and modernize a former petroleum refinery in Paramount, California, into a 100 percent renewable energy operation. An

estimated **1,000 local union construction jobs** will be created, through a collaboration between World Energy and the State Building and Construction Trades Council, for a facility producing low-carbon intensity biofuel for motor vehicles, trucks, heavy-duty equipment, and aviation.

Unionized workers can also be found operating ethanol plants. For example, as of 2019, Pacific Ethanol’s<sup>15</sup> Illinois ethanol plants provide **187 jobs, or one-third of all plant employees, to members of the United Steelworkers of America with payroll and benefits of over \$17 million per year.** In another example, Local 103G of the Bakery, Confectionery, Tobacco Workers and Grain Millers International Union represented **600 employees** at a 1,000-acre manufacturing complex in Illinois that processes corn into ethanol and other products. **Unionized workers can be found working for companies that produce ethanol in nearly 20 states, including Alabama, Iowa, Indiana, Kansas, Louisiana, Michigan, Minnesota, Missouri, Nebraska, Ohio, Oklahoma, Tennessee, Texas, and Wisconsin.**

Unionized workers also play a sizable role in the transportation of ethanol and biodiesel. Thirteen unions, some affiliated with larger international unions, represent more than 140,000 employees working for America’s freight rail companies. The freight rail industry is one of the country’s most heavily unionized industry sub-sectors. Looking at ethanol alone, it cannot be shipped through pipelines because of its alcohol content, so other transportation

<sup>14</sup> See, e.g., “National Trends in Self-Employment and Job Creation,” Pew Research Center (Oct. 22, 2015), available at <http://www.pewsocialtrends.org/2015/10/22/national-trends-in-self-employment-and-job-creation/>

<sup>15</sup> Pacific Ethanol, Inc. recently changed its corporate name to Alto Ingredients, Inc., see <https://ir.pacificethanol.com/press-releases/detail/559/pacific-ethanol-completes-name-change-to-alto-ingredients>.



modes must be used. **Rail union members help to ship roughly 70% of all ethanol in the United States.** According to the Renewable Fuels Association, since 2010, annual ethanol rail carload originations have held steady at 320,000 to 340,000 per year.<sup>16</sup> This means that approximately **11 billion gallons of ethanol are shipped by rail each year** with the help of workers who are represented by unions.<sup>17</sup>

## Data Sources

**JOBS ESTIMATES:** Union density in the ethanol and biodiesel industries was extrapolated from a report by Guerrilla Economics for Fuels America in 2014. That report estimated that the biofuels industry had created 313,371 jobs that were directly involved in ethanol production. The biofuel industry created another 355,206 jobs among suppliers, according to the Fuels America report. We have updated these estimates by applying industry growth estimates from the annual U.S. Energy and Employment Report (USEER). The “biofuel industry” is defined for statistical analysis to include components of related industries including agriculture, manufacturing, refining, and transportation. In the biodiesel industry, our analysis is based on an economic impact analysis report produced by LMC International for National Biodiesel Board in 2019. Both economic impact reports captured employment in the supply-chain components of ethanol and biodiesel and biodiesel production using an input-output (I-O) model that linked multiple data sources, including both private-sector lists

of manufacturing and refining sites and government data on industry employment and economic output. The reports highlighted three types of economic activity: direct, which is economic activity in ethanol and biodiesel production itself; supplier, which is economic activity at firms that provide goods or services used in ethanol and biodiesel production; and induced, which is the economic output across the broader economy from re-spending by employees of industry and supplier firms. Our analysis focused only on direct and supplier economic activity.

**UNION DENSITY:** Most national union density estimates are based on an annual BLS report. The “union members” report includes data that are broken down by major industry sectors, including both public sector and private sector. State-by-state union density measurements are also available, but these do not include breakouts by industry or public/private sector because the samples would be too small. Because we were able to look at industry sectors by states, we made an important adjustment to our analysis involving agricultural workers that is explained in greater detail in the methodology section below.

**OTHER REPORTS:** Until 2018, the Department of Energy produced an annual report on energy and jobs in the United States. That report, the U.S. Energy and Employment Report (USEER), is now produced by the Energy Futures Initiative (EFI), a nonprofit think tank based in Washington, D.C. We relied on the 250-

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<sup>16</sup> Renewable Fuels Association, Best Practices for Rail Transportation of Fuel Ethanol, found at <https://ethanolrfa.org/wp-content/uploads/2017/10/RFA-Best-Practices-for-Rail-Transport-of-Fuel-Ethanol-2017.pdf>

<sup>17</sup> U.S. Energy Information Association, Energy-by-rail Methodology, found at <https://www.eia.gov/petroleum/transportation/methodology.pdf>

page comprehensive 2020 USEER,<sup>18</sup> which reported demographics from 2019, Q4 and showed union membership rates of 7 percent in ethanol, 4 percent in “ethanol and non-woody biomass fuels (including biodiesel),” and 8 percent in “woody biomass fuel for energy and cellulosic biofuels.” The combined raw number of union employees in their data is 6,002. They also noted that 44.2 percent of employment identified as ethanol was in agriculture, which traditionally has a significantly lower-than-average union membership rate. Related, most employees in the non-woody biomass fuel, including biodiesel category were in “professional and business services,” totaling 47.3 percent, also a category that has lower-than-average union membership rate. Despite this, the union membership in the ethanol and biomass sectors as outlined by the EFI still rated higher than the national average of union membership.

## Methodology

ESTIMATES OF TOTAL direct and supplier employment by industry were produced by Guerrilla Economics using the IMPLAN Input-Output model in 2014. Direct employment includes all direct employment in the production or sale of ethanol and biodiesel. It is concentrated in agriculture, manufacturing, and retail sales. Supplier employment includes all indirect employment in supplier industries, and includes professional and business services, financial activities, transportation, and construction, among other industries.

Estimates of union density by industry were produced by the Bureau of Labor Statistics, Current Population Survey, Union Members Supplementary Survey. These were supplemented with Energy Department/EFI Report data, which found a higher overall union density among corn ethanol biofuel production than the national average. However, in consultation with EFI economists, we used only limited data from this survey because the small sample size would result in very large confidence intervals if broken out by industry.

We used the EFI overall estimate of union density to estimate an upper bound to direct employment union density, using the following formulas:

### Formula 1

$$\begin{aligned}
 & [\text{DOE Total Union Rate}] \times [\text{EFI Total Emp}] = \\
 & \quad [\text{DOE Total Union Emp}] \\
 & [\text{BLS Industry Union Rate}] \times [\text{EFI Industry Emp}] \\
 & = [\text{unadjusted Union Emp}] \text{ Sum } [\text{unadjusted} \\
 & \quad \text{Union Emp}] / [\text{EFI Total Emp}] = [\text{unadjusted} \\
 & \quad \text{Total Union Rate}] [\text{unadjusted Total Union} \\
 & \quad \text{Rate}] / [\text{EFI Total Union Rate}] = [\text{adjustment} \\
 & \quad \text{factor}] [\text{unadjusted Union Emp}] \times [\text{adjustment} \\
 & \quad \text{factor}] = \\
 & \quad [\text{adjusted Union Emp}]
 \end{aligned}$$

For the direct employment union members results published in Table 1, the estimates are the midpoint between the lower bound (estimated using solely BLS union density) and the upper bound (estimated using the adjustment factor above). In Table 3, we used LMC’s most conservative estimate of

<sup>18</sup> 2020 U.S. Energy and Employment Report (USEER), produced by the Energy Futures Initiative (EFI), available at <https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd>

928c61/t/5ee78423c6fcc20e01b83896/1592230956175/USEER+2020+0615.pdf

domestic biodiesel production as the baseline for biodiesel industry employment and union density. **This approach likely undercounts union membership in this rapidly growing sector.** For the supplier employment union members, the estimates use the BLS union densities, and the following formula:

### Formula 2

$$\begin{aligned} & [\text{BLS Industry Union Rate}] \times [\text{FA Industry} \\ & \quad \text{supplier Emp}] = \\ & [\text{FA industry supplier Union Membership}] \end{aligned}$$

Because agricultural workers are expressly excluded from the coverage of the NLRA, and only ten states provide protections to workers to organize,<sup>19</sup> we modeled agricultural union density separately from non-agricultural union density. Direct agricultural employment in ethanol and biodiesel is concentrated in just a handful of states, and the top seven states, accounting for over 50 percent of direct employment in agriculture, do not provide organizing and collective bargaining protections for agricultural workers. For our estimates, we assumed states without these protections had zero union members, and we used the methodology described above only for the ten states where agricultural workers have protections to organize. **This highly conservative approach likely undercounts union members in this area.** We were not able to make a similar adjustment for the effects of self-employment on union density in agriculture because it is geographically dispersed.

Employment in non-agriculture was not similarly concentrated. We tested our results using statewide union membership rates, and we found no correlation between ethanol and biodiesel employment and statewide union membership. This is because non-agricultural employment was not concentrated in any particular state; employment included states with higher union density like California as well as states with lower union density like Iowa. BLS only publishes industry union membership nationwide, and the only published statewide estimates of union density do not provide industry detail. Using statewide estimates of union density could bias the results based on states with stronger public-sector unions, unrelated to industries involved in ethanol and biodiesel production, so it was appropriate to rely on the national rates to produce our estimates.

The estimates produced here are extrapolations based on existing surveys and model output. Any survey is subject to both response and non-response (also known as sampling) error. BLS data is based on a survey of 60,000 households sampled nationwide and is considered very reliable. Table 2 shows BLS estimates of the 90-percent confidence intervals around union membership rates by industry. It is important to note that confidence intervals are larger when the sample size is smaller, so industries with less employment have less confidence in the estimates of union membership than industries with more employment. Confidence intervals were not available from EFI data, but after consultation with economists and statisticians involved in the production of these estimates, we know that the sample size of this survey would be too small to

<sup>19</sup> See supra note 15 and accompanying text.

produce reliable data on union membership rates by industry. For our purposes in this analysis, we have used EFI data to provide an upper bound on industry union membership rates for direct employment.

Model error is more difficult to estimate. Confidence intervals are not available (and the combination of inputs to the model utilized are proprietary). However, IMPLAN is a well-regarded model, relying on inputs from BLS, Census, and BEA data to estimate industry output and employment based on industry inputs.

Overall, we are combining data from a variety of sources, so it is not possible to directly estimate the error ranges of our estimates. It is possible the establishments that work in ethanol and biodiesel production are systematically more or less likely to have union membership than other establishments in the same industry not involved in ethanol and biodiesel production. The EFI and Energy Department estimates suggest that ethanol and biodiesel establishments are more likely to employ union members than other establishments. However, while the EFI and Energy Department estimates found higher rates of union membership among employees in the ethanol and biodiesel industries compared to private-sector workers overall, their sample was not large enough to confirm that this difference is statistically significant.

## Conclusion

**OVER 30,000 UNION MEMBERS** are working directly for, and in supplier industries to, the ethanol and biodiesel industries. This is particularly compelling because so many of these jobs are in agriculture, which traditionally has lower union membership because most agricultural workers do not have legally protected rights to organize and bargain collectively, and there is a disproportionate amount of self-employment in the sector.

The U.S. biofuel industry supports union jobs in construction and manufacturing, but as importantly relies on sectors with high union densities to store and transport its products. **A key takeaway is that continued support for the ethanol and biodiesel industries will have a positive causal effect on union jobs and is a pathway to an increase in union membership.**

Ethanol and biodiesel industries are also helping to mitigate against a downward trend in U.S. union density rates. **The result of ongoing support for ethanol and biodiesel is likely to be an increase in middle-wage and middle-skill union jobs in traditionally agricultural economies.**

This too is critical to limiting job polarization and economic disparity. The percentage of total employment in middle-skill occupations dropped from 54.9 percent in 1994 to 43.1 percent in 2017.<sup>20</sup> Meanwhile, the percentage of employment in high-skill

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<sup>20</sup> Didem Tuzemen, Job Polarization and the Natural Rate of Unemployment in the United States, Kansas City Federal Reserve (Mar. 2018), available at

[https://www.kansascityfed.org/~/\\_media/files/publicat/reswkpa/p/pdf/rwp18-03.pdf](https://www.kansascityfed.org/~/_media/files/publicat/reswkpa/p/pdf/rwp18-03.pdf)

occupations rose from 30.4 percent in 1994 to 39.2 percent in 2017, and the percentage in low-skill occupations rose from 14.7 percent in 1994 to 17.7 percent in 2017.<sup>21</sup>

Restoring middle-wage, middle-skills jobs – essential to the maintenance of the American middle class – is possible. Union members occupying those jobs increases the likelihood that wages will be appropriate, benefits will be provided, and workers will have a voice in their economic future. **This report provides data to support the understanding that ethanol and biodiesel industries are contributing to union jobs, with higher benefits, skills, and wages.** In sum, what's good for ethanol and biodiesel is good for unions; and what's good for unions is good for America.

**More than 30,000 union members are working directly for, and in supplier industries to, the ethanol and biodiesel industries. In sum, what's good for ethanol and biodiesel is good for unions, and what's good for unions is good for America.**

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<sup>21</sup> Id.

## Notes

Energy and fuel-related agricultural employment was derived using three different calculations for fuelwood, corn ethanol, and biodiesel. The Bureau of Labor Statistics' QCEW cover exclusions were used to develop a factor for agricultural worker exclusions and this factor was applied to employment for the NAICS codes specific to each of the three sub-technologies. Additionally, a technology-specific percentage was derived from ERS estimates for the percentage of total wood, corn, and biodiesel produced that is used for fuel. This percentage was applied together with the exclusion factor to the 2016 Q1 QCEW employment for fuelwood NAICS (113110, 113310, 115310), corn ethanol (11115), and biodiesel (11111) to determine the number of workers that are supporting agricultural fuel production.

### Acknowledgements:

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TABLE 1

**Estimates of Total Employment and Union Membership, Directly Employed in Ethanol Production and in Supplier Industries to Ethanol Production**

	Directly Employed in Ethanol Production	Union Membership	Supplier Employment	Union Membership
Agriculture and related industries	262,830	4,994	100,336	1,906
Mining, quarrying, and oil and gas extraction			5,477	362
Construction			18,611	2,494
Manufacturing	29,090	2,705	32,043	2,980
Wholesale trade	4,134	194	13,620	640
Retail trade	17,317	883	4,895	250
Transportation and utilities			28,088	5,281
Information			4,303	443
Financial activities			57,125	1,542
Professional and business services			73,607	2,208
Education and health services			1,376	133
Leisure and hospitality			12,396	347
Other services			3,329	100
<b>TOTAL</b>	313,371	8,776	355,206	18,686

Source: Total Direct and Supplier employment produced by Guerilla Economics for Fuels America. Union Membership from authors' calculations.

TABLE 2

## Estimates of Union Membership by Industry Sector

INDUSTRY	Union Membership 2020
Private sector	6.3
Agriculture and related industries	1.7
Mining, quarrying, and oil and gas extraction	5.6
Construction	12.7
Manufacturing	8.5
Wholesale trade	4.3
Retail trade	4.6
Transportation and utilities	17.6
Information	9.3
Financial activities	1.9
Professional and business services	2.2
Education and health services	8.4
Leisure and hospitality	2.2
Other services	2.5

Source: U.S. Bureau of Labor Statistics, Current Population Survey, <https://www.bls.gov/news.release/pdf/union2.pdf>



TABLE 3

**Estimates of Total Employment and Union Membership, Directly Employed in Biodiesel Production and in Supplier Industries to Biodiesel Production**

	Directly Employed in Biodiesel Production	Union Membership	Supplier Employment	Union Membership
Seed Production*	7,584	129	17,116	291
Animal Processing and grease collection	2,745	47	9,055	154
Local seed delivery	415	7	585	10
Elevation	605	10	1,795	31
Oilseed crush	872	74	4,328	368
Feedstock delivery by barge	227	39	673	114
Feedstock delivery by rail	76	13	224	38
Biodiesel processing	3,201	272	12,799	1,088
Rail deliveries of domestic Biodiesel used domestically	328	56	972	165
Rail deliveries of glycerin	76	13	224	38
Rail deliveries of imported Biodiesel	0	0	0	0
Rail deliveries of exported Biodiesel	50	9	150	25
Trucking domestic to sale	457	78	643	109
Trucking imports to sale	125	21	175	30
Import port activities	42	7	58	10
Export port activities	0	0	0	0
<b>TOTAL</b>	<b>16,802</b>	<b>774</b>	<b>48,798</b>	<b>2,472</b>

Note: We used LMC's most conservative estimate of domestic biodiesel production as the baseline for biodiesel industry employment and union density, which **likely undercounts union membership** in this growing sector.