The 2014 Fuels America Economic Impact Study

Methodology

Prepared for

Fuels America
101 Constitution Ave, Suite 525 E
Washington, D.C. 20001

By

John Dunham & Associates, Inc.
32 Court Street, Suite 207
Brooklyn, New York 11201

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Executive Summary

The Fuels America Economic Impact Study estimates the economic contributions made by renewable fuels industry to the U.S. economy in 2014. John Dunham and Associates conducted this research, which was funded by the Fuels America coalition. This work used standard econometric models first developed by the U.S. Forest Service, and now maintained by the Minnesota IMPLAN Group. Data came from The Biotechnology Industry Organization - Industrial & Environmental Section, Abengoa Bioenergy, POET, Zeachem, DuPont, Mascoma, Biodiesel Magazine, the National Biodiesel Board, Fuels America, the Renewable Fuels Association, the US Environmental Protection Agency, and Dun and Bradstreet, Inc.

The study defines the renewable fuels industry as corn ethanol refineries, cellulosic ethanol refineries, advanced bio fuels facilities, agricultural material producers supplying the refineries, and a portion of fuel distribution, and fueling stations in the United States. The study measures the number of jobs in these sectors; the wages paid to employees, and total output.

Industries are linked to each other when one industry buys from another to produce its own products. Each industry in turn makes purchases from a different mix of other industries, and so on. Employees in all industries extend the economic impact when they spend their earnings. Thus, economic activity started by the renewable fuels industry generate output (and jobs) in hundreds of other industries, often in sectors and states far removed from the original economic activity. The impact of supplier firms, and the "Induced Impact" of the re-spending by employees of industry and supplier firms, is calculated using an input/output model of the United States. The study calculates the impact on a national basis, by state and by Congressional District.

The study also estimates taxes paid by the industry and its employees. Federal taxes include industry-specific excise and sales taxes, business and personal income taxes, FICA, and unemployment insurance. State and local tax systems vary widely. Direct retail taxes include state and local sales taxes, license fees, and applicable gross receipt taxes. The renewable fuels industry pays real estate and personal property taxes, business income taxes, and other business levies that vary in each state and municipality. All entities engaged in business activity generated by the industry pay similar taxes.

The renewable fuels industry is a dynamic part of the U.S. economy, accounting for about $184.5 billion in total economic output or roughly 0.46% percent of GDP.[1] The renewable fuels industry directly or indirectly employed approximately 852,056 Americans in 2014. These workers earned over $46.2 billion in wages and benefits, and paid $14.5 billion in federal, state and local business taxes.

Summary Results

The Fuels America Economic Impact study measures the impact of corn ethanol refineries, celluistic ethanol refineries, advanced bio fuels facilities, agricultural material producers supplying the refineries, and a portion of fuel distribution, and fueling stations on the entire economy of the United States. The industry contributes about $184.5 billion in economic output or 0.46% percent of GDP and, through its production and distribution linkages, impacts firms in 426 of the 440 sectors of the US economy.[2]

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[1] Based on GDP of $17,089.6 billion. See: *National Income and Product Accounts Gross Domestic Product, 4th quarter and Annual 2013 (third estimate)*, News Release, US Department of Commerce, Bureau of Economic Analysis, March 27, 2014.

Other firms are related to the renewable fuels industry as suppliers. These firms provide a broad range of goods and services, including equipment, personnel services, financial services, advertising services, consulting services or transportation services. Finally, a number of people are employed in government enterprises responsible for the regulation of the sector. All told, we estimate that the renewable fuels industry is responsible for 333,792 supplier jobs. These firms generate about $70.12 billion in economic activity.

An economic analysis of the renewable fuels industry will also take additional linkages into account. While it is inappropriate to claim that suppliers to the supplier firms are part of the industry being analyzed,[3] the spending by employees of the industry and those of supplier firms whose jobs are directly dependent on the renewable fuels industry should surely be included. This spending on everything from housing, to food, to entertainment and medical care makes up what is traditionally called the "induced impact" or multiplier effect. In other words, this spending, and the jobs it creates is induced by the renewable fuels industry. We estimate that the induced impact of the sector is nearly $35.8 billion, and generates 226,098 jobs, for a multiplier of 0.77.[4]

An important part of an impact analysis is the calculation of the contribution of the industry to the public finances of the community. In the case of the renewable fuels industry, the traditional business taxes paid by the firms and their employees provide nearly $14.5 billion in revenues to the federal, state and local governments.

Table 1 below presents a summary of the total economic impact of the sector in the United States. Summary tables for each state are included in the Output Model, which is discussed in the following section.

Economic Contribution of the Renewable Fuels Industry

	Direct	Supplier	Induced	Total
Jobs	292,166	333,792	226,098	852,056
Wages	$14,576,013,800	$19,981,620,900	$11,646,600,400	$46,204,235,100
Output	$78,560,565,500	$70,118,797,400	$35,790,660,600	$184,470,023,500
Taxes				$14,462,478,600

Output Model

John Dunham and Associates, Inc. produced the economic impact study for the Fuels America coalition. The analysis consists of a number of parts, each of which will be described in the following sections of this document. These include data, models, calculations and outputs. These components were linked together into an interactive system that allows Fuels America to examine the links between the various parts of the industry and to produce detailed output documents on an as-needed basis. As such, there is no book – no thick report – outlining the impact of the industry, but rather a system of models and equations that can be continuously queried and updated.

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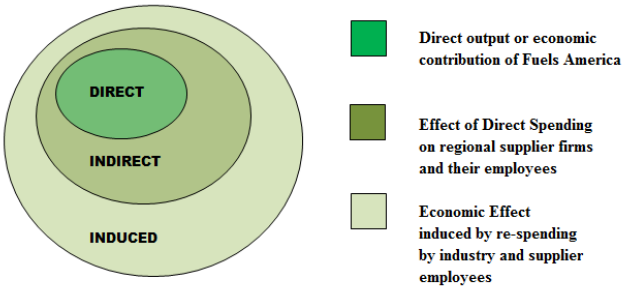
2 Economic sectors based on IMPLAN sectors.

3 These firms would more appropriately be considered as part of the supplier firms' industries.

4 Often economic impact studies present results with very large multipliers – as high as 4 or 5. These studies invariably include the firms supplying the supplier industries as part of the induced impact. John Dunham and Associates believes that this is not an appropriate definition of the induced impact and as such limits this calculation to only the effect of spending by direct and supplier employees.

Economic Impact Modeling – Summary

The Fuels America Economic Impact Study begins with an accounting of the direct employment in the renewable fuels industry. The data come from a variety of government and private sources.



It is sometimes mistakenly thought that initial spending accounts for all of the impact of an economic activity or a product. For example, at first glance it may appear that consumer expenditures for a product are the sum total of the impact on the local economy. However, one economic activity always leads to a ripple effect whereby other sectors and industries benefit from this initial spending. This inter-industry effect of an economic activity can be assessed using multipliers from regional input-output modeling.

The economic activities of events are linked to other industries in the state and national economies. The activities the renewable fuels industry perform such as hiring engineers, scientists, farmers, marketing and business teams among other jobs account for the direct effects on the economy. Regional (or indirect) impacts occur when these activities require purchases of goods and services such as real estate, equipment or electricity from local or regional suppliers. Additional, induced impacts occur when workers involved in direct and indirect activities spend their wages. The ratio between induced economic and direct impact is termed the multiplier. The framework in the chart above illustrates these linkages.

This method of analysis allows the impact of local activities to be quantified in terms of final demand, earnings, and employment in the states and the nation as a whole.

Once the direct impact of the industry has been calculated, the input-output methodology discussed below is used to calculate the contribution of the supplier sector and of the re-spending in the economy by employees in the industry and its suppliers. This induced impact is the most controversial part of economic impact studies and is often quite inflated. In the case of the Fuels America model, only the most conservative estimate of the Induced Impact has been used.

Model Description and Data

This analysis is based on data provided by: The Biotechnology Industry Organization - Industrial & Environmental Section, Abengoa Bioenergy, POET, Zeachem, DuPont, Mascoma, Biodiesel Magazine, the National Biodiesel Board, Fuels America, the Renewable Fuels Association, the US Environmental Protection Agency, and Dun and Bradstreet, Inc. The analysis utilizes the Minnesota IMPLAN Group Model in order to quantify the economic impact of the renewable fuels industry on the economy of the United States.[5] The model adopts an accounting framework through which the relationships between different inputs and outputs across industries and sectors are computed. This model can show the impact

[5] The model uses 2012 input/output accounts.

of a given economic decision – such as a factory opening or operating a sports facility – on a pre-defined, geographic region. It is based on the national income accounts generated by the US Department of Commerce, Bureau of Economic Analysis (BEA).[6]

Every economic impact analysis begins with a description of the industry being examined. In the case of the Fuels America model, the renewable fuels industry is defined industry as corn ethanol refineries, celluistic ethanol refineries, advanced bio fuels facilities, agricultural material producers supplying the refineries, and a portion of fuel distribution, and fueling stations in the United States.

The IMPLAN Group model is designed to run based on the input of specific direct economic factors. It uses a detailed methodology (see IMPLAN Methodology section) to generate estimates of the other direct impacts, tax impacts and supplier and induced impacts based on these entries. In the case of the Fuels America Economic Impact Model, direct employment in the renewable fuels industry is a base starting point for the analysis. Facility data on corn ethanol refineries, cellulosic ethanol refineries, and advanced bio fuels facility were compiled from a series of sources including Fuels America, the Renewable Fuels Association, the US Environmental Protection Agency, and Dun and Bradstreet, Inc. Multiple stages of cleaning are then performed on this data, including removing duplicates records, removing defunct facilities and companies, and correcting inaccurate data where possible. Direct employment for these facilities is based on data provided to John Dunham and Associates by Fuels America, and Dun and Bradstreet, Inc. The portion of transportation fuel distribution and fueling station jobs included in this study are calculated based on the percent of ethanol contained in transportation fuel sold in the United States. These are calculated based on data from Dun and Bradstreet, Inc.; the Economic Census of Retail Trade (U.S. Census Bureau); the Economic Census of Wholesale Trade (U.S. Census Bureau); Fuel Ethanol Consumption Estimates, 2012 (U.S. Energy Information Administration); and Motor Gasoline Consumption, Price, and Expenditure Estimates, 2012 (U.S. Energy Information Administrations). The impact of agricultural material producers are based on data from Renewable Fuels Association, Fuels America, and IMPLAN. Data on the type of feedstock used, supplied by the Renewable Fuels Association and Fuels America, are applied to IMPLAN supplier data in order to calculate agricultural material producer impact.

Once the initial direct employment figures have been established, they are entered into a model linked to the IMPLAN database. The IMPLAN data are used to generate estimates of direct wages and output. Wages are derived from data from the U.S. Department of Labor's ES-202 reports that are used by IMPLAN to provide annual average wage and salary establishment counts, employment counts and payrolls at the county level. Since this data only covers payroll employees, it is modified to add information on independent workers, agricultural employees, construction workers, and certain government employees. Data are then adjusted to account for counties where non-disclosure rules apply. Wage data include not only cash wages, but health and life insurance payments, retirement payments and other non-cash compensation. It includes all income paid to workers by employers.

Total output is the value of production by industry in a given state. It is estimated by IMPLAN from sources similar to those used by the BEA in its RIMS II series. Where no Census or government surveys

[6] RIMS II is a product developed by the U.S. Department of Commerce, Bureau of Economic Analysis as a policy and economic decision analysis tool. IMPLAN was originally developed by the US Forest Service, the Federal Emergency Management Agency and the Bureau of Land Management. It was converted to a user-friendly model by the Minnesota IMPLAN Group in 1993.

are available, IMPLAN uses models such as the Bureau of Labor Statistics Growth model to estimate the missing output.

The model also includes information on income received by the Federal, state and local governments, and produces estimates for the following taxes at the Federal level: Corporate income; payroll, personal income, estate and gift, and excise taxes, customs duties; and fines, fees, etc. State and local tax revenues include estimates of: Corporate profits, property, sales, severance, estate and gift and personal income taxes; licenses and fees and certain payroll taxes.

While IMPLAN is used to calculate the state level impacts, physical location data compiled from the multiple aforementioned sources and Census data provide the basis for Congressional district level estimates. Our model uses actual physical location data in order to allocate jobs – and the resulting economic activity – by physical address or when that is not available, zip code. For zips entirely contained in a single congressional district, jobs are allocated based on the percentage of total sector jobs in each zip. For zips that are broken by congressional districts, allocations are based on the percentage of total jobs physically located in each segment of the zip. Physical locations are based on either actual address of the facility, or the zip code of the facility, with facilities placed randomly throughout the zip code area. All supplier and indirect jobs are allocated based on the percentage of a state's employment in that sector in each of the districts. These percentages are based on Dun and Bradstreet data.

IMPLAN Methodology[7]

Francoise Quesnay one of the fathers of modern economics, first developed the analytical concept of inter-industry relationships in 1758. The concept was actualized into input-output analysis by Wassily Leontief during the Second World War, an accomplishment for which he received the 1973 Nobel Prize in Economics.

Input-Output analysis is an econometric technique used to examine the relationships within an economy.

It captures all monetary market transactions for consumption in a given period and for a specific geography. The IMPLAN model uses data from many different sources – as published government data series, unpublished data, sets of relationships, ratios, or as estimates. The Minnesota IMPLAN group gathers this data, converts it into a consistent format, and estimates the missing components.

There are three different levels of data generally available in the United States: Federal, state and county.

Most of the detailed data is available at the county level, and as such there are many issues with disclosure, especially in the case of smaller industries. IMPLAN overcomes these disclosure problems by combining a large number of datasets and by estimating those variables that are not found from any of them. The data is then converted into national input-output matrices (Use, Make, By-products, Absorption and Market Shares) as well as national tables for deflators, regional purchase coefficients and margins.

The IMPLAN Make matrix represents the production of commodities by industry. The Bureau of

Economic Analysis (BEA) Benchmark I/O Study of the US Make Table forms the bases of the IMPLAN model. The Benchmark Make Table is updated to current year prices, and rearranged into the IMPLAN

[7] This section is paraphrased from IMPLAN Professional: Users Guide, Analysis Guide, Data Guide, Version 2.0, MIG, Inc., June 2000.

sector format. The IMPLAN Use matrix is based on estimates of final demand, value-added by sector and total industry and commodity output data as provided by government statistics or estimated by IMPLAN. The BEA Benchmark Use Table is then bridged to the IMPLAN sectors. Once the re-sectoring is complete, the Use Tables can be updated based on the other data and model calculations of interstate and international trade.

In the IMPLAN model, as with any input-output framework, all expenditures are in terms of producer prices. This allocates all expenditures to the industries that produce goods and services. As a result, all data not received in producer prices is converted using margins which are derived from the BEA Input-Output model. Margins represent the difference between producer and consumer prices. As such, the margins for any good add to one. If, for example, 10 percent of the consumer price of ethanol is from the purchase of electricity to run distilleries, then the electricity margin would be 0.1.

Deflators, which account for relative price changes during different time periods, are derived from the Bureau of Labor Statistics (BLS) Growth Model. The 224 sector BLS model is mapped to the 432 sectors of the IMPLAN model. Where data are missing, deflators from BEA's Survey of Current Businesses are used.

Finally, one of the most important parts of the IMPLAN model, the Regional Purchase Coefficients

(RPCs) must be derived. IMPLAN is derived from a national model, which represents the "average" condition for a particular industry. Since national production functions do not necessarily represent particular regional differences, adjustments need to be made. Regional trade flows are estimated based on the Multi-Regional Input-Output Accounts, a cross-sectional database with consistent cross interstate trade flows developed in 1977. These data are updated and bridged to the 528 sector IMPLAN model.

Once the databases and matrices are created, they go through an extensive validation process. IMPLAN builds separate state and county models and evaluates them, checking to ensure that no ratios are outside of recognized bounds. The final datasets and matrices are not released before extensive testing takes place.