

# The Jobs and Economic Development Impact Model (JEDI)

## About JEDI and Frequently Asked Questions (FAQ)

### Introduction

The Jobs and Economic Development Impact Model (JEDI) was developed in 2006 to demonstrate the economic benefits associated with developing power generation and biofuel plants in the United States. The primary goal in developing this state level model was to provide a tool for developers, government officials, decision makers and other potential users, to easily identify the local economic impacts associated with constructing and operating such plants. Consistent with this goal, a strong emphasis was placed on designing the model in a user-friendly format that could be easily modified — reflecting different levels of project specific information and user skill. This insures the greatest flexibility, for inexperienced spreadsheet users, those unfamiliar with economic impact analysis, and more experienced and knowledgeable users who have a need for this specific type of analysis.

### Methodology

Given basic information about a power generation or biofuel project (minimally, the state it is to be located in, the year of construction and the size of the facility), users can determine not only what a project will cost (i.e., specific expenditures), but also the number of jobs, income (i.e., wages and salary) and economic activity that will accrue to the state (or local region) from the project. To evaluate these impacts, input-output or multiplier analysis is used.

Input-output models were originally developed to trace supply linkages in the economy. For example, they show how purchases of equipment not only benefit the equipment manufacturers, but also the fabricated metal industries and others businesses supplying inputs to those manufacturers. The benefits that are ultimately generated by expenditures for power generation or biofuel plants depend upon the extent to which those expenditures are spent locally and the structure of the local economy. Consistent with the spending pattern and state specific economic structure, different expenditures support a different level of employment, income, and output.

Input-output analysis can be thought of as a method of evaluating and summing the impacts of a series of effects generated by an expenditure (i.e., input). To determine the total effect of developing a biofuels plant, three separate impacts are examined for each expenditure. These include: direct effect, indirect effect and induced effect.

**Direct Effect:** These are the on-site or immediate effects created by an expenditure. In constructing a power generation or biofuel plant, it refers to the on-site jobs of the contractors and crews hired to construct the plant. It also refers to the jobs at the manufacturing plants that build the equipment, among others.

**Indirect Effect:** This refers to the increase in economic activity that occurs when a contractor, vendor or manufacturer receives payment for goods or services and in-turn is able to pay others who support their business. For instance, this includes the banker who finances the contractor, the accountant who keeps the contractor's books, and the steel mills and electrical manufacturers and other suppliers that provide the necessary materials, among others.

**Induced Effect:** This refers to the change in wealth that occurs or is induced by the spending of those persons directly and indirectly employed by the project.

The sum of these three effects yields a total effect that results from a single expenditure. To accomplish this analysis, state specific multipliers and personal expenditure patterns are used to derive the results. These state-by-state multipliers, for employment, wage and salary income and output (economic activity), and personal expenditure patterns were derived from the IMPLAN (IMPact Analysis for PLANning) Professional model using 2006 state data (the most current available at the time the model was developed). The changes in expenditures brought about by investments in developing power generation or biofuel plants are matched with their appropriate multipliers for each industry sector affected by the change in expenditure. If the year for which the expenditure dollars are entered does not match the model's multiplier data year, the JEDI model applies price deflators to account for changes in actual dollar value.

Consistent with an analysis of this type and scope, the assumptions used play an important role in influencing the results. Thus, to accommodate the greatest level of flexibility in user skill level and availability of specific detailed project information, the model is designed to incorporate model default values or new values entered by the user. The default values represent a reasonable expenditure pattern for constructing and operating a power generation or biofuel plant in the United States and the share of expenditures spent locally. The default expenditure pattern is based on a review of available plant data.

Admittedly, not every project will follow this exact "default" pattern for expenditures. Project size, location, financing arrangements and numerous site-specific factors influence the construction and operating costs. Similarly, the availability of local resources, including labor and materials, and the availability of locally manufactured plant components, can have a significant effect on the costs and the economic benefits that accrue to the state or local region. To the extent the user has and can incorporate project specific data, and the share of spending that is expected to occur locally, the more localized the impact analysis will be.

## **Inputting Data and Running the Model**

The JEDI model is designed for all levels of users; requiring no experience with spreadsheets or background in economic modeling. The model includes instructions on how to proceed with entering data for analysis as well as detailed information (comments) to assist users in understanding the type of data required in specific cells. The "comments" are viewed by pointing the cursor to the triangle located in the corner of the cell. Please note: the model formulas and default data are protected and any user modified data is only applicable to the specific analysis you are performing while the model is open. If you think you've made changes you didn't want to make (or aren't sure) merely hit the "Restore Default Values" button on the ProjectData page or close the model and reopen it to start over with the initial model defaults.

For those users with little or no experience with power generation or biofuel plants or economic impact analysis, you need only, at a minimum, choose the state in which the plant will be built, enter the year the plant will be built and the size of the plant. The user can then choose to accept all project defaults (or review and edit the defaults) and go directly to Summary Impacts to view the results of the analysis. Note: if you choose to review and modify the defaults (i.e., not utilize the default model values) you must enter an "N" in the designated cell on the ProjectData page to have the new data incorporated in the analysis.

For those users with more experience with power generation or biofuel plants and/or economic impact analysis (i.e., those with more project specific information on costs and expenditures, financing, taxes, and local share of spending, among others) simply review and choose to (or choose not to) modify the default values and then go to Summary Impacts to view the results of the analysis. The default expenditure values are entered in purchaser prices. The model then automatically allocates the expenditures to the respective producing industries. Note: if you choose to review and modify the defaults (i.e., not utilize the default model values) you must enter an “N” in the designated cell on the ProjectData page to have the new data incorporated in the analysis.

Once the analysis is complete the user has several options for saving the data and results. If a hard copy is desired the user can choose to print (from the summary page) a “Project Data Summary and Summary Results” (the data and results contained on the summary page) and/or print the “Detailed Project Data” (a detailed version of all cost and expenditure data used in the analysis). If the user desires to have the inputs and results in a spreadsheet format (but not in the model itself), merely click on the “Export all project data and summary results” button and the desired data will be saved to a new spreadsheet. Finally, if the user wishes to save the model (with the user modified data) for future use or reference, merely hit the file “save” button on the toolbar and you will be prompted to save the model with a different name and to a directory of your choice. Changing the name insures the original model (with model defaults) is kept intact for future analysis.

## **Interpreting the Results**

Regardless of how much “project specific” data is entered by the user, JEDI provides sufficient information to help users (and others) better understand the magnitude of the economic impacts associated with the respective project being analyzed.

The model provides basic project information to help users identify the magnitude of the construction related spending and ongoing operating and maintenance (O&M) expenditures as well as the portion of the spending that occurs locally (again, this is determined by the “local share” values – default or user modified - used in the model for each of the expenditures). Similarly, the model identifies local spending on debt and equity payments, property taxes and land lease or purchase payments.

In addition to the basic project information the model provides analysis of the local jobs, earnings and output (economic activity) generated as a result of the project – broken out by direct, indirect and induced impacts. This includes the one-time impacts resulting from the construction phase as well as the annual or ongoing impacts that result from the annual operations.

For example, a user interested in understanding the economic impacts from a 100 MW solar-powered parabolic trough plant in California to be built in the year 2008 can easily and quickly find the answers by using JEDI. By inputting these few pieces of information into the model (in project description) and accepting the model defaults, we might find (by going directly to the summary results) that the construction of the plant will support over 2,000 local jobs (full-time equivalent for a year) and generate over \$330 million in local economic activity during the construction period. Of the total jobs we found, almost 600 are directly in the construction sector.

Once it is up and running, this same project continues to benefit the state. We see a total of just over 100 jobs (full-time equivalent each year of operations) supported, with approximately 33 of these

directly employed by the plant. The total annual local economic activity supported by the ongoing operations is just under \$14 million.

## **Caveats**

Several important caveats should be noted at this point. First, the intent of the JEDI models is to construct a reasonable profile of investments (i.e., plant construction and operating costs) and demonstrate the economic impacts that will result, assuming a project occurs during the stated period of analysis. Given future changes in power generation or biofuel plant costs and potential changes in industry and personal consumption patterns in the economy, the analysis is not intended to provide a precise forecast, but rather an approximate estimate of overall impacts.

Second, the JEDI model is considered a static model. As such, it relies on inter-industry relationships and personal consumption patterns existing at the time of the analysis. The analyses does not account for feedback through final demand increases or reductions that could result from price changes. Similarly, the model does not account for feedback from inflation, or potential constraints on labor and money supplies. The model assumes there are adequate local resources and production and service capabilities to meet the level of local demand identified in the modeling assumptions. Similarly, the model does not automatically take into account industry productivity improvements that may occur over time or changes that may occur in the construction or O&M processes (e.g., production recipe for labor, materials, and service cost ratios) for new power plants

Third, the model was not designed to provide cash flow projections or for use as a cash flow analysis tool.

Fourth, the analysis is specific to developing a power generation or biofuel plant and thus provides a gross analysis. That is, it does not reflect net impacts associated with alternate spending of the money, such as constructing and operating other types of power generating or biofuel plants or replacement of existing generating or biofuel resources.

Fifth, the analysis assumes the sale of power or biofuels from the plant generates sufficient revenues to accommodate the equity and debt repayment and annual operating expenditures. To the extent additional revenues (i.e., profits and/or tax advantages above actual costs) accrue to the project owner there will be added benefits. These benefits are not included in the analysis.

## **User Add-in Location Feature**

The initial design for the JEDI model provided for state level impact analysis. However, it was apparent that many potential users might wish to perform a similar level of analysis for a smaller or more localized region (such as an individual county or group of counties) or for a larger region (such as a group of states) to better capture the regional benefits. Unfortunately, the high cost of including multiplier and expenditure data in the model for every county in the United States and the complexities associated with designing the model to analyze the endless number of possibilities for combining counties and states made this impractical.

However, to accommodate those users who desire to do this level of analysis a User Add-in Location feature is provided in the model. This feature allows users with the capability to derive or obtain the

necessary data, to complete analysis for a specific region of interest other than the state level included with the base model. The necessary inputs include direct, indirect and induced multipliers for employment, earnings and output (per million dollars change in final demand) and personal consumption expenditures (i.e., average consumer expenditures on goods and services — calculated as a percentage for each industry — totaling 100 percent combined), for the fourteen aggregated industries.

The aggregated industries include:

1. Agriculture
2. Construction
3. Electrical Equipment
4. Fabricated Metals
5. Finance, Insurance and Real Estate
6. Government
7. Machinery
8. Mining
9. Other Manufacturing
10. Other Services
11. Professional Services
12. Retail Trade
13. Transportation, Communication and Public Utilities
14. Wholesale Trade

To customize the model, for IMPLAN users, gathering the necessary data will require several steps:

1. Purchase the desired county or state level data files.
2. Using IMPLAN Pro Social Accounting & Impact Analysis Software, create a new model with the desired region (one county, group of counties or group of states).
3. Construct the model.
4. Aggregate the model. This step requires the user to create a new fourteen industry aggregation scheme and aggregate the new model. Once the model is aggregated, reconstruct the social accounts and multipliers.
5. Open Reports, Study Area, and save Household Commodity Demand (personal consumption expenditures) to a spreadsheet file. Go to Multipliers, and save Employment, Employee Compensation and Output, each to a spreadsheet file.
6. The data contained in each of these files can then be formatted to easily input (i.e., cut and paste) into the respective location (MyCounty for a single county or MyRegion for a group of counties or states) in the User Add-in Location worksheet in JEDI.

Once the User data is entered into JEDI the user need only identify the location of the plant (in the project description section of the ProjectData worksheet) as MyCounty or MyRegion, depending upon where the data is entered, and proceed with the analysis.

For non-IMPLAN users or those unfamiliar with input-output modeling, there are several options for gathering the necessary data to perform a more specific county or regional analysis.

These include:

1. Follow a similar process as that noted above to derive the aggregated multiplier and consumer expenditure data, from another input-output modeling tool;

2. Purchase the necessary data (aggregated multiplier and consumer commodity demand – see description above) from someone skilled in input-output modeling, IMPLAN or another modeling tool); or
3. Purchase the necessary data (aggregated multiplier and consumer commodity demand – see description above) from Minnesota IMPLAN Group, Inc. (IMPLAN).

## **Accessing and Viewing Model Work Areas**

There are several sheets in the model that should not be modified except by a skilled input-output modeler familiar with all the intended interactions in the existing model. Modifying any of the data or formulas could seriously impact the accuracy or usability of the model. These sheets are: default data, calculations and deflators. The model contains two additional worksheets: Multipliers and Household Expenditures. These worksheets are hidden to protect proprietary data derived from IMPLAN (Minnesota IMPLAN Group).

## **Data**

Analyzing the economic impacts of constructing and operating power generation or biofuel plants requires a large amount of project specific data, state specific input-output multipliers and personal expenditure patterns, and price deflators.

The project specific data includes a bill of goods (costs associated with actual construction of the facility, roads, etc., as well as costs for equipment and other services and fees required), annual operating and maintenance costs and data on the portion of expenditures spent locally, financing terms, and tax rates among others. More specifically, the model requires the following project inputs:

1. Construction Costs (materials and labor)
2. Equipment Costs (feed handling, boilers, process, etc.)
3. Other Costs (engineering, insurance, etc.)
4. Annual Operating and Maintenance Costs (personnel, materials and services)
5. Other Parameters (financial – debt and equity, taxes and land lease)

Unfortunately, many developers consider this type of information proprietary due to competitive forces in the marketplace. Similarly, project specific differences can and do significantly impact costs. As a result, it is near impossible to identify a one-price fits all situations. Nevertheless, the model provides default values for each of the inputs noted above and all those necessary for the analysis. These values represent average costs and spending patterns developed from a number of resources, including research and analysis of renewable and fossil fuel resources undertaken by the model developer during the last 10 years. Other resources including personal communications and anecdotal evidence gathered to complete this model, previous renewable and fossil fuel energy studies, and project-related case studies.

The state-by-state input-output multipliers and personal consumption expenditure patterns were derived from IMPLAN Professional™, using 2002 state data files. IMPLAN Professional™ Version 2.0 is a social accounting and impact analysis tool. See Minnesota IMPLAN Group (MIG, Inc), Stillwater, Minnesota, 651/439-4421, [www.IMPLAN.com](http://www.IMPLAN.com).

The U.S. price deflators were derived from the U.S. Bureau of Economic Analysis, Current Dollar and “Real” Gross Domestic Product data downloaded from the Bureau's website, [www.bea.gov](http://www.bea.gov).

## Frequently Asked Questions (FAQ)

### **How do I know if I have the most current version of the JEDI model?**

The most current version of the JEDI model is available on NREL's Energy Analysis website at <http://www.nrel.gov/analysis/jedi/>.

### **How can I determine which version of the JEDI model I have?**

The version (release number) of the model you are currently using can be found in the File Name.

### **Is there a mailing list I can get on to be notified by email when new versions of JEDI are released?**

Yes. Prior to downloading, all users are required to register with their contact information and accept our User Agreement. You may elect to "Opt-In" and be placed on the JEDI mailing list.

### **When I open up the model I receive a security alert message stating "the macros in the file have been disabled," how do I change the security setting so I can run the model with the macros enabled?**

The message you are receiving is related to the level of security you have chosen in your Excel™ set up. To change the setting for opening files, open Microsoft Excel™, on the top toolbar, click on "tools," then "macros" then "security." Reset the security level to "medium," this will enable you to choose to enable or disable macros each time you open a file. Alternately, the model can be successfully run with the macros disabled.

### **How do I run a county or regional level analysis?**

Running a county or regional level analysis is similar to running a state level analysis, although there are two key differences users must keep in mind. First, the model does not contain county or regional level multipliers, thus users must obtain these and add them into the model. See *User Add-in Location Feature* discussion above on obtaining county or regional level multipliers and how to add in the data. Second, to run a county or regional level analysis, users must enter the county or regional population in the Project Description area. The population provides a reference for the model to automatically insert "local share" defaults for the analysis.

### **Where can I get county or regional level data to add-in to the model to run a county or region specific analysis?**

County level multipliers and personal consumption expenditure patterns are available from a number of sources. Users familiar with IMPLAN or input-output modeling can purchase the raw county level data and derive the multipliers themselves, purchase them from someone familiar with input-output modeling, or purchase them directly from IMPLAN ([www.implan.com](http://www.implan.com)). See *User Add-in Location Feature* discussion above for more information about sources.

### **How do I add in county or regional level multipliers and the personal consumption expenditure data?**

Adding-in county or regional level multipliers and personal consumption expenditure data involves going to the "User Add-in Location" worksheet in this model and cutting and pasting the data into their respective locations. With the data installed it is also necessary to insert the county or region name and the year of the data. See *User Add-in Location Feature* discussion above for more information about how to add in data.

**What does the "local share" refer to?**

The "local share" refers to the percentage of each expenditure that is actually spent locally (i.e., in the state, county or region being analyzed). For example, if \$1 million is going to be spent on construction materials and half (\$500,000) of this total will be purchased from local suppliers, we say the "local share" is 50 percent.

**I want to make my analysis as accurate as possible, where can I get information to adjust the default "local share" values (in the ProjectData worksheet) for my state or county?**

Since the "local share" is directly related to the availability of local businesses and services and their ability to meet the construction and annual operating demands of the project, it is important to have an accurate picture of these local resources. This can be obtained in a number of ways: contacting experienced and knowledgeable persons in the area, contacting local business and contractor organizations and/or the local chamber of commerce, among others.

**I am interested in viewing and possibly editing internal formulas within the model, how do I access them?**

The JEDI model contains several intermediate worksheets that are an integral part of the model analysis. These worksheets are not designed to be changed by users. Several of these worksheets, including default data, calculations, and deflators may be viewed by merely clicking on the respective worksheet and scrolling to the right. Although these sheets may be viewed by users they are protected and can not be edited. The model contains two additional worksheets: multipliers and household expenditures. These worksheets are hidden to protect proprietary data derived from IMPLAN (Minnesota IMPLAN Group).

**Is additional technical support available?**

Yes, technical support is available. Please see our JEDI Help Web page (<http://www.nrel.gov/analysis/jedi/help.html>) and select the appropriate contact based on the technology and type of support being sought.