Economic Impact of the Proposed 28.8 MW Antrim Wind Power Project in Antrim, NH

Prepared for Antrim Wind Energy, LLC
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1. Executive Summary

This is an update to the economic impact analysis *Economic Impact of the Proposed Antrim 30 MW Wind Power Project in Antrim, New Hampshire* which was originally released in January 2012. The purpose of the update was to examine the potential impact of the proposed 28.8 MW Antrim Wind Power Project ("Project") on the local area economy in Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties. The Project has reduced its size by one wind turbine from its previous design to nine wind turbines. The Project has an anticipated capital cost of $61 million, dependent upon market prices for turbines and other materials and services.

The previous economic impact analysis found:

> *The 30 MW wind power project proposed in Antrim, NH is expected to have a positive economic impact on Hillsborough County and the surrounding local area with the highest impact experienced during the construction phase.*
>
> *Total benefits (including direct, indirect and induced) to the local economy from the Project are expected to be $55.7 million or $1.85 million per MW over a 20-year period.*

This update reviewed the latest NH economic data and reviewed updated financial and construction information on the Project provided by Antrim Wind Energy, LLC and its construction partner Reed & Reed, Inc. This update also reviewed wind power project economic impact studies that have been released since the original economic impact analysis. Using the same methodology as the original economic impact analysis, the latest versions of the JEDI and IMPLAN economic model were run utilizing the most current information.

Development activities from Antrim Wind Energy, LLC have already brought investment into the NH economy. Antrim Wind has spent over $4.5 million to-date on development activities with 48% spent in New Hampshire in areas including professional services, and lease payments.

The construction phase of the Project is the time period when there will be the greatest economic activity and benefits for Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties. During the construction phase, the Project is expected to contribute $11.6 million in economic activity and generate 25 full-time equivalent (FTE) construction jobs and support an additional 59 FTE jobs in the local area economy.

In the on-going operating phase after construction, the economic and jobs impact of the wind power project are reduced but still positive. The project is expected to contribute $2.2 million annually. The project is expected to create an estimated 4 FTE new jobs for employees of Antrim Wind and support an additional 8 FTE jobs in the surrounding local area.

The Antrim Wind Power Project is expected to bring $53.4 million in increased economic activity to NH over the next twenty years. This economic impact analysis update supports the original findings of the economic impact analysis. The Project is expected to have a positive impact on the NH economy.

2. Introduction

Antrim Wind Energy, LLC is proposing the 28.8 MW Antrim Wind Power Project on private land located in the Town of Antrim located in Hillsborough County, New Hampshire. The Project will consist of nine wind turbines situated along the ridge lines of Willard Mountain and Tuttle Hill in the north-western area of Antrim. The Project is expected to involve a total investment of $61 million.

The purpose of this economic impact analysis update is to independently examine the potential impact of the Project on the local area economy—defined as the Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties in NH—based on the latest economic conditions and the current characteristics of the proposed Antrim Wind Power Project. In conducting this economic analysis, emphasis was placed on providing conservative estimates of the economic impacts of the Project.

This economic impact analysis update considers the direct, indirect and induced economic impacts of the Project on the local area economy. This update includes evaluation of the local area economic impacts during the construction phase and the on-going operations phase. Economic factors considered in the update were: employment, local capital expenditures, tax revenue, local material and supplies purchases, landowner payments and the broader economic "multiplier" impacts of the Project.

3. Analysis

Development activities from Antrim Wind Energy, LLC have already brought investment into the NH economy. Antrim Wind has spent over $4.5 million to-date on development activities with 48% spent in New Hampshire in areas including professional services, and lease payments.

The Antrim Wind Power Project is expected to bring $53.4 million in increased economic activity to NH over the next twenty years. The construction phase of the Project is the time period when there will be the greatest economic activity and benefits for Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties. During the construction phase, the Project is expected to contribute $11.6 million in economic activity and generate 25 full-time equivalent (FTE) construction jobs and support an additional 59 FTE jobs in the local area economy.

The construction activity from the Antrim Wind Power Project would help support the strengthening NH economy. During the construction phase, the impact on local area employment would be significant with an expected 84 full-time equivalent (FTE) jobs and $5.9 million in wages and earnings. The 84 FTE jobs is a point estimate of employment. Depending on the actual percentage of construction work that is competitively won by NH contractors, the actual work filled by NH-based firms would be expected to vary between 50 to 100 FTE jobs.

Table 1: Economic activity in Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties during the construction phase of the Antrim Wind Power Project

Impacts	FTE Employment	Earnings (Millions)	Economic Output (Millions)
Direct	25	$2.5	$2.7
Indirect	40	$2.4	$6.3
Induced	19	$1.0	$2.6
Total	**84**	**$5.9**	**$11.6**

In the on-going operating phase after construction, the economic and jobs impact of the wind power project are reduced but still positive. The project is expected to contribute $2.2 million annually. The project is expected to create an estimated 4 FTE new jobs for employees of Antrim Wind and support an additional 8 FTE jobs in the surrounding local area.

Table 2: Annual economic activity in Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties after the construction of the Antrim Wind Power Project

Impacts	FTE Employment	Earnings (Millions)	Economic Output (Millions)
Direct	4	$0.3	$0.3
Indirect	4	$0.2	$1.3
Induced	4	$0.2	$0.6
Total	**12**	**$0.7**	**$2.2**

3.1. Energy Market

New Hampshire has a Renewable Portfolio Standard (RPS) that has been enacted by the NH Legislature in RSA 362-F. The NH RPS drives demand for utility-scale renewable energy. Wind power projects compete with other wind power projects and other modes of renewable energy for utility supply contracts. To meet the NH RPS requirements, either renewable energy projects need to be built in the state or NH utilities must procure this energy from projects located outside of the state.

The study *Wild Meadows Wind Project: Economic Impact Report* (Dec. 2013) provides an in-depth discussion of the market impact of the NH RPS and its relationship to new wind power projects including the following:

> Despite what appears to be an emerging cost advantage for wind energy, it is important to note that a direct cost comparison with fossil fuels such as natural gas is not appropriate. While it is the case that currently wind is more expensive than natural gas, the two are not substitutes. Because of state mandates, one megawatt produced from a natural gas plant cannot be substituted for one megawatt from wind and still meet state standards. The legislative body that represents the citizens of New Hampshire has determined that there exists a public benefit to having a portion of the electricity used in the state derived from renewable sources. It is the duly elected representatives of the public who have already made the determination that those benefits are at least as large as the difference between the cost of generating electricity from renewable sources and a lower cost alternative.

In this update, a formal analysis of the NH power market was not conducted. However, the Project was assumed to have neither a positive or negative impact on electricity rates in this economic impact analysis. This is based on the fact that NH law requires utilities to purchase a certain percentage of their customer load from renewable energy sources and any new wind power project would compete against other renewable energy projects to meet that demand at a market rate.

3.2. Fiscal Impact on the Town of Antrim

Antrim Wind has signed an annual Payment In Lieu of Taxes (PILOT) agreement with the Town of Antrim in the amount of $11,250 per MW for the first post-construction year, escalating at 2.5% per year during the 20 year operating term. The first year's payment after construction would be $324,000 for the 28.8 MW Project. This is in addition to payments made prior to the commencement of the operating term and results in a total of $8.4 million being paid to the Town of Antrim in PILOT payments during construction and the first 20 years of operations.

This update did not specifically consider how Antrim might utilize the PILOT payments but classified it as tax revenue in the Jedi model. It was beyond the scope of this economic impact analysis update to consider how the Town of Antrim would expend those payments as it does not impact the benefit for the defined local area economy. Under state law, the NH Department of Revenue Administration utilizes the "PILOT Value" of the wind farm for equalization, therefore the Project will make payments under the terms of the PILOT agreement signed with Town of Antrim and those payments will be dispersed between municipal, county and school tax uses as would any other tax bill.

3.3. Property Value Impacts

The relationship between wind power projects and residential property values was reviewed in the economic impact analysis update.

Based on review of the *Impact of the Lempster Wind Power Project on Local Residential Property Values Update* (Dec. 2014), there was no evidence to indicate that a relationship exists between wind power projects and residential real estate markets, therefore there is not expected to be any impact on residential real estate values in the region from the Antrim Wind Power Project.

3.4. Tourism

The relationship between wind power projects and tourism was reviewed in the economic impact analysis update. The study *The Impact of Wind Farms on Tourism in New Hampshire* (Dec. 2013) examined and compared economic trends in the region before and after the construction of the Lempster Wind Power Project to determine if there was any evidence of the Lempster Wind Power Project impacting tourism activity in NH. The study reviewed publicly available data of spending on accommodations, food services, recreational activities, traffic volumes, and changes in employment.

Key findings of the study were:

> The introduction of the Lempster Wind project appears to have had little or no impact on meals and rooms sales in the region where the project is located.
>
> Since Lempster Wind began operating, growth in tourism-related employment in the project region has been as large, or larger, than it has been in a majority of regions in the state.
>
> State park revenues have grown more at the state parks closest to the Lempster Wind region than have aggregate state park revenues, with the largest increase at the park closest to Lempster Wind.
>
> Weekend traffic volume (an indication of visitor activity) in the Lempster Wind region suggests that the presence of the wind farm has not discouraged visits to the region.

The Antrim Wind Power Project is located in close proximity (approximately 20 miles away) to the Lempster Wind Power Project. Towns in the vicinity of the two wind power projects are split between two tourism regions—as defined by the State of New Hampshire Department of Travel and Tourism—the Dartmouth Lake Sunapee, and Monadnock Region.[1] The Dartmouth Lake Sunapee tourism region features tourism-related activities including: dining, outdoor recreation, water-based recreation, state parks and regional events.[2]. The Monadnock Region features similar tourism-related activities including: dining, outdoor recreation, water-based recreation, state parks, and regional events.[3].

Based on review of the *The Impact of Wind Farms on Tourism in New Hampshire* (Dec. 2013), there was no evidence to indicate that a relationship exists between wind power projects and tourism, therefore there is not expected to be any tourism impact on the region from the Antrim Wind Power Project.

[1] "Maps", NH Department of Resources and Economic Development, Division of Travel and Tourism Development, available on-line at http://www.visitnh.gov/welcome-to-nh/about-the-regions/maps.aspx

[2] "Dartmouth-Lake Sunapee," NH Department of Resources and Economic Development, Division of Travel and Tourism Development, available on-line at http://www.visitnh.gov/welcome-to-nh/about-the-regions/darthmouth-lake-sunapee.aspx

[3] "Monadnock Region ," NH Department of Resources and Economic Development, Division of Travel and Tourism Development, available on-line at http://www.visitnh.gov/welcome-to-nh/about-the-regions/monadnock-region.aspx

3.5. Wind-Related Construction Capacity in Local Region

The employment in the Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties was reviewed to determine if the local area economy has the skilled labor capacity necessary to participate in the construction of the Antrim Wind Power Project. In 2014, there were 5,005 employed in firms that provide the types of construction services required for the Antrim Wind Power Project. Given the estimated work demand of 25 local construction jobs relative to the size of the regional wind-related construction labor pool of 5,005, it appears that there is a sufficient local construction labor force for the Antrim Wind Power Project.

Based on a review of location quotients (LQ), it appears that the local region has a strength in site preparation, but a weakness in structual steel and pre-cast concrete, and poured concrete foundation and structure. Any of these firms in the area could competitively bid on the project, however NH firms would most likely perform work in: 1)site preparation, 2) power/communication line and related structures, 3) highway, street, and bridge, and 4) electrical and other wiring installation. It would be less likely—but still possible—that NH firms would perform work in the areas of: 1) structural steel and pre-cast concrete, and 2) poured concrete foundation and structure.

Table 3: Wind-related construction labor pool in Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties, NH in 2014

Industry	Employees	Total Wages (Millions)	Average Annual Wage	Location Quotient
Power & Communication Line & Related Structures	504	$48.9	$97,031	0.91
Highway, Street, & Bridge	824	$47.1	$57,100	0.9
Poured Concrete Foundation & Structure	354	$14.5	$41,045	0.63
Structural Steel & Precast Concrete	118	$7.4	$62,945	0.48
Electrical & Other Wiring Installation	2,051	$103.1	$50,271	0.78
Site Preparation	1,154	$47.7	$41,364	1.23
Total Employment	5,005	$268.7	$53,686	

Source: Average labor force for first six months of 2014. Bureau of Labor Statistics

4. Conclusion

This is an update to the original economic impact analysis *Economic Impact of the Proposed Antrim 30 MW Wind Power Project in Antrim, New Hampshire* which was released in 2012. The purpose of this economic impact analysis update was to answer the question "what is the economic impact of the 28.8 MW Antrim Wind Power Project on the local area economy if it is developed?" To answer this question, both a review of existing research on the economic impact of wind power projects and economic modelling of the Project was undertaken.

This economic impact analysis update was a net impact assessment. Economic factors considered in the update were: employment, local capital expenditures, tax revenue, local material and supplies purchases, landowner payments and the broader economic "multiplier" impacts of the Project. This economic impact analysis update also considered the context of the project in the broader regional electricity market and any potential impacts the Project might have on residential property values or tourism. In considering all of these factors, the Project was found to positively impact the economies of the Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties.

The Antrim Wind Power Project is expected to bring $53.4 million in increased economic activity to NH over the next twenty years. During the construction phase, economic activity associated with the Project will add $11.6 million to the local area economy. The Project will help support the strengthening NH economy. The construction jobs and direct employees of Antrim Wind created by the Project are expected to be well-paying. The Project is expected to create 84 FTE jobs in the local economy paying $5.9 million in wages and benefits during construction.

Long term, on-going benefits will be from an estimated 4 FTE on-site jobs, local purchases of goods and services by Antrim Wind Energy, LLC, land owner lease payments, and tax/tax equivalent payments to local and state government which would result in an annual increase of 12 FTE jobs and $2.2 million in local area economic activity.

A. Economic Impact Analysis Update Background

Antrim Wind Energy, LLC (AWE) is a Delaware limited liability company formed in 2009 as a special purpose entity to develop, build, own and operate the proposed Antrim Wind Power Project.

In 2011, AWE approached Professor Ross Gittell, P.h.D and Matthew Magnusson, M.B.A. from the University of New Hampshire's Whittemore School of Business and Economics to independently examine the potential impact of the Project on the local area economy in Hillsborough County and the surrounding counties in New Hampshire. The intent of the economic impact assessment was to inform the members of the New Hampshire Site Evaluation Committee and other stakeholders as to the expected local area economic impacts of the Project. In conducting this economic analysis, emphasis was placed on providing conservative estimates of the economic impacts of the Project.

To evaluate the local area economic impacts of the Project, the research team drew on their previous research performed that had focused on the economic impacts of wind power projects in New Hampshire including: 1) the New Hampshire Renewable Portfolio Standard legislation, 2) New Hampshire's participation in the Regional Greenhouse Gas Initiative (RGGI), 3) green industry employment in New Hampshire, 4) the Granite Reliable Power Windpark in Coos County, and 5) the Groton Wind Farm in Grafton County. The research team also considered current studies related to the economic costs and benefits of wind power project developments.

The research team considered the direct, indirect and induced economic impacts of the Project on the economies of the Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties. This analysis included evaluation of the local area economic impacts during the construction phase and the on-going operations phase. Economic factors considered in the update were: employment, local capital expenditures, tax revenue, local material and supplies purchases, landowner payments and the broader economic "multiplier" impacts of the Project.

The economic impact assessment titled *Economic Impact of the Proposed Antrim 30 MW Wind Power Project in Antrim, New Hampshire* was issued in January 2012. Ross Gitell was primary author and Matthew Magnusson was secondary author. Matthew Magnusson conducted all JEDI and IMPLAN modelling in the original assessment.

In 2014, AWE approached Matthew Magnusson of the consulting firm Seacoast Economics to review the assessment and its findings and conclusions, to consider modifications that had been made to the Project, and to update the assessment as necessary. Ross Gittell was not available to participate in the assessment update. The intention of the update was to inform the members of the New Hampshire Site Evaluation Committee of the expected local area economic impacts of the Project for the re-filed application utilizing the most currently available research.

The following activities were undertaken to update the original economic impact assessment:

1. Review the economic impact analysis *Economic Impact of the Proposed Antrim 30 MW Wind Power Project in Antrim, New Hampshire*.
2. Review any economic studies released after the original economic impact analysis that may inform the findings in this economic impact analysis update.
3. Update the economic impact analysis with the latest available economic information and include any changes made to the Project using the same methodology as that used in the original economic impact analysis.

B. Methodology & Assumptions

In the economic impact analysis update, the following economic modeling tools were used:

Jedi Land-based Wind Model The Job & Economic Development Impact (JEDI) Land-based Wind Model *release W4.28.14* was obtained from the National Renewable Energy Laboratory (NREL).In appendix D on page 15, there is additional discussion of the JEDI model.

MIG IMPLAN IMPLAN *3.1.1001.12* (2013 data) was used to develop multipliers of the defined local area economy. These multipliers were used in the JEDI model. In appendix E on page 16, there is additional discussion of the IMPLAN economic model.

Spreadsheet modelling Employment data available through the U.S. Bureau of Labor Statistics was analyzed using spreadsheet modelling to supplement and expand on the model outputs from the JEDI and IMPLAN models.

The Project was evaluated in two phases: construction and on-going operations (post-construction). In determining the job impacts of the Project, the "Study Area " was defined as the Cheshire, Hillsborough, Merrimack, Rockingham and Sullivan counties.

A capital expenditure (CAPEX) budget for the Project was provided by Antrim Wind Energy, LLC and was used as the basis for customizing the expenditure categories in the Jedi Land-based Wind Model to Antrim Wind Power Project. Hourly construction rates—based on data submitted by Reed & Reed, Inc.—were calculated for each of the JEDI model job categories. For the job categories, the percentage of labor coming from local sources was based on information provided by Antrim Wind Energy, LLC, Reed & Reed, Inc., and Jedi Land-based Wind Model default inputs. Antrim Wind Energy, LLC and Reed & Reed, Inc. provided itemized estimates of labor and operation costs (including percentage expected to be spent locally), taxes, and land lease payments for the on-going operations phases.

Confidentiality provisions in proposals received by Antrim Wind Energy, LLC for the Antrim Wind Power Project require that only aggregated economic impacts be presented and discussed in this report.

Table 4: JEDI job category model inputs

Job Category	% Local Area
Foundation	30%
Erection	30%
Electrical	30%
Management	30%

The NREL Jedi Land-based Wind Model was used to calculate the direct, indirect and induced jobs associated with the construction phase of the project. The Jedi Land-based Wind Model calculated direct jobs as the sum of jobs associated with foundation preparation, turbine erection, electrical installation, management/supervision services, and professional services.

Demand from material expenditures in these different sectors combined with economic activity from direct construction employment was used by the Jedi Land-based Wind Model to calculate indirect and induced economic activity associated with the construction phase of the project. In calculating these impacts, economic and employment multipliers were obtained from the IMPLAN model for the specific New Hampshire counties of interest and applied to

the Jedi Land-based Wind Model. The Jedi Land-based Wind Model was used to calculate the direct, indirect and induced economic impacts of the on-going operations phase of the Project. The Jedi Land-based Wind Model took inputs of direct employment wages, local company expenditures, tax payments, and land lease payments.

Separately the potential for Hillsborough County and the surrounding area to supply direct types of construction labor for the project was assessed. A list of industries directly involved in wind construction, based on the North American Industry Classification System (NAICS), was developed. Employment and wage data for 2014 was obtained from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages for the counties considered in this analysis. In this study, industry location quotients (LQ) were calculated by comparing the industry's share of regional employment with its share of national employment. In appendix F on page 18, there is additional discussion of location quotients.

Table 5: NAICS classifications of direct industries in wind power project construction

NAICS	Category Description
23713	Power and Communication Line and Related Structures Construction
23731	Highway, Street, and Bridge Construction
23811	Poured Concrete Foundation and Structure Contractors
23812	Structural Steel and Precast Concrete Contractors
23821	Electrical Contractors and Other Wiring Installation Contractors
23891	Site Preparation Contractors

B.1. Assumptions

The following assumptions were made in this analysis:

- The investment that will occur in the Project in the defined local area would not have otherwise gone to a similar magnitude capital expenditure. In other words, if the Project were not to move forward, it is not anticipated that the investors supporting the Project would make a similar investment in another infrastructure project of greater economic impact in the defined local area.
- That the project will be completed and achieve commercial operation; and that the construction will move forward in an orderly manner. That funds will be spent as indicated in the Capex provided by Antrim Wind Energy, LLC and the project estimates provided by Reed & Reed, Inc.
- The average annual PILOT payment over a 20 year period is assumed to average $398,879 annually or $8.376 million in total and will follows the language in the agreement PAYMENT IN LIEU OF TAXES AGREEMENT BETWEEN THE TOWN OF ANTRIM AND ANTRIM WIND ENERGY LLC signed June 27, 2013 and FIRST AMENDMENT TO PAYMENT IN LIEU OF TAXES AGREEMENT signed November 24, 2014. This assumes a $100,000 payment for year 1 (encompassing start and end of construction) followed by an $11,250 payment per MW that increases at a rate of 2.5% annually thereafter.
- Tax payments in the defined local area consist of Payment In Lieu of Taxes (PILOT) payments, New Hampshire Utility Property Tax, and Business Enterprise Tax (BET).
- Wholesale electricity rates will not change due to the Project. See section 3.1 on page 6 for additional discussion of this assumption.
- No manufacturing of wind turbine components or related electrical components occurs in NH.
- For on-going operations, that there will be an average of 4 FTE jobs on-site—combination of direct employees of Antrim Wind Energy, LLC and contracted employees of the wind turbine manufacturer— based on information provided by Antrim Wind Energy, LLC.
- Residential property values will not change due to the Project. See section 3.3 on page 7 for additional discussion of this assumption.
- Economic activity from tourism will not change due to the Project. See section 3.4 on page 7 for additional discussion of this assumption.
- That there is not a mutually exclusive higher value economic activity that would otherwise occur in the Project footprint. This assumption is supported by landowners accepting land lease payments in exchange for use of their land from Antrim Wind Energy, LLC.

C. Economic Impact Analysis

The technique used to estimate the economic activity in this study is called economic impact analysis. Economic impact analysis describes how spending from a particular project, event, or industry flows through a study area (e.g. a county, group of counties, state, or group of states) and it can be useful in estimating how an economic change—such as the loss of an existing industry or the addition of a new industry—would be expected to affect the wider local or regional economy in the study area.

Economic impact analysis begins with evaluating the change in gross output or expenditures of businesses that are "directly impacted" by the change of interest. Increased expenditures by these businesses (referred to as **direct** expenditures) trigger a series of additional spending flows throughout other sectors of the local economy as businesses spend on 1) payroll and benefits, and 2) supplies, equipment, and service contracts with local vendors (referred to as **indirect** expenditures). The purchase of goods and services from local vendors supports the hiring of workers at those firms and also provides funds to enable those firms to purchase additional goods and services from suppliers situated further down the supply chain.

The activity at companies involved in direct or indirect expenditures results in their employees earning salaries and wages. A portion of their wages will be spent on local goods and services at different industries including: health care, retail, and leisure (referred to as household spending or **induced expenditures**). This round of spending by employees helps support workers in those industries who then will spend portions of their incomes locally which, in turn, triggers another round of spending.

This entire chain of spending is referred to as the "ripple" or "multiplier" effect. The rounds of spending and re-spending do not continue indefinitely but typically diminish rapidly. The impacts of the initial economic activity rapidly leave or "leak" out of the local economy through the imports of goods and services produced in other regions, savings, spending in areas outside the local economy, and taxes.

Effects evaluated in economic impact analysis:

- **Direct effects**:
  - The direct activity of the economic change.
  - Typically defined in terms of output or employment.
- **Indirect effects**:
  - The impacts of firms that supply the activity defined in the direct effect.
  - Also called a Type I multiplier.
- **Induced effects**:
  - The impacts of spending by households receiving income based on both the direct and indirect effects.
  - Also called a Type II multiplier.

D. Jobs and Economic Development Impact (JEDI) model

The Jobs and Economic Development Impact (JEDI) model is a Microsoft Excel™ based economic tool developed by the U.S. National Renewable Energy Laboratory (NREL). The JEDI model provides an estimate of the employment and economic impacts that will likely result during the construction and operating periods of a new energy generation project based on user-entered project-specific data or default inputs derived from industry norms. For example, the JEDI model can estimate the number of in-state construction jobs from a new wind power project. The JEDI model does not calculate or report any type of intangible effects–including environmental benefits or power grid improvement—from new projects.

The JEDI model reports gross impacts from the project analyzed.[4] Jobs, earnings, and output estimated by the JEDI model are distributed across three categories:

- Project Development and On-site Labor Impacts
- Local Revenue and Supply Chain Impacts
- Induced Impacts

The Jedi model calculates the number of jobs for any given job category as full-time equivalent (FTE). A FTE job is equal to 2,080 work hours.

The JEDI model utilizes economic input-output data derived from the Minnesota IMPLAN Group (MIG) to estimate the local economic activity and the resulting impact from new energy generation plants. State multipliers for employment, wage and salary, and output and personal spending patterns are derived from the MIG accounting software. These input-output relationships are updated from IMPLAN every two years. The IMPLAN model considers 536 industry sectors in its economic analysis engine. The JEDI model aggregates the industry sectors in IMPLAN down to 14 industry sectors. The JEDI model allocates inputs for capital expenditures to employment and economic activity in the 14 different industry sectors. In appendix E on page 16, there is additional discussion of the IMPLAN economic model.

The National Renewable Energy Laboratory performed interviews with power generation project developers, state representatives, and other industry stakeholders to determine appropriate default values for the JEDI model. However, as actual project spending on goods and services can vary significantly by project and location, these values can be adjusted by the user to account for variability among projects and specific locations. Project-specific data that can be entered into the JEDI model includes: construction costs,equipment costs, annual operating and maintenance costs, land lease payments, and local tax rates. Expenditures are adjusted to account for only those spent in the defined local area economy.

[4] "Limitations of JEDI Models," NREL, available on-line at http://www.nrel.gov/analysis/jedi/limitations.html

E. IMPLAN Economic Model

IMPLAN (IMpact analysis for PLANing) is a system of software and databases produced by the Minnesota IMPLAN Group (MIG), Inc that is widely used and accepted for local and regional economic modelling. IMPLAN was originally developed in 1976 by the US Forest Service, the Federal Emergency Management Agency, and the Bureau of Land Management to allow for analysis of private and public sector decisions on local, state and regional economic impacts. MIG, Inc. was formed in 1993 to privatize the development and maintenance of IMPLAN data and software. IMPLAN is currently in its third version.

MIG compiles and aggregates national and regional economic and demographic data to calculate inter-industry linkages and the relationships between changes in demand for goods and services, and the associated economic activity at the local, state and regional levels. IMPLAN utilizes input-output (I-O) accounts to model how the more than 500 industries that comprise the U.S. economy interact. Input-output (I-O) analysis quantifies the relationships of how industries provide input to and use output from each other. IMPLAN data and accounts follow the accounting conventions used by the U.S. Bureau of Economic Analysis (BEA) when developing an Input-Output (I-O) model of the U.S. economy as well as formats recommended by the United Nations.

The IMPLAN program uses an ordered series of steps to build the model starting with selection of a study-area. The study-area can be at the county level (including multiple counties), the state level (including multiple states), and the national level. The IMPLAN model allows substitution of data at each stage of the process which can serve to increase the robustness of the model. The model can also have its import and export functions modified and industry groupings changed. IMPLAN also allows for the creation of aggregate models consisting of industries grouped together to streamline the modeling process.

The creation of the study-area database constructs a descriptive and prescriptive model. The descriptive model describes the transfer of money between industries and institutions. This model provides data tables on regional economic accounts that capture local economic interactions. These tables describe the local economy in terms of the flow of dollars from purchasers to producers within the study-area region. The descriptive model also produces trade flows the movement of goods and services within a study-area and the outside world (regional imports and exports).

The prescriptive model is a set of input-output multipliers that estimate total regional activity based on a change entered into the IMPLAN model. Multiplier analysis is used to estimate the regional economic impacts resulting from a change in final demand. New industries or commodities can be introduced to the local economy, industries or commodities may be removed, and reports can be generated to show the consequences (on output, employment, and value-added) of various impacts. Impacts include: output, labor income, value added, and employment. Impacts can be in terms of direct and indirect effects (commonly known as Type I multipliers), or in terms of direct, indirect, and induced effects.

Implan applies historical relationships between demand and the resulting economic activity to estimate how new expenditures will affect economic development metrics including jobs and earnings. Results are based on the assumption that all industrial inputs and factors of production are used in fixed proportions and respond perfectly elastically. This means that the impacts will typically be linear or directly proportional to the size of the impact without respect to economies of scale. Also, prices do not change with demand. This type of model is appropriate where the additional source of demand is a small proportion of the local economy, or the economy is relatively open and integrated with outside economies.

Table 6: Implan summary measures of regional economic activity

Measure	**Description**
Output	The value of production by industry in a calendar year. Output is measured by sales or receipts and other operating income plus the change in inventory. For retailers and wholesalers output is equal to gross margin not gross sales.
Labor Income	All forms of employment income, including employee compensation (wages and benefits) and proprietor income.
Value Added	The difference between total output and the cost of intermediate inputs. It is a measure of the contribution to Gross Domestic Product (GDP) and equals output minus intermediate inputs. Value added consists of compensation of employees, taxes on production and imports less subsidies, and gross operating surplus.
Employment	The annual average of monthly jobs in an industry and includes both full-time and part-time workers.

Table 7: Examples of underlying data sources for the IMPLAN model

Source	**Data**
U.S. Bureau of Labor Statistics (BLS)	Census of Wages and Employment (CEW) County Business Patterns
U.S. Department of Census	Annual Survey of Manufacturers (ASM) Construction Spending (Value Put in Place)
Bureau of Economic Analysis (BEA)	Regional Economic Information System (REIS) National Income and Product Accounts (NIPA) Gross State Product (GSP) series Output series

F. Location Quotients

A location quotient (LQ) is an economic statistic that measures a region's specialization for a given economic measure (e.g. gross product or employment) relative to a larger geographic area (usually the overall nation). One of the most frequent applications of a LQ is the ratio of an industry's share of a region's employment—region could be a town, county, counties, state, states, etc.— relative to its share of total national employment.

$$LQ = \frac{\frac{e_i}{e}}{\frac{E_i}{E}} \tag{1}$$

$e_i = Industry's\ regional\ employment$
$e = Total\ regional\ employment$
$E_i = Industry's\ national\ employment$
$E = Total\ national\ employment$

For example, a LQ of 1.0 in an industry—such as wholesale merchants—indicates that the region and typically the nation (as the larger geographic area) are equally specialized in wholesale merchant activity; while a LQ above 1.0 indicates that the region has a "strength" in wholesale merchant activity evidenced by its higher concentration than the nation . Conversely, a LQ below 1.0 indicates that the region had a "weakness" in wholesale merchant activity evidenced by its lower concentration than the overall nation .[5]

LQs can help reveal what makes a particular region "unique" by highlighting the industries that differ from the overall nation. LQs can also be used to identify the *export orientation* of an industry. A value above 1.0 would indicate that the industry is export oriented as it would be believed to be supplying more than the local needs of the region's economy. Conversely, a value below 1.0 would indicate that the industry is not export oriented. Exports can be a source of economic growth for an economy.

[5] "What are location quotients (LQs)?" U.S. Department of Commerce, available on-line at http://www.bea.gov/

G. Study Author

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