Wind Power and Economic Impact Analysis

Economic Impacts of Wind Power in Kittitas County--ECONorthwest

Two different wind energy companies (Zilkha Renewable Energy and enXco) are currently developing plans for constructing and operating wind power turbines in Kittitas County, WA. ECONorthwest was hired by the Phoenix Economic Development Group to evaluate the potential economic impacts of constructing and operating the wind plants in Kittitas County. Specifically, ECONorthwest was asked to analyze and help quantify impacts in three key areas of interest:

- Property values: possible reduced property values due to views being “marred” by turbines
- Economic impacts: possible job creation and increased spending during construction phase and during plant operations
- Tax revenues: due to the increased jobs and spending

ECONorthwest utilized several different analysis techniques. They surveyed tax assessors in other counties with wind projects to determine the potential effects of wind farms on property values. They also conducted a review of the available academic literature for additional information on property value effects. Local economic impacts were estimated using an input-output model based on construction and operations data obtained from the two companies proposing the wind projects. Tax revenues were estimated from the input-output model results based on tax rate and spending information obtained form Kittitas County.

Property Values

- ECONorthwest conducted a phone survey of tax assessors for counties that recently had wind turbines installed in their areas, with the finding that views of wind turbines do not negatively impact property values.
- In addition, ECONorthwest reviewed the current literature for statistical studies that quantified the impact of wind turbines on property values. There was only one such study available for review, and it was a hedonic study done in Denmark. The study showed that house values were lower close to wind farms that other houses located farther away but with otherwise similar characteristics. This result was based on a small sample of homes, however, and the difference in home price was not statistically significant.

Economic Impacts

ECONorthwest interviewed representatives from both Zilkha and enXco to determine the amount of spending and employment for the proposed projects. Using this information, they used a regional input-output model with data specific to Kittitas County to estimate the economic impacts of the project, for both the construction phase and the operations phase of the project.

- Construction
    - Input parameters for the construction phase (of 260 individual wind turbines)
        - 85 full and part time local construction jobs

        - 10 full and part time jobs for wind company and utility personnel to manage the plant construction phase
        - $6,400,00 in local spending on construction materials
        - $886,000 in spending on food and lodging for non-local labor brought to Kittitas County for the construction period
    - Based on these and other input parameters, they estimated the impacts to the local economy for a construction period predicted to last approximately one year.
    - Their results show that most of the spending during this phase occurs in the Construction sector. Sectors that will support this sector, such as the Wholesale and Retail Trade and Services sectors will also see a significant increase in spending.
- Operations
    - During the operations phase, spending will consist of primarily:
        - 22 employees hired to operate and manage the wind power plants
        - spending on equipment, maintenance, and materials to operate the wind turbines (no figure given)
        - income to property-owners that rent land for the wind turbines ($4,500 per turbine)
    - The impact to the local economy due to the wind plant operations was modeled based on these factors. Most of the impacts during this phase will be in the Transportation, Communications, and Utilities sector. The Real Estate and Service sectors will also see increased economic activity due to the continued operation of the wind farm.

Tax Revenues

The overall increase in economic activity from the wind power plant will increase tax revenues for Kittitas County. Based on their review of Kittitas County budgets and spending, and their evaluation of the proposed wind power facility, ECONorthwest estimated the potential revenue impacts for the county.

The primary increase in tax revenues is from property taxes on the wind turbines themselves. For this calculation, they valued each turbine at approximately $765,000, which is consistent with their experience in other wind projects and with the information provided to them by the wind companies involved with the Kittitas County project. The property tax rate used for the calculation is 1.35% for Kittitas County. Given these parameters, for the proposed 260 turbines, they estimate new property tax revenues of $2,683,125 annually.

The development of this project will also have an effect of increasing the value of other properties due to the increase in wages and overall economic activity in Kittitas County. This results in an additional $201,971 in property tax revenues annually due to increases in other property values. The property tax revenue estimates reflect funds that are spent in a variety of sectors, both inside and outside Kittitas County.

In addition to these property taxes, ECONorthwest estimated the tax revenue that will accrue to the Kittitas County Government. This was done by comparing the current tax revenues as a fraction of total econo9mic output for Kittitas County with and without the wind farm. Using the results from their I-O model, they estimated the total increase in economic output from the proposed wind plant. Given the increase of output with the project, they estimated the increase in tax revenues assuming that tax rates remained constant. For each individual tax, the increases were generally on the order of 0.2% annually. Note that ECONorthwest did not attempt to estimate the increases in costs or the provision of county services (i.e., fire, sheriff) that the wind power plant might require.

Modeling Process

- Used IMPLAN input-output model to estimate the impacts
- Ideally, expenditures for the proposed wind farm would be available and specific enough to allocate to each of the 528 sectors contained in the IMPLAN model. In addition, the expenditures should be delineated between local and non-local providers, as purchases of goods and services from out-of-state vendors will have no economic impact on Washington employees and businesses. In absence of this detailed information, ECONorthwest opted to use the production function data for the utility and government sectors contained in the IMPLAN modeling software. From and I-O modeling perspective, this is a standard modeling approach in the absence of detailed primary source data. Indeed, IMPLAN's production function data contains information, called regional purchase coefficients that describe the proportion of a given commodity that will be provided by Washington producers. ECONorthwest's previous modeling experience has shown that the data contained in the IMPLAN modeling system for the various sectors are sufficient to permit an accurate rendering of impacts.

<u>Appropriate Methodology for Assessing the Economic Development Impacts of Wind Power</u>—Northwest Economic Associates (NEA)

NEA investigated three case study areas in the U.S. where wind power projects were recently developed. The methodology used for that study is summarized here in order to provide guidance for future studies of the economic impacts of other wind power developments.

Identify Project Phases

Wind power development results in local economic impacts during two different phases: construction, which creates a one-time surge in economic activity, and operation and maintenance (O&M), which makes an ongoing economic contribution by creating long-term jobs and continuing income streams. Both phases should be analyzed to offer a more complete picture of the economic benefits from a project.

Identify Inputs and their Sources

To relate these inputs to the local economy, it is necessary to determine which inputs are obtained locally as opposed to inputs obtained from sources outside of the local area.

Researchers should first attempt to obtain these data from the project developer. When data on inputs for construction are not readily available, information can be obtained through interviews of potential suppliers in the local area. This information, combined with knowledge of the local economy, allows the estimation of what inputs are necessary, and which inputs can be obtained from local sources. The search for information should focus on those activities likely providing the greatest opportunities for local inputs and local economic impacts, such as the construction of roads, tower foundations, and operations buildings.

Estimate Direct, Indirect, and Induced Effects

Using knowledge about local sources, and about the local economy, it is possible to identify those elements that have a direct effect on the local economy. A relatively straightforward situation typically involves a single industry which already exists in the study area and for which the value of a new or additional output can be measured. The total value of the additional final demand can easily be calculated based on the quantity of new output and its value per unit. This change in output (in monetary terms) is entered into the model, which then estimates the impact on the rest of the economy (the indirect and induced effects).

Use Established Economic Models to Estimate Effects

NEA employed the IMPLAN I-O model to measure the additional impact that the direct effects identified for the construction and O&M phases have had on the local economy, in terms of additional industry output, employment, and income. NEA used county-level IMPLAN data to develop models for each of the case study regions. The models were used to estimate the effects on the rest of the local economy of spending related to the initial construction and ongoing O&M of the wind power developments.

More complex situations arise when the business is contained in an industry sector that is aggregated from dissimilar production technologies. This applies in the case of wind power, as wind power generation is included in the electric services industry, along with hydropower, coal and gas-fired power generation, and nuclear power production. Even without a specific production function for wind power generation, the technology varies significantly among electricity generators represented in the IMPLAN electric services industry. Even if the value of output from a wind power project could be estimated, entering this value as a final demand change to the electric services industry could lead to misleading impact estimates. It is therefore necessary to use care in portraying the changes in final demand associated with wind power construction and O&M.

For construction, the estimates of final demand changes include local expenditures made by labor for specific IMPLAN sectors, such as fuel, lodging, eating and drinking, or retail trade. Construction inputs purchased from local suppliers are also estimated and entered as changes in final demand for these items. The effects on output, income, and employment are estimated in the model.

For O&M, much the same process is followed. The exception is that jobs in the electric services industry are located permanently in the local area. By entering an "expenditure pattern" for local O&M expenses in the same manner as for construction these jobs are not picked up in the effects measured by the model. To adjust for this occurrence, these jobs in the electric services industry are estimated outside the model and added to the results estimated by the model. Land-owner revenues and tax impacts are entered into the model as a change in local household spending, resulting in additional impacts within the local economy.

Consider Returns an Invested Capital

Another major input into O&M for wind power projects is the return on the initial capital investment. Such impacts should be considered for those projects where local investors play a significant role.

Ideal List of Inputs for Wind Power Development Projects

- Construction costs
  - Materials
    - Construction (concrete rebar, equipment, roads, and site prep)
    - Transformer
    - Electrical (drop cable, wire)
    - HV line extension
  - Labor
    - Foundation
    - Erection
    - Electrical
    - Management/Supervision
  - Equipment costs
    - Turbines (excluding blades and towers)
    - Blades
    - Towers
  - Other costs

        - HV Sub/Interconnection
        - Engineering
        - Legal services
        - Land easements
        - Site certificate/permitting
- Annual O&M costs
    - Personnel
        - Field salaries
        - Administrative
        - Management
    - Materials and services
        - Vehicles
        - Miscellaneous services
        - Fees, permits, licenses
        - Utilities
        - Insurance
        - Fuel (motor vehicle gasoline)
        - Tools and miscellaneous supplies
        - Spare parts inventory
    - Financing (average annual debt payment)
    - Equity payment—individuals (average annual payment)
    - Equity payment—corporations (average annual payment)
    - Land lease

<u>The Energy Balance of Modern Wind Turbines</u>—Wind Power Note

This paper calculates the energy balance in the manufacture, operation, maintenance, and scrapping of a typical modern wind turbine. The basic calculation method is input-output analysis using the energy matrices published by Danish Central Bureau of Statistics.

Basic Assumptions

Modern wind turbines have a design lifetime of 20 years. The basis for the calculations is a modern Danish 600 kW wind turbine manufactured in 1995. The basis for cost calculations is the cost of wind turbine installation for private individuals—power companies may have somewhat lower costs since they usually place turbines in wind parks.

Annual costs of operation and maintenance (O&M) are assumed to be at the level of 3 percent of the price of the turbine. This corresponds to historical Danish experience, though the assumption is probably outdated for the large wind turbines today. A figure between 1.5 and 2.5 percent would appear more reasonable since larger turbines should imply lower maintenance cost per kW installed power.

Energy Use in the Manufacture and Installation of a 600 kW Wind Turbine

The domestic market price of a 600 kW Danish wind turbine was on average 3 million DKK at the end of 1995. The estimated ex factory value of the different components of a wind turbine are also given, as well as the installation costs and the O&M costs of the turbine. The Danish Central Bureau of Statistics publishes so-called *energy multipliers* each year for each of the 117 sectors of the Danish economy. These multipliers indicate the direct and indirect global use of energy per 1 million DKK of gross value-added.

It is obvious that there is some uncertainty in both the calculation of the energy multipliers and the implicit assumption that the energy use in the production of wind turbine components corresponds to the average energy use per million DKK of gross value-added. However, this method has many important advantages compared to engineering calculations of energy use in the manufacture of different products. Firstly, the I-O method accounts in great detail for the energy use in subcomponents and raw materials. Secondly, the tables have been constructed to ensure that the sum of energy use per sector and in total corresponds exactly to deliveries from other sectors. The substantial amount of detail in the 117 subsectors of the economy furthermore enables us to make calculations on the basis of individual components of the turbines. The advantage of this method is that we eliminate several potential sources of bias if wind turbine components differ from the average in the fabricated metal sector. Potential errors at the detailed sectorial level would tend to cancel out, in any case. Consequently, there is good reason to give a substantial amount of credibility to the *totals* rather than the subtotals for individual components, as economists familiar with I-O analysis will be aware.

Operation and Maintenance of a 600 kW Wind Turbine

The Automobile Repair Services sector was used when calculating the energy content in O&M, since that sector is as close as one can get to something resembling wind turbine service.

Scrapping of a 600 kW Wind Turbine

Many parts of a wind turbine may be dismantled and re-used for other purposes. I-O analysis was not used for this particular calculation, since these very specific processes are not adequately covered by any particular sector in the available tables. An engineering calculation was therefore used.

<u>A Guidebook for Estimating the Local Economic Benefits of Small Wind Power Projects for Rural Counties in Washington State</u>--ECONorthwest

Project Background

ECONorthwest anticipates that this guidebook will be useful for analysts at county or local government agencies, local economic development groups, and non-profit organizations that are interested in determining the potential economic benefits of wind power in the local area.

The economic benefit factors developed for this guidebook rely on IMPLAN model results. In addition, IMPLAN is the model chosen by the National Renewable Energy Lab (NREL) and the National Wind Coordinating Committee (NWCC) in recent projects analyzing the economic benefits of wind power. This model has also been used by ECONorthwest to estimate the economic impacts of specific wind power plant projects in the Pacific Northwest.

ECONorthwest has narrowed the focus of this guidebook to address only economic benefits and these are presented in a relatively aggregated form. They believe that this level of detail is sufficient for most county-level planning purposes.

The tool most closely-related to this guidebook is the JEDI-WIM model developed by the US Department of Energy and the NREL. The model runs using Microsoft Excel and is available for free download at: http://www.eere.energy.gov/windandhydro/windpoweringamerica/filter_detail.asp?itemid=707. Like this guidebook, the JEDI-WIM model uses IMPLAN to estimate the economic benefits of wind projects at the county level. The primary difference between the JEDI-WIM model and this guidebook is the treatment of locally-owned projects (community wind). Currently, the JEDI-WIM does not provide an option for analyzing the additional local economic benefits of community wind projects. As discussed below, this guidebook provides factors for estimating the additional benefits of locally-owned projects.

Economic Benefit Estimation Method

Input-Output Model Framework

ECONorthwest developed the wind project inputs for the IMPLAN model based on 1) cost information supplied by the Lawrence Berkeley National Laboratory and 2) the availability of local materials and labor for the construction and operation of the wind plant based on information obtained from several wind companies as part of other economic development studies conducted by ECONorthwest.

Counterfactual Scenario

In many cases with wind power projects, the choice is relatively straightforward between building or not building the facility. In more complex cases, the choice may be between constructing the wind plant or using the same land for commercial development. In this latter case, the benefits that would have resulted from the commercial development need to be subtracted from the wind plant benefits in order to determine the *net economic benefit* of the project.

Due to the almost limitless range of possible alternative development scenarios, this guidebook does not attempt to estimate counterfactual scenario benefits. In those cases where there is a credible counterfactual development scenario other than the nobuild option, ECONorthwest encourages local agencies to conduct a separate study to determine the economic impacts of the alternative development scenario and use these estimates in their assessment of the net economic benefits associated with the wind plant.

Non-Market Costs and Benefits

Non-market benefits include environmental attributes such as reduced emissions and improved air quality. While the existence of these wind power benefits is generally agreed upon, determining the magnitude of these benefits is notoriously difficult. Nonetheless, they are benefits that should be considered when evaluating the potential merits of a wind plant.

In addition to non-economic benefits, wind power projects also can generate concerns about external costs that negatively impact the community. Common concerns include the effect of the wind turbines on birds and the potential negative effect that views of wind turbines might have on property values. Recent research has shown that costs from these types of impacts are typically negligible or non-existent with a well-designed wind facility, but concern regarding these impacts persists.

Geographic Areas

For this guidebook, ECONorthwest describes only those benefits that accrue to the *county* where the wind plant is located. For example, money that is spent outside of the county to purchase equipment for a wind plant inside the county is not considered a benefit in these calculations, as spending in the outside county would not provide any economic impact within the county being studied.

This guidebook provides estimates for 6 individual counties in Washington. These counties were chosen because they provide a good mix of rural counties within the state and cover a wide geographic area. For adjacent counties, or counties where the characteristics are known to be similar, benefit estimates from one of the original 6 counties can be applied.

Large urban counties were specifically omitted from this analysis. This guidebook is intended to assist in estimating economic benefits for rural areas, and including these large counties would artificially inflated the economic benefit estimates for the less populous regions. Analysts interested in estimating benefits within these urban counties should consider conducting a separate study tailored specifically for their project.

Wind Plant Cost Assumptions

Not all costs will increase proportionately to the size of the project, and the costs per MW for some items will decrease with larger projects due to economies of scale. The focus of this guidebook is on a 1.5 MW project, and ECONorthwest recommends that the cost information presented here be used only for projects less than 10 MW in size. Even within this narrower range, actual costs may still vary across project sizes. With these caveats in mind, the numbers presented in the guidebook can be considered reasonable approximations for project costs and economic benefits and can be used in the absence of a more detailed, project-specific analysis.

For the construction phase, information on wind plant costs will vary from application to application and a common assumption for construction costs is $1 million per MW capacity. For this guidebook, ECONorthwest was able to utilize more detailed construction cost information that was provided by LBNL for use in their I-O model.

Similar information for wind plant operation and maintenance costs was provided by LBNL for use in the model. The costs are for the first year of operation and these costs will increase over time due to inflation. This guidebook does not attempt to include the various changes in tax costs over time, such as depreciation and property values as the equipment ages, as these will vary significantly across counties and projects.

To estimate the revenues associated with power sales from the wind plant, ECONorthwest also needed to make assumptions on power production and expected revenue from power sales. These parameters can vary substantially across locations, particularly the capacity factor that measures the amount of time that the wind plant will be producing power in a given year. They assumed a price of $0.04 per kWh generated to develop the economic benefit factors. This is likely higher than the price that would be paid for the power alone and assumes that the Green Tags are also sold in order to achieve this price. Other incentives, such as the Federal Production Tax Credit, will also increase the overall price that can be achieved for wind power sales.

Economic Benefit Calculations

Construction Phase Impacts

A large portion of the economic benefits is created during the construction phase, as this is when the majority of the project spending occurs. These are one-time benefits that last as long as the initial construction period. Impacts include:

- *Output* of the project is measured by the increase in all economic activity within the county and is measured as the change in sales of goods and services. Output can be expected to increase during wind plant construction due to the hiring of construction workers, the purchase and rental of equipment, and general increases in spending commonly associated with large construction projects.
- *Wages* reflect the change in wage income for workers within the county during the construction phase. Changes in wage income occur due to a direct impact of the hiring resulting from the wind plant construction, and from the general increase in spending in the county for all affected industries during the construction period. Note that wages are a subcomponent of the output benefit measure and consequently should not be added together with the output value when determining total benefits.
- *Business Income* is a component of the broader output category discussed above. While output reflects all economic activity within the county, business income refers only to the change in income to local businesses. As with wages, business income is a component of output and consequently its value should not be added together with the output value as this will double-count the total benefits of the project.
- *Jobs* show the change in full-time and part-time jobs within the county that will result from the wind plant construction. These jobs will last for the duration of the construction period.
- *State and Local Taxes* changes result from the increase in economic activity plus the change in real property value due to the completed wind project.

Operations Phase Impacts

Economic benefits continue to accrue throughout the period when the wind power plant is operated, but at a generally lower rate than during the construction phase.

Benefits result during this phase due to power sales, rental payments to landowners, and payments to staff and engineers to maintain and operate the turbines. These benefits occur annually throughout the life of the project (15 to 20 years).

The operations benefits result from spending on plant management and maintenance needed to keep the wind farm functioning smoothly. In addition, rents paid to landowners (and the subsequent spending of this money) also create economic benefits during the operations phase. Finally, if the wind plant is locally- or community-owned, then electricity sales will also create economic benefits for the county.

In general, annual operations phase impacts tend to be lower than construction phase impacts. However, these economic benefits are achieved annually throughout the life of the wind plant. The operations phase benefits will likely change over time depending on cost inflation and depreciation of the equipment over time.

<u>An Analysis of the Economic Impact on Utah County, Utah from the Development of Wind Power Plants</u>—U.S. Department of Energy

For this evaluation, economic and demographic data were obtained in the Fall of 2005 from three sources: 1) the Economic Development Corporation of Utah (EDCU), 2) IMPLAN multipliers for Utah County supplied by NREL, and 3) two local wind developers.

General Overview of JEDI Model

JEDI is an easy-to-use model to analyze the economic impacts of constructing and operating wind power plants. Users enter basic information about a wind project (i.e., state, year of construction, facility size) to determine project cost (i.e., specific expenditures) and income (i.e., wages and salary), economic activity, and number of jobs that will accrue to the state or local region from the project. The more project-specific the data, the more localized the analysis.

Although JEDI contains default data for virtually every input field, not every project follows 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 power plant components can have a significant effect on the costs and the economic benefits that accrue to the state or local region.

Project-specific data include costs associated with actual construction of the facility and supporting roads as well as costs for equipment, annual operating and maintenance costs, and expenditures spent locally, financing terms, and tax rates. Specifically, the model requires the following project inputs:

- Construction Costs (materials and labor)
- Equipment Costs (turbines, rotors, towers, etc.)
- Other Costs (utility interconnection, engineering, land easements, permitting, etc.)
- Annual Operating and Maintenance Costs (personnel, materials, and services)
- Other Parameters (debt and equity, taxes, and land lease)

The model provides reasonable default values for each of the above inputs and all of those necessary for the analysis. As incorporated in the model, these values represent average costs and spending patterns derived from a number of sources (project-specific data contained in reports and studies) and research and analysis of renewable resources undertaken by the model developer during the past 10 years.

In addition to the above input parameters, the JEDI Model allows users to input local taxation parameters, local ownership percentages, land lease easement payments, and county multipliers, among other inputs.

How the JEDI Model Works

The JEDI Model was developed to enable spreadsheet users with limited economic modeling experience to identify county-level, regional, and/or statewide economic impacts associated with constructing and operating wind power generation facilities. JEDI's user add-in feature allows researchers to conduct county-specific analyses using county IMPLAN multipliers, while state-level multipliers are contained within the model as default values for all 50 states.

JEDI is an I-O model, an analytical tool developed to trace supply linkages in the economy. I-O analysis is a method of evaluating and summing three economic impacts:

1. Direct effects: In the construction of wind parks, these refer to the on-site jobs of contractors and crews hired, as well as the jobs at turbine, tower, and blade factories.
2. Indirect effects: This could include a banker who finances the contractor or an accountant who maintains a manufacturer's books. Other indirect effects may include steel manufacturers that supply towers, legal firms that write contracts for the project developer, hardware stores that provide building supplies for construction crews, or electric utility suppliers that procure goods, such as high-voltage transmission lines.
3. Induced effects: These would include spending by those directly or indirectly employed by the project on food, clothing, retail services, public transportation, gasoline, vehicles, property and income taxes, medical services, and the like.

In determining economic effects, the model considers 14 aggregated industries that are impacted by the construction and operation of a wind park: agriculture, construction, electrical equipment, fabricated metals, finance/insurance/real estate, government, machinery, mining, other manufacturing, other services, professional services, retail trade, transportation/communication/public utilities, and wholesale trade. Estimates are made using state- and county-level multipliers and personal expenditure patterns. These multipliers for employment, wage and salary income and output (economic activity), and personal expenditure come from IMPLAN.

Applying the JEDI Model

The model is programmed in Microsoft Excel and it requires four sets of inputs:

1. Project Descriptive Data:
    a. Project location (county)
    b. Year of construction
    c. Project size (nameplate capacity)
    d. Turbine size (kW)
    e. Number of turbines
    f. Project construction costs ($/kW)
    g. Annual operation and maintenance cost ($/kW)
    h. Money value (current dollar year)
2. Project Cost Data:
    a. Construction costs
    b. Equipment costs
    c. Other miscellaneous costs
3. Annual Wind Plant Operating and Maintenance Costs
    a. Personnel
    b. Materials and services
4. Other Parameters
    a. Debt financing
    b. Equity financing/repayment
    c. Tax parameters
    d. Land lease parameters

e. Payroll parameters

Regarding the expenditure pattern and the local share of expenditures for a particular county or region, assumptions play a significant role in determining the economic impact of a wind project. The JEDI Model provides two options: default values or new values entered by the analyst. The default values represent a reasonable expenditure pattern for constructing and operating a wind power plant in the U.S. and the share of expenditures spent locally based on a review of numerous wind resource studies. Not every wind project, however, will follow this exact default pattern for expenditures. Consequently, analysts are encouraged to incorporate project-specific data and the likely share of spending in a given county or region to reflect localized economic impacts. In this analysis, the authors consulted with local wind developers to determine reasonable local spending levels for specific costs.

JEDI Model Outputs

The JEDI Model generates the following outputs for a given set of inputs:

- Jobs: refers to the FTE employment for a year
- Output: the economic activity or "project value" in the state, region, or county economy
- Earnings: refers to annual wage and/or salary compensations paid to workers involved with direct, indirect, and induced effects
- Local spending: refers to the actual annual dollars spent on goods and services in the area being analyzed
- Annual lease payments: provides an annual total of lease/easement payments to landowners
- Property taxes: represents the annual property taxes that the project will generate, exclusive of any property tax exemptions that may be available

JEDI Evaluation Results

The authors studied five wind development projects of varying size. They report projected construction costs with the percentages of how much of those costs will be spent locally in Utah County based on their interviews with wind developers and labor statistics and local industry profiles provided by EDCU. For example, because of the presence of the construction industry in Utah County, most of the project construction costs will be spent locally. Finally, because ownership information and financial arrangements can vary widely for wind development, they did not assume any local ownership in their economic projections. However, if local ownership does occur, it will increase total economic benefit for the county. When projecting operating and maintenance costs, all personnel are assumed to be hired locally.

Guidelines for Assessing the Economic Development Impacts of Wind Power—National Wind Coordinating Committee

The following guidelines are a consensus-based NWCC Economic Development Working Group product designed to guide the assessment of the economic impacts of wind power development. The purpose of the guidelines is to identify the most important factors that should be considered in economic impact analyses of wind power development as well as to provide a consistent basis for comparing the impacts across studies. The intended audience for these guidelines are economists, analysts, consultants, planners, and users of the results of the economic development studies.

Guidelines

1. The audience for the study and the objective to be pursued should receive primary consideration.
2. The assumptions and scenarios used to analyze economic development impacts should be clearly stated.
3. The model used to calculate impacts should use regional economic input data.
4. Both the potential positive and negative (i.e., displacement) economic impacts of wind power development should be considered by addressing the following questions:
    a. How would equivalent new electric service be provided if not by wind power?
    b. Does wind power displace alternatives inside or outside the region?
    c. What are the net economic impacts of developing wind relative to the alternatives?
    d. Does wind power raise or lower the price of electricity in the region? What are the resulting impacts on expenditures for other goods and services?
    e. What impact does wind power development have on existing infrastructure (e.g. damage to roads, bridges, and land from truck traffic and construction, etc.)?
    f. Does wind development attract new tourism revenues? If so, what is the net economic impact?
    g. Does wind development reduce emissions and the cost of complying with environmental regulations and healthcare costs in or outside the region? If so, what is the net economic impact?
    h. Does wind-generated electricity become an export product sold outside the region, acting much like a manufactured product importing dollars into the region?
5. The evaluation should consider the ownership, equity, and sources of capital, and markets for the project for their relative impacts on the local community, reservation, state, region, or country.
    a. Will the project be financed by local banks?
    b. Will the project be locally-owned or owned by wind developers located outside the region?
    c. Is the project owned by a community-based utility such as a municipal or coop? Does the project have access to low-cost capital?

   d. Is there public or private funding/incentives for minority ownership or equity in the project? What are the resulting impacts for project feasibility and economic development?
   e. What are the property and/or production tax implications of the wind project?
   f. What are the impacts from non-electricity products to the economy? Are they retained by the project, sold, traded, or retired?
6. The evaluation should consider the timing and scale of the project in relation to other wind development in the state, region, or country. Pioneering projects in new areas face economic considerations different from those of incremental projects in mature wind-resource areas.
7. The evaluation should distinguish between short-term (construction) and long-term (operation and maintenance) impacts.
8. The evaluation should consider relative impacts on the economy at a level appropriate to the scope of the study by addressing the following questions:
   a. How significant is the impact?
   b. What is the quality of the jobs that are created (e.g. FT vs. PT, average wage relative to other industries in the region)?
   c. Does the regional economy have the capacity to create new jobs and economic activity? Alternatively, will the jobs and activity be taken from other industries in the region or outside the region?
   d. What are the quantitative impacts of the wind development and spin-off industries related to the retention of students and the educational value of the development?
   e. What are the qualitative impacts related to fostering entrepreneurial activity in the region and improved community spirit?
9. For both wind development and the displaced alternative, the evaluation should consider how new labor, materials, and services would be supplies. Questions such as those below should be addressed:
   a. Recognizing that wind turbines are highly specialized equipment with only a handful of manufacturers located in a few states, what are the prospects for attracting manufacturing jobs to the region?
   b. Is wind power displacing imported fuels (gas, coal, nuclear, etc.)?
   c. Can components for wind turbines be supplied by local industries?
   d. Will local residents be trained to operate and maintain wind projects, or will labor be imported?
   e. How will public procurement regulations affect development, installation, maintenance, operation, and ownership of wind power generation?
   f. Is there information about the type of labor use and whether it is union or non-union?

<u>Renewable Energy: Wind Power's Contribution to Electric Power Generation and Impact on Farms and Rural Communities</u>—U.S. Government Accountability Office

What GAO Found

In the U.S., a wind turbine with generating capacity of 2 MW, placed on a tower situated on a farm, ranch, or other rural land, can generate enough electricity in a year—about 6 million kWh—to serve the needs of 500 to 600 average U.S. households.

While many people could benefit indirectly from the clean air and economic growth brought about by wind power development, farmers and other rural landowners, such as ranchers, can benefit directly. They can receive lease payments from commercial developers for the turbines placed on their land or own projects outright, selling electricity to a local utility. Furthermore, even large wind turbines use only about a quarter-acre of land each, including access roads, so farmers can continue to plant crops and graze livestock up to the base of the turbines.

Wind power's developers have relied on the federal production tax credit, which provides a credit for electricity generated by renewable energy sources such as wind turbines—about 1.8 cents per kWh during 2003. Recipients of the tax credit receive it for up to 10 years from the project's initial operation. This credit has helped to offset the significantly higher capital costs per unit of generating capacity needed to start up wind power projects compared with projects for fossil fuel power generation, according to government and industry experts.

A farmer who leases land for a wind project can expect to receive $2,000 to $5,000 per turbine per year in lease payments. In addition, large wind power projects in some of the nation's poorest rural counties have added much-needed tax revenues and employment opportunities.

Farmers generally find leasing their land for wind power projects to be easier than owning projects. Leasing is easier because energy companies can better address the costs, technical issues, tax advantages, and risks of wind projects. However, ownership of a turbine may double or triple the farmer's expected income over leasing.

To conduct this work, GAO interviewed officials or reviewed documentation from DOE's Energy Information Administration, Office of Energy Efficiency and Renewable Energy, and NREL; USDA's Economic Research Service, Office of Energy Policy and New Uses, Farm Service Agency, National Agricultural Statistics Service (NASS), and Rural Business-Cooperative Service; the EPA; the Federal Energy Regulatory Commission; commodity groups such as the National Corn Growers Association; the Union of Concerned Scientists; AWEA; the Edison Electric Institute; the Electric Power Research Institute; and Windustry (a rural-based wind stakeholder organization). They also visited nine wind power projects in five states with substantial installed wind power generating capacity (California, Colorado, Iowa, Minnesota, and Texas). At these locations, they generally met with landowners, project investors and owners, state and local taxing authorities, community leaders, and electric utility officials. They focused on utility-scale wind power projects—projects that generate at least 1 MW of electric power annually for sale to a local utility. Utility-scale projects account for most U.S. wind power generation.

Objectives, Scope, and Methodology

For each state, GAO collected information on the number of farms; the types of agricultural crops produced; total farm income; farm, ranch, and rural lands acreage; wind energy generation sources; and state policies and financial and tax incentives designed to encourage wind power development. They obtained this information from a variety of sources, including USDA's Farm Services Agency, Economic Research Service, and NASS, and state and local taxing authorities.

To select the projects visited, GAO compared lists of wind projects for each state obtained from AWEA, Windustry, and the states of California, Iowa, and Minnesota. From these lists they selected a mixture of leased, farmer-owned, and community-operated wind projects that also were geographically dispersed within a state.

Their work focused on utility-scale wind power projects—projects that generate at least 1 MW of electric power (from one or more turbines) annually for sale to a local utility. Utility-scale wind power accounts for over 90 percent of wind power generation in the U.S.

They asked NREL to model the economic impact of wind power projects on the counties they visited. Specifically, they asked NREL to use its Wind Impact Model to assess the employment and income impacts of three hypothetical scenarios on the ten counties included in their visits. The scenarios were 1) a 150 MW project that is owned by an out-of-state firm, 2) a 40 MW project that is owned by an out-of-state firm, and 3) several small projects with total capacity of 40 MW that are owned by county residents.

To determine the advantages and disadvantages for farmers and rural communities of owning a wind power project or leasing their land to a commercial wind power developer, GAO interviewed officials or reviewed documentations from DOE's NREL and Wind Powering America Program; AWEA; the Environmental and Energy Study Institute; the NWCC; Windustry; the Izaak Walton League of America; and the Union of Concerned Scientists. The documentation they reviewed covered issues such as Wind project economics and development, research, technology, site selection, electricity transmission, economic and legal constraints, and various federal and state incentives. They also discussed these issues with farmers, landowners, wind project investors, state and local government officials, including local taxing authorities, and others during the course of their site visits.

The Wind Impact Model

The model, based on a spreadsheet, emulates, on a small scale, the basic function of an I-O model. It relies on I-O multipliers that, in this case, estimate how much a dollar of expenditures injected into an economy will generate in total employment or income. The source of the multipliers used in the model is MIG, Inc., whose databases and modeling system are used by many government agencies, academic institutions, and other researchers worldwide for economic impact modeling and analyses.

The model is designed to examine economic impact on the state or county levels, and it does so separately for the construction period and operating years of a wind power project. Construction phase impacts are reported as a one-year equivalent of the incremental change to state or county employment, earnings, and income attributable to a new project. Economic output as defined in the model is a measure of economic activity (value of production) on the state or local level that is similar to the measure of the GDP on the national level.

Inputs into the model include cost data for a given wind power project and parameters that characterize the particular state- or county-level economy being analyzed. A major portion of the required inputs into the model are cost data, including:

- Construction costs (e.g. materials and labor);
- Equipment costs (e.g. turbines, rotors, towers, etc.);
- Other construction period costs, such as for interconnection to the electric grid, engineering services, land easements, and permitting;
- Annual operating and maintenance costs, including payroll of direct employees, material, and various services; and
- Financing and lease costs and taxes.

Other inputs include estimates of local share value for certain dollar expenditures and labor.

Model Results

Overall, the model results showed that employment and income impacts tend to be greater for counties that are more highly populated and have a larger economic base, and for projects that are locally-owned.

Caveats to and Reliability of the Modeling Effort

GAO did not expect a high level of accuracy in the model results because data sources on costs and expenditures are limited, in part because companies may consider these data to be proprietary. Rather, they expected the model's analysis to illustrate the differences between counties that have different economic structures. The cost data and assumptions for local share values seemed reasonable and consistent with what they found during their visits regarding economic conditions in those counties. The model's results also generally conform to what they found during their visits, especially for employment effects.

Ponnequin Wind Farm in Colorado

The Ponnequin Wind Farm is the first utility-scale wind power project in Colorado. A key factor in the development of wind power in Colorado, including the Ponnequin wind farm, is the Windsource program offered by Xcel Energy, the state's largest electric utility. This program offers customers the option of signing up for 100 kWh blocks of electric power produced by wind power or other renewable sources at a premium of $2.50 per block over regular rates.

About half—23 of 44—of the Ponnequin turbines are located on 942 acres of land belonging to the state of Colorado. According to the state land board, Colorado received $40,763 from this project for the use of the land in 2003. The state receives $1.50 per acre for the 942 acres leased to the project. The state also receives an annual payment per MW of installed capacity. Per the lease agreement, every 5 years the state has the option to adjust the latter payment for inflation, based on the producer price index for commercial electric power. The remaining turbines are located on 420 acres of a privately-owned cattle ranch. According to the ranch owner, the lease income from the turbines is significant and constitutes a much larger share of the ranch's total income than the earnings from cattle production. Xcel Energy, which owns 37 of the 44 turbines, indicated that it paid about $100,000 for the two land leases and related rights-of-way in 2001.

Weld County officials told GAO that the property taxes paid by the Ponnequin project do not constitute a significant share of the county's total property taxes. For 2003, the project's property taxes were about $53,000; the county's total property taxes collected in 2002 were almost $200 million. The project employs 2.33 FTE employees for maintenance and operation.