ECONOMIC FEASIBILITY EVALUATION OF SMALL WIND SYSTEMS IN MICHIGAN AGRICULTURE

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Overview

Small wind energy systems (100 kW or less) have been becoming increasingly present on the rural landscape over the last two decades. According to the American Wind Energy Association small wind turbine sales have grown at an annual rate of 14-25% since 1990 without the aid of government incentives. Small wind systems provide a variety of benefits to consumers such as clean renewable energy, power production in remote areas, and the offset of electricity purchases. Rising energy prices and increased energy use as an input for production are growing concerns within the agriculture industry. Through offsetting the purchase of electricity agricultural producers can increase farm profits and decrease incentives to convert farmland to non-farm uses.

The majority of the literature concerning wind energy economics is in the form of a case study approach to utility scale wind energy feasibility. This analysis is often technical in nature dealing with the political economy and/or technological advancement associated with wind farms. On the other hand most of the past literature concerning small wind energy is based on site specific studies. These studies analyze details such as siting, permits, grid interconnection and energy output with respect to meteorological conditions most of which are unique to a particular location. There are a variety of models available for calculating the feasibility of utility scale projects; however, small wind projects lack feasibility analysis of a general model. This study seeks to provide an integrated general model for analyzing the feasibility of small wind energy projects, specifically using policy options available to Michigan agriculture producers. Sensitivity and scenario analysis are used to compare options and test the robustness of selected parameters.

Methods

The economic feasibility of small wind energy systems is determined through the integration of a capital budgeting framework with technical wind turbine specifications. The capital budgeting framework includes a comprehensive list of expenses, utility offsets, technical information and potential credits. This allows the model to be sufficiently flexible to incorporate the unique characteristics in small wind energy economic analysis. The economic data was gathered through a survey of manufacturers, anecdotal evidence, and industry accepted standards. The technical model incorporates site specific wind data from the Michigan Anemometer Loan Program. The two separate models are integrated together and then solved for the net present value and the number of years with negative cash flow. The net present value is used as the primary benchmark for economic feasibility.

Due to inherent uncertainty in the economic and technical models sensitivity and scenario analysis is also undertaken. A variety of parameters are chosen, each of which account for a different aspect of the feasibility decision. The parameters are given discrete high, low, and central values. The robustness of the parameter is then determined by the amount of variability between the three parameter values. Three separate scenarios are also analyzed in conjunction with the sensitivity analysis. These three scenarios, newly manufactured wind turbines, reconditioned wind turbines, and the Rural Wind Energy Development Act, all represent current or potential small wind energy options.

Results

The results of the feasibility analysis for newly manufactured wind turbines shows a large negative net present value of $63,755 over a 20 year wind turbine lifetime. Some of the parameters vary significantly up to $80,000 in net present value at times. The turbine size, cost of installed capacity, and system performance parameters are found to be the most volatile. The net present value is not positive even in the best-case scenario for newly manufactured turbines.

The reconditioned wind turbines result in a significantly higher central net present value of negative $8,510. The variation in the parameters is also less than newly manufactured turbines, varying less than $20,000 in each case. The higher central net present value allows for several economically feasible situations with the best-case scenario resulting in a net present value of $15,775.

In the case of the Rural Wind Energy Development Act, a $1,500 tax credit for each half kilowatt of installed capacity, there is a positive net present value of $11,365 at the parameter’s central values. The variation in each parameter is similar to that of a newly manufactured wind turbine, except for the interest rate and firm size parameters. In the Rural Wind Energy Development Act the interest rate has an almost 8 times greater variation than in newly manufactured turbines. As expected the firm size parameter is highly volatile with a net present value that varies $52,719. The benefits for consumers from the Rural Wind Energy Development Act are noteworthy, where only the worst-case scenario and lowest firm size parameter create a negative net present value.

Conclusions

Small wind systems take up relatively small amounts of land and are not intrusive within rural and agrarian areas. When they are economically feasible small wind systems offset potential expenses and create an incentive to not convert farmland to non-farm uses. The sensitivity analysis shows that parameters act similarly within the different scenarios, and that the installed capital costs along with the system performance are the two key parameters for identifying economic feasibility. This makes pre-testing a location’s wind conditions along with educated capital purchases vitally important for the economic feasibility of a small wind energy project. Small wind energy systems in agriculture are by no means a wise investment for everyone. However, even without significant government incentives they may be feasible under the right circumstances. The increased number of reconditioned wind systems on the market as well as falling prices per kW of newly manufactured systems make small wind appear feasible at times today and potentially in the future. Government incentives such as the U.S. Department of Agricultures 9006 funds and the potential Rural Wind Energy Development Act increase economic feasibility dramatically and could be used as a temporary support system until technology catches up.