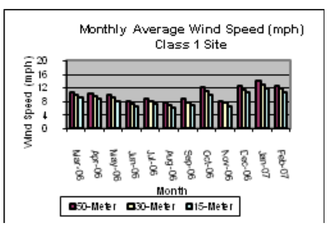
Small Wind Estimator

Four Examples of How Wind Can Pay: A Look at a Class 3 Wind Site

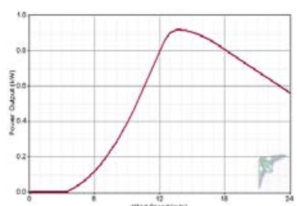
The Renewable Energy Center has put together the Small Wind Estimator series to be used in conjunction with our Renewable Energy Installers Directory, County Wind Maps and other print and online resources, to allow people and organizations to make informed decisions about utilizing small wind power systems. This resource consists of four examples of the manner in which a project may progress from a financial standpoint. One of these examples is a base example, and the other three are obtained from the base example by altering it slightly.

Our goal is to give individuals an idea of the financial costs and returns of installing various types of small wind turbines in different wind classes, Class 1 (poor), Class 2 (fair), and Class 3 (good). See our *Factsheet: Wind Power Classes* for more on how wind is classified. The Small Wind Estimator uses many assumptions to give people an idea of the kinds of costs and returns of a small wind project (assumptions are explained below). Therefore, these figures should not be considered universal for all Class 3 sites since the wind at your site will not be identical to that shown here.

How did we come up with these estimates?



Our Data



Turbine Output Analysis

Mock Financial Examples

The Renewable Energy Center has used our wind data obtained from various sites in Pennsylvania to cross with turbine power output figures to generate estimated costs and returns. The steps involved:

- **Our Data:** we obtained data from our Community Wind Project sites. This Project puts up 50 meter testing towers at eligible sites across the state. As we collect and analyze this data, a site's wind power class is determined. Though each site is different, there are many general trends that allow one to use data from one site to represent another. For example, as can be seen in the bar graph above, wind speeds vary seasonally with the stronger winds in the winter and weaker winds in the summer. This same wind speed curve is seen at all of our sites.

- **Turbine Output Analysis:** each wind turbine has a *power curve* that tells how much electricity is produced at different wind speeds. We crossed the wind speed data with this power curve to determine how much total electricity is produced monthly and annually

- **Mock Financial Examples:** Once we had the total electricity produced we conducted some simple calculations assuming various values for price per kilowatt hour (kwh) and maintenance costs. It is then possible to use various calculations to obtain an estimate of the approximate payback period for each model of turbine based on installation costs, annual expenses, and annual savings for our examples.

Since the wind behaves similarly at different sites which share the same wind power class, it is safe to assume that these calculations are good estimates for what would transpire financially at a site with a given wind power class.

Post Office Box 600 Loretto, Pennsylvania 15940 814.472.2872 renewable@francis.edu

What does our base example consist of?

We have made several different assumptions throughout this process in order to make our financial examples easier to understand while as realistic as possible. For each wind turbine incorporated into our overview, the results are broken down into 7 results. The following offers a description of these results.

Annual kilowatt-hours produced: This is a calculation of the total amount of energy that a specific wind turbine would produce each year based on the monthly wind speed data from a sample site sharing the same wind power class.

Total Installed Cost: This is the approximate total cost of a wind project (turbine, tower, permitting, installation, etc.) based on averages given by the manufacturers, retailers, and installers of the different wind turbines. In our examples, we are assuming that an individual starting a project would pay for these costs in their entirety at the beginning of the project. Therefore, we are not including any figures on interest payments in our analysis. We understand this is a broad assumption but we trust the final calculations still prove useful in helping you make an informed decision.

Annual Expenses: This is the approximate amount that the owner of a wind project would have to spend on turbine operation and maintenance. It is typically about 1% of the total installed cost annually. This is not a guaranteed expenditure each year but it is recommended that money be set aside for parts, maintenance, etc.

Annual Savings: This is the approximate amount of money the wind project owner would save each year from the electricity produced by the turbine. This value is very dynamic from year to year, considering that it is calculated by multiplying the annual kilowatt hours (kwh) produced with the current electricity cost, which are both values that vary greatly with the passage of time. We are assuming that the value for the total kwh produced is typical of an average year. Our calculations assume that all the generated electricity is used on site and NOT sold to the utility, therefore offsetting your electricity usage (i.e you get full retail price). Under state and federal regulations, your utility is required to purchase any excess electricity. The purchase price however is not the retail price but a so-called “spot price” which depends on when the excess electricity is generated. Generally, this is a much lower rate, in the range of 2 – 4 cents per kilowatt hour. See our *Factsheet: Net-metering* for more information.

Price per kWh: This is the current average cost of electricity in Pennsylvania, as reported by the Energy Information Agency.

Financial Assistance: This is a monetary figure we have inserted into each example based on average grant and loan amounts and other forms of financial aid that could be provided for a wind project by programs such as the Keystone Help Loan Program and the Department of Environmental Protection Energy Harvest Grant Program. There is no guarantee that a project owner would be given these exact amounts, but rather these amounts are simply provided for illustrative purposes.

Payback Period: This is the calculated length of time it would take for the specific turbine to pay for itself based on installed costs, annual expenses, and annual savings. Ultimately, this is the most important value in determining whether a project is worth undertaking or not. The typical life of a wind turbine is approximately 20 years, so calculated payback periods can be compared to this length to aid in determining the economic feasibility of a wind project at a certain wind power class. Again, we are not including any figures on interest payments in our analysis.

A Look at the Other Three Examples

Example B	**Financial Assistance Increase:** The value used for financial assistance is increased by a set amount. If the total installed cost of the project is less than $50,000, financial assistance is increased by 20%. If the total installed cost is greater than $50,000, financial assistance is doubled.
Example C	**Electricity Price Increase:** The price per kwh is increased by 50%.
Example D	**Electricity Price & Financial Assistance Increase:** Both the electricity price and financial assistance price are increased in the same manners as described above.

Why these turbines?

We have chosen these four specific turbines for our financial examples for the following reasons. First of all, each turbine has a different rated output, providing our financial study with a wide range of project sizes. Second of all, the Small Wind Estimator is geared toward small wind projects, and these four turbines are some of the most commonly used turbines for small wind projects that we know of.

Class 3 Examples

Whisper 100 Turbine (900 W)
http://www.windenergy.com/

	Base Example	Example B	Example C	Example D
Annual kilowatt-hours produced:	**1,391**	**1,391**	**1,391**	**1,391**
Total Installed Cost:	**$1,919**	**$1,919**	**$1,919**	**$1,919**
Annual Expenses:	**$20**	**$20**	**$20**	**$20**
Annual Savings:	**$139.10**	**$139.10**	**$208.65**	**$208.65**
Price per kWh:	**$0.10**	**$0.10**	**$0.15**	**$0.15**
Financial Assistance:	**$1,000**	**$1,200**	**$1,000**	**$1,200**
Payback Period (in years):	**8**	**6**	**5**	**4**

Rotor Diameter: 2.1 m
Tower Height: 24.4 m
Warranty: 5 years

Skystream 3.7 Turbine (1.8 kW)
http://www.windenergy.com/

	Base Example	Example B	Example C	Example D
Annual kilowatt-hours produced:	**5,131**	**5,131**	**5,131**	**5,131**
Total Installed Cost:	**$15,000**	**$15,000**	**$15,000**	**$15,000**
Annual Expenses:	**$150**	**$150**	**$150**	**$150**
Annual Savings:	**$513.10**	**$513.10**	**$769.65**	**$769.65**
Price per kWh:	**$0.10**	**$0.10**	**$0.15**	**$0.15**
Financial Assistance:	**$7,500**	**$9,000**	**$7,500**	**$9,000**
Payback Period (in years):	**21**	**17**	**12**	**10**

Rotor Diameter: 3.6 m
Tower Height: 33.5 m
Warranty: 5 years

Bergey Excel-S Turbine (10 kW)
http://www.bergey.com/

Rotor Diameter: 7 m
Tower Height: 30 m
Warranty: 5 years

	Base Example	Example B	Example C	Example D
Annual kilowatt-hours produced:	18,901	18,901	18,901	18,901
Total Installed Cost:	$60,000	$60,000	$60,000	$60,000
Annual Expenses:	$600	$600	$600	$600
Annual Savings:	$1,890.10	$1,890.10	$2,835.15	$2,835.15
Price per kWh:	$0.10	$0.10	$0.15	$0.15
Financial Assistance:	$7,500	$15,000	$7,500	$15,000
Payback Period (in years):	30+	30+	23	20

Entegrity EW50 Turbine (50 kW)
http://www.entegrity.com/

Rotor Diameter: 15 m
Tower Height: 31.1 m
Warranty: 5 years

	Base Example	Example B	Example C	Example D
Annual kilowatt-hours produced:	107,141	107,141	107,141	107,141
Total Installed Cost:	$210,000	$210,000	$210,000	$210,000
Annual Expenses:	$2,100	$2,100	$2,100	$2,100
Annual Savings:	$10,714.10	$10,714.10	$16,071.15	$16,071.15
Price per kWh:	$0.10	$0.10	$0.15	$0.15
Financial Assistance:	$60,000	$120,000	$60,000	$120,000
Payback Period (in years):	17	10	11	6