Instructions for the DWEA AgWind On-Line Performance and Financial Analysis Tool

6/10/2024 Rev.2

The WindReport Model

The WindReport on-line model was developed by New Roots in 2010 and customized for Bergey Windpower (BWC). In 2014 BWC purchased the model from New Roots and has updated it several times to incorporate new incentive programs. The latest version covers incentives provided in the IRA legislation from 2022. BWC has provided DWEA a no-cost license to customize WindReport for its AgWind project. There are no costs to users of AgWind WindReport.

WindReport combines a Visalia wind data base (annual averages), a MS Bing mapping tool, an industry standard "method-of-bins" turbine performance tool[1], and an economics tool to provide an easy method to evaluate the performance and economics of candidate wind systems at the location of your choosing.

The Visalia (formerly 3Tier) wind annual wind speed database is provided at a nominal height of 100 ft (30m) above ground level and has a resolution of 5 km x 5 km, or 3.1 miles x 3.1 miles. Corrections for different tower heights are calculated with the shear exponent that you can enter. Please understand that wind turbine performance predictions are not an exact science and wind maps are not perfect[2].

The geographical data base is provided by Microsoft Bing. Bing includes most street addresses in the U.S. It can also locate sites using digital latitude and longitude (lat/lon). If you have a non-U.S. location, we recommend using lat/lon. Neither the geographical nor the wind data bases cover the continents of the Artic and Antarctica or offshore locations.

The tool allows the user to select from 16 wind turbine models from 7 manufacturers. Turbines must be certified[3] to be included in the AgWind WindReport options. Newly certified small and medium wind turbines will be added in an ongoing basis.

A unique username and pass code for each user or organization is required to access and use the AgWind WindReport tool. AgWind is available for use by U.S. based organizations and DWEA members. To request

[1] Developed by Dr. Robert Atkins and Mike Bergey in 1977.

[2] It is important to understand that the wind speed database is calculated from available upper air and terrestrial wind data using the ground topology in the area. The mathematics employed were first developed by the US-DOE/NREL and later refined by private sector companies such as 3Tier and AWS Scientific (now UL). All current wind maps are based on these methods. There is an uncertainty, however, in the wind speeds that you will see for the sites you analyze. A PNNL and NREL study in 2022 (https://www.nrel.gov/docs/fy22osti/82742.pdf) showed that WindReport averaged a 6% overestimation error. There will also an inter-annual performance variation that can be as much as 20%.

[3] Certified by an accredited certification body to AWEA 9.1-2009, ACP 101-1-2021, or an IEC 61400 series (either -1 or -2, plus -11 and -12)

an application form, please send an email to DWEA@agwindenergy.org. Again, there is no cost to use DWEA's AgWind WindReport.

Logging In

Users log in at https://windreport.agwindenergy.org/

Enter your username and password. You will get a menu screen, as shown below.

The **Turbine Production** session will provide you with the Visalia wind speed and a prediction of the average energy production.

The **Financial Analysis** sessions provides the performance prediction, but also provides a financial projection based on the customer's specific location and situation. It provides the payback and internal rate of return (IRR) information that most potential customers want to see before purchasing.

Saved Sessions shows your previous sessions that you have chosen to save. This feature is useful when you want to make multiple runs for the same customer or similar runs for different customers.

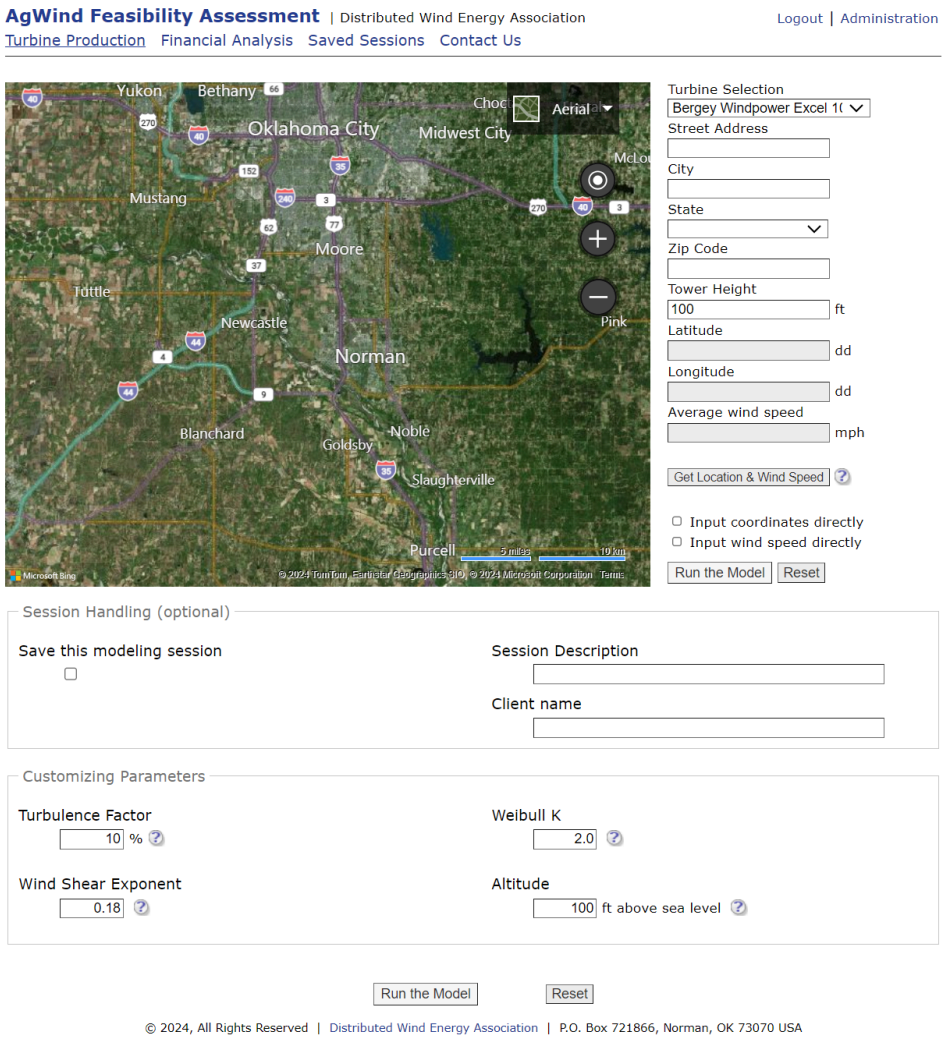
Administration is only available to site administrators.

Log Out takes you out of WindReport. You will have to re-enter your user name and password to begin a new session once you log out, unless your browser has saved your log-in. You can run and save multiple sessions while logged in.

Turbine Production Session

When you select Turbine Production you will see the screen shown on the following page.

Step 1: Turbine Selection - select the turbine model from the drop down menu. Note that some turbines, such as the Northern Power 1000 kW have several rotor size options. Please refer to the manufacturer in this case to determine which versions are best for your situation. In general, larger rotors are designed for lower wind speed sites and smaller rotors are meant for higher wind speed sites.



Step 2: Street Address – enter the customer's street address, if known. If it is not known you can use the city or use the lat/lon feature described later.

Step 3: City – enter the customer's city.

Step 4: State – select the customer's State from the drop down menu.

Step 5: Lat/Lon – Skip this step if you entered a physical address or a city. If you want to use lat/lon instead of a physical address for the customer's site, you need to first check the "Input coordinates directly" box and then enter the site's latitude and longitude in the boxes provided. Lat/lon needs to be in digital format (e.g., 32.869452). You can obtain lat/lon's using Google Earth or a variety of other mapping programs. If you obtain lat/lon in degree, minute, second format (e.g., 32 54' 41.26"), you will need to convert them to digital format. There are many web based converters, but one is www.fcc.gov/mb/audio/bickel/DDDMMSS-decimal.html

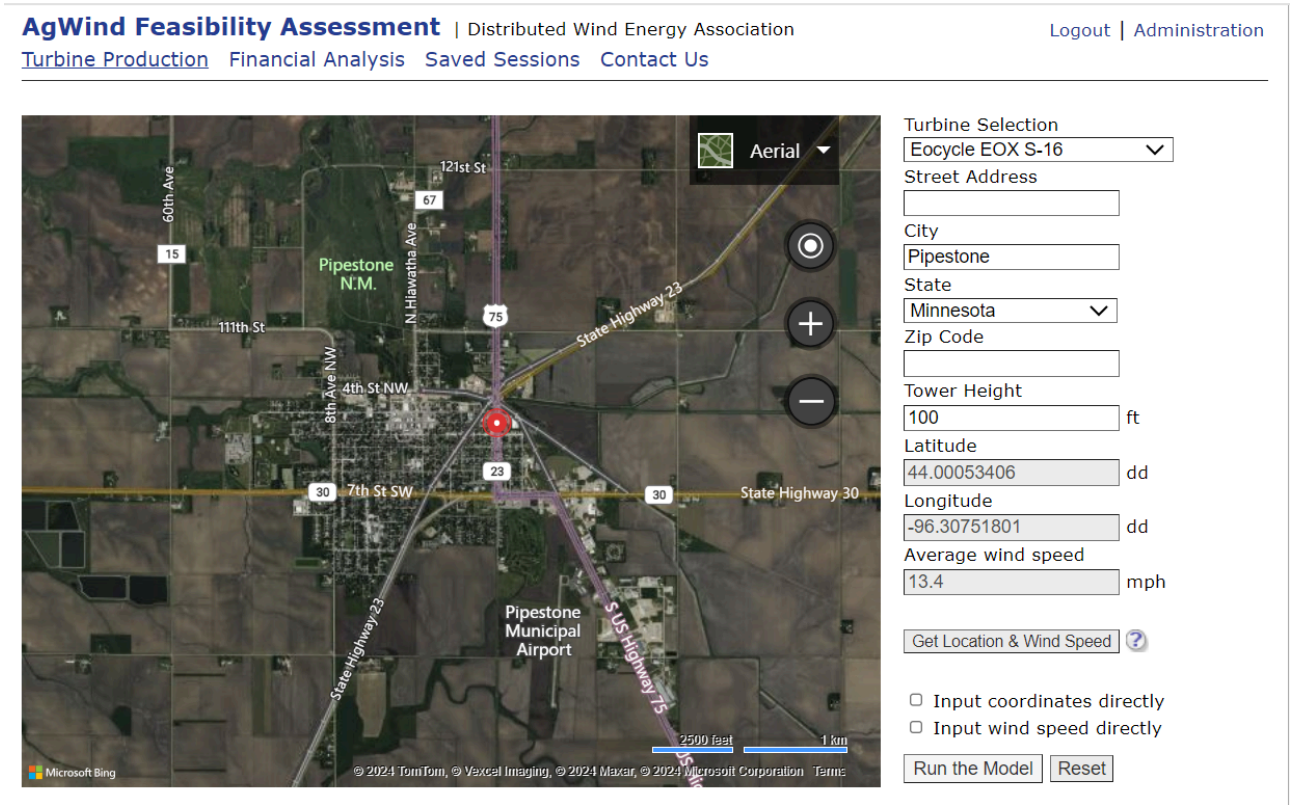
Step 6: Tower Height – the default is 100 ft, but you can enter a different tower height as necessary. The wind speed is obtained from Visalia at a height of 100 ft and adjusted for tower heights other than 100 ft using the Wind Shear Exponent.

Step 7: Input wind speed – in most cases you will use the wind speed obtained from Visalia. However, you do have the option of entering an annual average wind speed you have obtained elsewhere. To do this, first check the "Input Wind Speed Directly" box and then enter your average wind speed in mph. To use the Visalia wind speed, skip this step - leaving the "Average wind speed" box blank.

Step 8: Click the "Get Location & Wind Speed" button. This will give you a screen, such as the one shown below, showing the site and providing the average wind speed and lat/lon. You can move the aerial view around and change its scale using your computer mouse. Click this button every time you change the tower height or location.

Note that you can move the indicated turbine location (red bullseye) on the Bing map with your cursor. A pop-up will ask whether you want to update the wind speed. Bing also offers different types of views in addition to the default Aerial. You can also select Map View, Bird's Eye, and Street View.

If you click on the "Run the Model" button in the upper section without first entering a client name in the Session Handling section, you will get an error message.



Step 9: Session Handling – you can choose to save the session for future reference using the "Save this modeling session" check box. You may also enter a description of the session, such as "Meyer's Site – 100 ft Tower" in the Session Description box. You must enter a client name in the Client name box.

Customizing Parameters Block

Step 10: If you do not want to change the default values for "Turbulence Factor", "Wind Shear Exponent", and "Weibull K", you must still enter the elevation for the customer's site in the box provided. Failure to change the default value of 100 ft will over predict performance for most sites. If you do not know the site elevation you can find it on Google Earth, Googling the name of the closest city, or visiting https://whatismyelevation.com/map. Be sure to use feet, not meters.

You can now hit the "Run the Model" button.

Step 11: You have the option of changing the default values of "Turbulence Factor", "Wind Shear Exponent", and "Weibull K". In most cases we recommend leaving these parameters alone. However, sometimes changes are recommended:

- If the site is smooth and treeless, the Turbulence Factor can be reduced to 5% and the Shear Exponent should be reduced to .1
- If the site is really hilly or has obstructions higher than 30 ft below the lowest point of the rotor then the Turbulence Factor should be increased to 15% and the Shear Exponent should be increased to .3
- If the site is coastal the Weibull K should be increased to 3.
- If the site is in a trade wind regime, the Weibull K should be increased to 4.

Hit the "Run the Model" button after making these changes.

The output screen for a Turbine Production session will look like this:

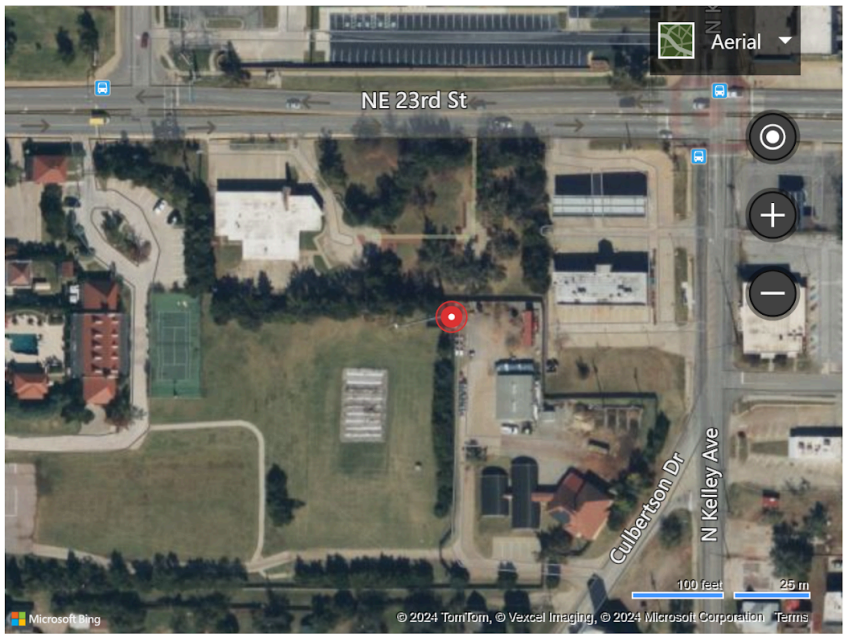
AgWind Feasibility Assessment | Distributed Wind Energy Association

Turbine Production Financial Analysis Saved Sessions Contact Us

Print Report

Logout | Administration

Turbine Production:



Turbine Selection	Bergey Windpower Excel 15
Nameplate Capacity [kW]	15.6
Rotor Diameter [m]	9.6
Site Location: Governor's Mansion Oklahoma City, Oklahoma	
35.493° latitude -97.495° longitude	
Average Wind Speed [mph]	12.42
Tower Height [ft]	100.0
Altitude [ft]	1,232.0
Weibull K	2.0
Wind Shear	0.18
Turbulence Factor [%]	10.0
Average Output Power [kW]	3.7
Daily Energy Output [kWh]	89.2
Monthly Energy Output [kWh]	2,711.9
Annual Energy Output [kWh]	32,543.3
Hub Average Wind Speed [mph]	12.4
Air Density Coefficient	1.0
Operating Time [%]	99.5

In this example we see that the average wind speed at the Governor's Mansion in Oklahoma City at a height of 100 ft is predicted to be 12.42 mph and that we would expect a Bergey Excel 15 kW turbine to produce ~ 32,500 kWh per year. Note that there is a Bergey 10 kW at this site that was installed in 2006.

You will also see a graph of the turbine power curve and a table showing the "Method-of-Bins" calculation. Note that the turbine output powers in the table are derated by the Turbulence Factor.

You can print the report using the "Print Report" link at the top of the page. To save in PDF format choose "Print Report" but select "Adobe PDF" in your printer selection.

Financial Analysis Session

When you select Financial Analysis, you will see the screen shown below.

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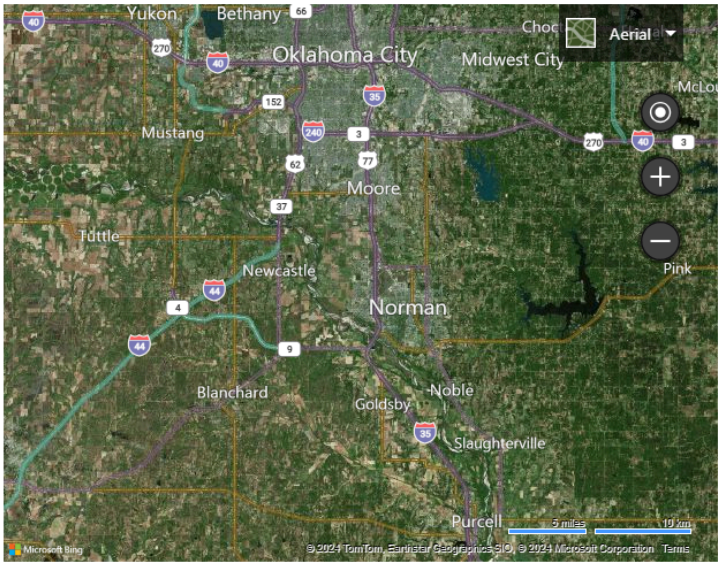
Logout | Administratio

Turbine Production | Financial Analysis | Saved Sessions | Contact Us



Turbine Selection
Bergey Windpower Excel
Street Address
City
State
Zip Code
Tower Height
100 ft
Latitude
dd
Longitude
dd
Average wind speed
mph

Get Location & Wind Speed

☐ Input coordinates directly
☐ Input wind speed directly

Reset

Session Handling (optional)

Save this modeling session ☐

Session Description

Client name

Model Time Span

years, beginning in 20

Turbine Information

How many wind turbines? 1

Cost per maintenance visit 0

Total system cost $

End-of-life resale value of system $ 0

Customizing Parameters

Turbulence Factor 10 %

Weibull K 2.0

Wind Shear Exponent 0.18

Altitude 100 ft above sea level

Electrical Information

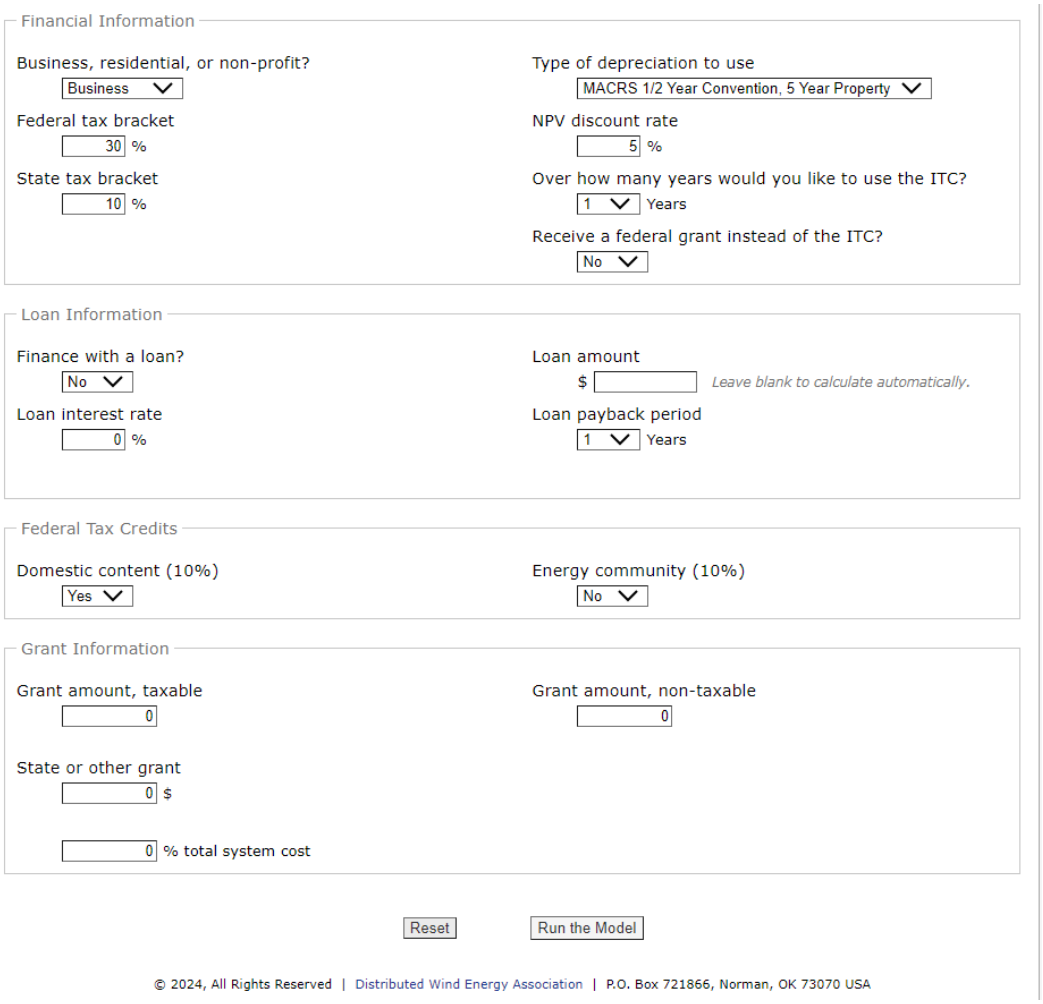
Total annual energy usage kWh / year

Current cost of energy 0.10 $ / kWh

De-rate from measurements 0 %

Energy inflation rate estimate 5 % / year

Purchase rate for over-production 0 $ / kWh



Follow **Steps 1 – 11** for the Turbine Production session, which will take you through "Session Handling." There are quite a few steps to provide necessary inputs for the financial analyses but after you've done it a few times we think you'll find it relatively quick and easy to complete the form.

Model Timeframe Block

Step 12: Model Time Span – select the model time span and start year from the drop down menus. The time span will typically be 20-30 years, though some small wind turbines have been in operation for over 40 years.

Turbine Information Block

Step 13: How many turbines? – the default is 1, but the model will accommodate installations with multiple turbines.

Step 14: Total system cost – enter the total installed cost. You do not need to add a "$" or a comma. Use total project costs if multiple turbines are being analyzed. Please consult with a dealer or the manufacturer for representative total costs in your area for the model(s) you are evaluating. Manufacturers contact information is provided below:

Company	Contact	Website	Email	Phone Numbers	Address
Bergey Windpower Co	Michael Soriano	www.bergey.com	msoriano@bergey.com	405-364-4212	2200 Industrial Blvd Norman OK 73069
Eocycle Technologies Inc.	Richard Legualt	www.eocycle.com	rlegault@eocycle.com	612-750-2123	10250 Louis-H. Lafontaine Montreal Quebec H1J 2T3 Canada
ESPE Srl	Matteo Vecchiato	www.espegroup.com	m.vecchiato@espe.it	(049) 945-5033	Via Dell'Artigianato 6 Grantorto 35010 Italy
EWT	Brett Pingree	www.ewtdirectwind.com	b.pingree@ewtdirectwind.com	207-808-3452	Lindeboomseweg 51 3825 AL Amersfoort The Netherlands
Northern Power Systems	Ken Kotalik	WWW.NPS100.COM	kkotalik@nps100.com	928-607-7034	403 North WCRiles Street Flagstaff, AZ 86001
Ryse Energy LLC	Ketter Ulrich	www.ryse.energy	Ketter@ryse.energy	281-687-7651	8748 Clay Road, Suite 320 Houston, TX 77080
Siva Powers America	Padma Kasthurirangan	www.sivawind.com	padma@buffalorenewables.green	7-6-513-0114	3840 E. Robinson Rd., Suite 310 Amherst, NY 14228

Step 15: Cost per maintenance visit – enter the estimated annual cost of maintenance. This will vary by manufacturer, so we recommend obtaining recommended values from them.

Step 16: End-of-life value of the system – the default value is 30% of the total system cost, which is based on industry experience of certified turbines. However, you can enter a different value if desired. WindReport will apply this "income" at the end of the Model Time Span you chose. It will not affect payback period and will affect IRR only minimally.

Customizing Parameters Block

Step 17: The Customizing Parameters were covered in Step 10 of the Turbine Performance session instructions.

Electrical Information Block

Step 18: Total annual energy use – Enter the customer's typical annual energy consumption. Use an appropriately higher figure if the customer anticipates adding load (e.g., switching to electric heat, adding on the house or business, or purchasing an electric vehicle) within the estimated payback period.

Step 19: De-rate from measurements – For a state or utility offering annual net metering use 0%. For a state or utility with monthly net metering, use 15%. For a state or utility with no net metering, use 30%. These de-ratings will help account for the partial mismatch between when the home or business needs power and when wind energy is available. On utilities without annualized net metering the value of excess production will be less than the retail rate.

Step 20: Net-metering rate for over-production – enter the rate that the utility will pay for excess production. In some annual net metering states that rate may be zero.

Step 21: Cost of energy – enter the current average total cost of electricity. If the customer's bill includes a demand charge you should use only the energy charge.

Step 22: Energy inflation rate estimate – 5% is the default, but you can enter any rate that you or your customer feel is appropriate. The rate is applied throughout the Model Time Span, so you should use the average rate you expect over that time frame.

Financial Information Block

Step 23: Business, residential, or non-profit? – select the appropriate category for your customer.

Step 24: Federal tax bracket – enter the appropriate figure for your customer.

Step 25: State tax bracket – enter the appropriate figure for your customer.

Step 26: Type of depreciation to use – Wind turbines are classified by the IRS as 5-year, accelerated depreciation (MARCS) property. Businesses can also choose to use their Section 179D equipment expensing allowance for full expensing in one year. WindReport reduces the basis for depreciation by 50% of the ITC, per IRS rules.

Step 27: NPV discount rate – this accounts for the expected rate of return that a business might expect to get with their money if they didn't buy a wind turbine. The default rate of 5% is a representative figure, but you should follow any guidance provided by your customer or their CPA.

Step 28: Over how many years would you like to use the ITC? – If your customer, residential or business, anticipates enough tax obligation to utilize the full Investment Tax Credit in the first year, then leave this at the default value of 1. If they will not have enough obligation use this feature to input the number of years the ITC will have to be spread over.

Step 29: Receive a federal grant instead of the ITC? – If the customer is a non-profit or tribe select YES, since they are eligible for Direct Pay. If a business customer intends to take the Elective Pay (transferability) option for the ITC, select YES from the menu. But in this case, you must also account for the reduction in ITC value (typically receiving 80 – 90% of full value) in Step 34.

Loan Information Block

Step 30: Loan Information section – this section allows WindReport to take into account the costs and cash flows of financing. If your customer will be using financing, you should select YES from the menu in the "Finance with a loan?" box and then fill in the remainder of the boxes in this section. If there is no financing, leave the first box at NO.

Federal Tax Credits Block

Step 31: Domestic content – For business customers select YES if the wind equipment qualifies for the 10% Domestic Content Bonus of the ITC. A manufacturer or dealer should be able to provide you with the answer for their equipment.

Step 32: Energy community – For business customers select YES if the project will be located in an Energy Community area. The Energy Community map can be found at

https://arcgis.netl.doe.gov/portal/apps/experiencebuilder/experience/?id=a2ce47d4721a477a8701bd0e08495e1d Note that the map is updated annually based on employment data.

Grant Information Block

Step 33: Grant amount, taxable – if you anticipate your customer receiving a grant under the USDA REAP program (up to 50%) and/or another taxable federal grant, enter the total $ amount of the grant(s) you expect the customer to receive. Note that all federal grants are taxable unless they are specifically exempted.

Step 34: Grant amount, non-taxable – if you anticipate your customer receiving a non-taxable federal grant enter its $ amount. You can also use this input to account for the cost of monetizing an ITC through the Elective Pay (transferability) option for the ITC. As an example, the customer will qualify for a $60,000 ITC but they don't pay that much in federal income tax so they will sell the credit to another business. They expect to receive 85% of the value ($51,000) in a cash payment. To account for the cost of selling the credit you should enter -$9,000 in this section.

Step 35: State or other grant – this section covers state incentives and will be different for each state offering an incentive. Enter either a $ amount or a percentage (check for an upper limit), but not both.

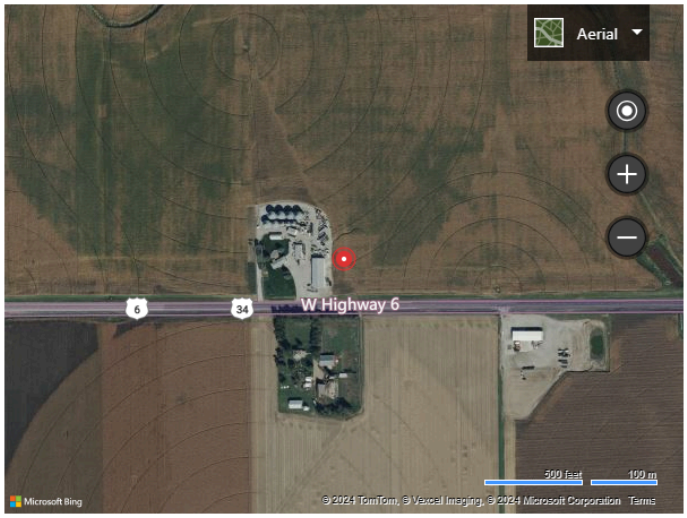
Hit the "Run the Model" button after entering all the necessary inputs.

The output screen for a Financial Analysis session will look like this:

Provided For	
Client Name	FTS Enterprises
Address	10600 W 6th Juniata, Nebraska
Latitude	40.569°
Longitude	-98.529°

Provided By	Edit Info
Company	
Name	Mike Bergey
E-Mail Address	mbergey@bergey.com
Phone	405-364-4212

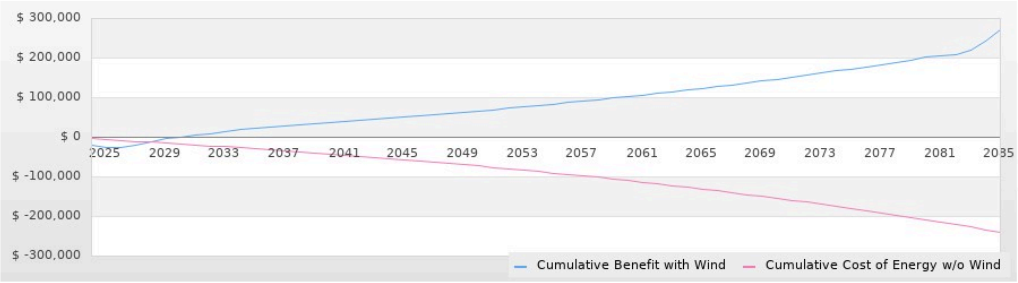
Input Parameters & Turbine Production:



Turbine Selection	Bergey Windpower Excel 15
Nameplate Capacity [kW]	15.6
Rotor Diameter [m]	9.6
Site Location: 10600 W 6th Juniata, Nebraska	
40.569° latitude -98.529° longitude	
Average Wind Speed [mph]	13.94
Tower Height [ft]	100.0
Altitude [ft]	1,998.0
Weibull K	2.0
Wind Shear	0.18
Turbulence Factor [%]	10.0
Average Output Power [kW]	4.6
Daily Energy Output [kWh]	110.7
Monthly Energy Output [kWh]	3,366.7
Annual Energy Output [kWh]	40,400.6
Hub Average Wind Speed [mph]	13.9
Air Density Coefficient	0.9
Operating Time [%]	99.3

NPV	$ 108,069
IRR	31.84 %
Lifetime Cost of Energy	$ -0.09 /kWh
Payback Period	2.8 years

Costs & Benefits:



Turbine Production:

Cashflow Summary:

Cost of System [$]	Resale Value [$]	Cost of Energy [$/kWh]	Annual Energy Usage [kWh]	Energy Inflation Rate [%]	Over-Production Rate [$/kWh]	Maintenance Visit Cost [$]
120,000	40,000	0.10	150,000	4.0	3.00	150

Entity Type	Federal Tax Bracket [%]	State Tax Bracket [%]	Blended Tax Rate [%]	Depreciation Type	Years to Use ITC	NPV Discount Rate [%]
Business	30.0	6.0	34.2	MACRS 1/2 5	1	5.0

Loan Financing	Loan Amount [$]	Loan Interest Rate [%]	Loan Payback Period [years]	Taxable Grant [$]	Non-Taxable Grant [$]
No	n/a	n/a	n/a	48,000	0

Age	Year	Energy Savings Yearly w/ Net Metering	ITC Federal Tax Credit	Add. Federal Tax Credits	Federal Depreciation Tax Savings	State Depreciation Tax Savings	Grant if Taxable	Blended Tax on Taxable Grant	Cost of System to Install (Less Any Non-Taxable Grants)	Annual Cash Flow
0	2024	4,040	36,000	12,000			48,000		-120,000	-19,960
1	2025	4,202			6,120	1,008		-16,416		-5,086
2	2026	4,370			9,792	1,613				15,775
3	2027	4,545			5,875	968				11,387
4	2028	4,726			3,525	581				8,832
5	2029	4,915			3,525	581				9,021
6	2030	5,112			1,763	290				7,165
7	2031	5,316								5,316
8	2032	5,529								5,529
9	2033	5,750								5,750
10	2034	5,980								5,980
11	2035	6,219								6,219
12	2036	6,468								6,468
13	2037	6,727								6,727
14	2038	6,996								6,996
15	2039	7,276								7,276
16	2040	7,567								7,567
17	2041	7,870								7,870
18	2042	8,184								8,184
19	2043	8,512								8,512
20	2044	8,852								8,852
21	2045	9,206								9,206
22	2046	9,575								9,575
23	2047	9,958								9,958
24	2048	10,356								10,356
25	2049	10,770								10,770
26	2050	11,201								11,201
27	2051	11,649								11,649
28	2052	12,115								12,115
29	2053	12,600								12,600
30	2054	13,104								13,104
		239,690	36,000	12,000	30,600	5,040	48,000	-16,416	-120,000	234,914

Age	Year	Annual Cash Flow Carried Over	O&M Yearly Cost	Tax Savings from O&M	Annual Cash Flow	Cumulative Cash Flow
0	2024	-19,960	-150	51	-20,059	-20,059
1	2025	-5,086	-150	51	-5,185	-25,244
2	2026	15,775	-150	51	15,676	-9,568
3	2027	11,387	-150	51	11,289	1,721
4	2028	8,832	-150	51	8,733	10,454
5	2029	9,021	-150	51	8,922	19,377
6	2030	7,165	-150	51	7,066	26,443
7	2031	5,316	-150	51	5,218	31,660
8	2032	5,529	-150	51	5,430	37,091
9	2033	5,750	-150	51	5,652	42,742
10	2034	5,980	-150	51	5,882	48,624
11	2035	6,219	-150	51	6,121	54,745
12	2036	6,468	-150	51	6,370	61,114
13	2037	6,727	-150	51	6,628	67,743
14	2038	6,996	-150	51	6,897	74,640
15	2039	7,276	-150	51	7,177	81,817
16	2040	7,567	-150	51	7,468	89,286
17	2041	7,870	-150	51	7,771	97,056
18	2042	8,184	-150	51	8,086	105,142
19	2043	8,512	-150	51	8,413	113,555
20	2044	8,852	-150	51	8,754	122,309
21	2045	9,206	-150	51	9,108	131,417
22	2046	9,575	-150	51	9,476	140,892
23	2047	9,958	-150	51	9,859	150,751
24	2048	10,356	-150	51	10,257	161,009
25	2049	10,770	-150	51	10,671	171,680
26	2050	11,201	-150	51	11,102	182,782
27	2051	11,649	-150	51	11,550	194,333
28	2052	12,115	-150	51	12,016	206,349
29	2053	12,600	-150	51	12,501	218,850
30	2054	13,104	-150	51	53,005	271,854
		234,914	-4,650	1,590	271,854	

In this example we have a very short payback period and an excellent internal rate of return.

If you want to change one of the inputs, just hit the back button on your browser, make the change(s), and then rerun the model.

You can print the report using the “Print Report” link at the top of the page. To save in PDF format choose “Print Report” but select “Adobe PDF” in your printer selection.