Atlantic DESIGN ENGINEERS, LLC.

UPDATED TURBINE FEASIBILITY STUDY
CAMELOT DRIVE WIND PROJECT
PLYMOUTH, MA

Prepared for:

Mr. Joseph Balboni
The Balboni Companies
Camelot Industrial Park
Plymouth, MA 02360

Prepared by:

Atlantic Design Engineers, LLC
P.O. Box 1051
Sandwich, MA 02563

March 19, 2009

ADE Project #2572

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Atlantic

THE CAMELOT DRIVE WIND PROJECT
UPDATED TURBINE FEASIBILITY/SITING EVALUATION

March 19, 2009

I. BACKGROUND

In July, 2008, Atlantic Design Engineers, LLC (Atlantic) was retained by The Balboni Companies (the client) to complete an initial wind resource evaluation and siting feasibility reviews at two potential wind turbine site locations in the Camelot Industrial Park in Plymouth, Massachusetts. One of these locations, Site I – 125 Camelot Drive, is the subject of this updated report.

Atlantic completed a "Preliminary Findings Turbine Feasibility/Siting Evaluation" dated July 10, 2008. The results of this evaluation indicated that the wind regime at the 125 Camelot Drive property met commercial grade operating requirements for a 389 foot (80 meter hub height) AAER 1,500 kilowatt wind turbine and initial financial reviews indicated the viability of a commercial turbine installation.

Based upon the favorable results of the July 2008 study, the client pursued and obtained a Special Permit from the Plymouth Zoning Board of Appeals for an 80 meter turbine in March 2009.

The purpose of this report is to analyze three new turbine alternatives for the site and to update/refine the associated construction cost and financial models utilizing current energy market values and considering recent revisions to the state net-metering laws.

II. TURBINE EVALUATIONS

A. Turbine Characteristics

The table below provides relevant dimensional data for the potential wind turbines that Atlantic reviewed for installation at the site. Each turbine was selected as a representative of the moderate wind regime class of turbines available from seasoned turbine vendors such as Fuhrlander or General Electric. The 80 meter AAER A-1500 turbine was originally presented as the proposed turbine in information submitted to the Town of Plymouth during the local permitting process. However, the Special Permit granted by the Town allowed for flexibility in the make/model of the actual turbine to be constructed, as long as the final turbine chosen was presented to them for consistency with the permit.

The three additional turbines selected for analysis, including a newer AAER model, represent newer, more efficient machines that are anticipated to provide more energy production on the site.

Table 1: Turbine Characteristics

MODEL	Nameplate Capacity (kWh)	Overall Height (feet)	Hub Height (feet)	Rotor Diameter (feet)	Blade Sweep Clearance From Grade (feet)
AAER A-1500	1,500	389	263	253	136
AAER A-1650	1,650	394	263	263	131
Vestas V82	1,650	397	263	269	128
Gamesa G80	2,000	387	256	263	124

Note that several of the turbines chosen are slightly larger in height than the 389' overall height presented to the town during the local permitting process. In order to site these turbines on the property, the tower location would need to be revised to comply with property line setback requirements of the bylaw and restrictions would need to be placed on abutting Balboni, LLC properties. Refer to Figure 1 "Alternate Turbine Location Plan" provided in the Appendices.

B. Wind Resource Review

The wind resource review, completed in the July 2008 report using the New England Wind Map developed from AWS Truewind wind data and meteorological tower data from the Plymouth County Property northwest of the proposed turbine site, was utilized for this updated report. This wind resource data is presently being reviewed by a certified meteorologist to both confirm that the data from the Plymouth County Met tower is suitable for use on the Camelot Drive site and the wind speeds/capacity factors for the selected turbine are suitable as well. A wind resource review by a certified professional meteorologist is necessary to ensure project financing and wind turbine suitability. The results of the wind resource review for each of the selected turbines is provided in Table 2.

Table 2
Camelot Drive, Plymouth, MA
Estimated Wind Energy Production

Turbine Model	Turbine Hub Height (m)	Average Annual Wind Speed (meters/second)	Projected Capacity Factor* %	Estimated Energy Delivered
AAER A-1500	80	6.7	30%	3,998,00
AAER A-1650	80	6.7	32%	4,651,00
Vestas V82	80	6.7	31%	4,532,00
Gamesa G80	78	6.7	26%	4,604,00

*The capacity factors presented above were generated using the specifications for the AAER-1500-77, AAER A-1650-80, Vestas V82, and the Gamesa G80 model turbines which are representative of a turbine that is, in our opinion, suitable for the Camelot Drive site. Turbine availability, costs, and delivery timeline are subject to change, thus, these aspects should be continually evaluated throughout the project lifespan.

C. Capital Construction Costs

For purposes of this assessment, the following costs have been projected for the installation of the AAER A-1500-77, AAER A-1650-80, Vestas V82, and Gamesa G80 wind turbines. These costs are based upon discussions with turbine salespersons, construction companies, and our current understanding of permitting/engineering design costs associated with approval processes with the Town of Plymouth.

Table 3: Projected Costs Summary

Vendor	Preliminary Cost Estimate (US Dollars)	Rated Machine Capacity (kW)	Cost/kW of Rated Capacity
AAER A-1500	$4,219,072.00	1,500	$2,813.00
AAER A-1650	$4,479,904.00	1,650	$2,715.00
Vestas V82	$4,916,340.00	1,650	$2,980.00
Gamesa G80	$5,326,464.00	2,000	$2,663.00

Please note these estimates are preliminary based upon a generic unit cost estimate with adjustments for anticipated site specific development costs (access road, wetland impacts, etc). A key next step will be to prepare site specific cost estimates for turbine installations based on unit pricing and construction rates/ timelines projected by the client.

For baseline comparison, some of the costs for completed/proposed turbine projects in Massachusetts are as follows:

Table 4: Existing/Proposed Wind Turbines

a). Existing Turbines:

Year Built	Site/Location	Wind Turbine Capacity	Turbine Height (M)	Initial Construction Cost	Cost/kW of Capacity
2005	Hull/Landfill	1-1.8 MW	70M	$3.0 M	$1,667
2006	Bourne, MA	1-660 kW	50M	$1.4 M	$2,121
2007	Jiminy Peak	1-1.5 MW	78M	$4.0 M	$2,667

b). Proposed/Pending Turbines:

Year Built/ Planned	Site/Location	Wind Turbine Capacity	Turbine Height (M)	Estimated Construction Cost	Cost/kWh of Capacity
2009	Fairhaven/Wastewater Treatment Plant	2-1.65 MW	80M	$8.30 M	$2,520
2009	Cape Cod Community College	1-600 kW	50M	$2.2 M	$3,667
2009	Princeton	2-1.5 MW	70M	$8.0 M	$2,670
2009	Falmouth Wastewater Treatment Plant	1-1.65 MW	80M	$4.3 M	$2,606

D. Financial Analysis

RET Screen Energy Models for the four chosen turbines were refined and updated to reflect more current renewable energy market conditions and to incorporate recent revisions to the net-metering laws. The RET Screen models are provided in Appendix B and summarized in Appendix A.

Various incentive programs are in place to assist in funding a wind turbine project. The following potentially available incentives were used in the RET Screen modeling for this project:

- *Production Tax Credits (PTC:* Offered by the U.S. government for renewable energy facilities that pay taxes and sell the electricity generated to outside sources. The current rate for a PTC, as applied to wind energy is $0.02 per kWh. The availability of a PTC has been extended to December 31, 2012. To be eligible, the commissioning date for a facility must be before this deadline.
- *Renewable Energy Credits/Certificates (REC's):* Purchased from renewable energy producers by various power organizations. Rates vary between three cents (3¢) and six cents (6¢) per kilowatt hour. Contract durations may range from 1-10 years and they may be renewable.
- *Net Metering:* Recently enacted legislation (Green Communities Act of 2000) that allows generators of renewable energy to sell energy generated at a rate almost equal to that of the average retail cost of electricity for a given market. For the purposes of this assessment, a net metering value of 18 cents per kilowatt hour has been used as the "avoided cost of energy" in our financial modeling. This assigned value is used as the selling price of the electricity generated from a wind energy net metering facility.
- *Forward Capacity Market (FCM):* Ensures the reliable delivery of electricity during periods of high and low demand by offering incentives to expand generating capacity. Energy production facilities installed

may receive Forward Capacity Payments (FCP) from Independent Service Operators of New England (ISO New England), determined by the generating (name plate) capacity of a given facility. These payments provide capital for the purposes of investing in generating capacity during generation shortages. This ensures that excess generating capacity is available when demand increases. These payments are made for a total of 10 years.

There are also several tax incentive programs potentially available for wind turbine projects as follows:

- *Massachusetts Renewable Energy Property Tax Exemption:* For any wind energy facility that uses the energy generated on site. This tax exemption applies only to the increase in property value related to installing a turbine, not total property tax. This exemption can be claimed for a total of 20 years.
- *The Modified Accelerated Cost Recovery System and Bonus Depreciation:* A federal program designed to give a return on an initial investment, related to renewable energy facilities. A business may recover investments through depreciation deductions, offered as 50% of the depreciation value of the property for 2008-2009. This incentive is in place to provide additional funding to expedite the construction process.

Our RET Screen models did not consider the accelerated depreciations and the associated after tax rate of returns, but it is recommended that the they be evaluated by Tom Condon and the financial projections adjusted accordingly.

The table below presents a complete financial summary of all turbines evaluated.

Table 5: Financial Summary
Camelot Drive Wind Turbine

Vendor	Energy Delivered (kWh)	Annual Energy Revenue	Annual Life Cycle Savings	Raw Production Cost per kWh	Net Cost per kWh (With FCP + RECs)
AAER A-1500	3,998,000	$719,728	$568,351	$0.0692	$0.0384
AAER A-1650	4,651,000	$837,233	$695,424	$0.0633	$0.0328
Vestas V82	4,532,000	$815,740	$630,896	$0.0712	$0.0403
Gamesa G80	4,604,000	$828,669	$609,721	$0.0769	$0.0448

III. PERMITTING

The following permitting activities have been completed to date:

a) **Town of Plymouth Zoning Board of Appeals – Special Permit for Wind Energy Facility**
As part of this permit process, a complete set of site plans, balloon test and photosimulations, acoustic noise analysis, environmental impact statement and shadow flicker analysis were completed and reviewed by the Town. The Planning Board issued a favorable recommendation and the ZBA voted unanimously to grant the Special Permit on 3/4/09.

b) **FAA -** A Determination of No Hazard to Air Navigation was issued by the FAA on 10/16/08 for a turbine height of 394 feet above ground level (471 feet above mean sea level).

Note that if a turbine greater than 394' above ground level is ultimately chosen, a new FAA application/approval will be needed.

c) **MAC** - A final determination that the project does not violate MAC Airspace Laws or Regulations was issued on 9/2/08.

Note that if a turbine greater than 394' above ground level is ultimately chosen, a new MAC application/approval will be needed.

d) **Town of Plymouth Airport Commission –** Gave a unanimous vote of support for the Camelot Drive wind project on 10/9/08.

Remaining permitting issues that are anticipated at this time are as follows:

a) **Town of Plymouth Conservation Commission/Order of Conditions**
A Notice of Intent filing (prepared by others) is pending for work proposed within 100 feet of the bordering vegetated wetland on the site.

Note that if the final location of the chosen turbine is different from the location approved by the Conservation Commission, an amended Order of Conditions may be needed.

b) **Town of Plymouth Building Inspector – Zoning Permit**
A Zoning Permit Application, previously denied due to the need for a Special Permit, will need to be re-filed with the Building Inspector for zoning approval.

c) **Town of Plymouth Building Inspector – Building Permit**
Upon receipt of an approved Zoning Permit, a Building Permit application will need to be filed along with final construction plans with the building inspector.

d) EPA – NPDES General Permit for Stormwater Discharges from Construction Activities (aka Construction General Permit)
An NPDES Construction General Permit (CGP) will be required if the construction site disturbs greater than one acre of land. The CGP requires preparation of a Stormwater Prevention Plan (SWPPP) and filing of a Notice of Intent with the EPA 30 days prior to construction.

e) Utility Connection Permits – Pending, to be completed by Glynn Electric.

f) Town of Plymouth Zoning Board of Appeals
The final chosen turbine specifications will need to be presented informally to the ZBA to determine compliance with the conditions of the Special Permit.

Note that if a turbine with a larger height and revised location on the site is ultimately chosen, the ZBA may consider re-opening the Special Permit process.

IV. FINDINGS

1. In our opinion, adequate wind resources exist for a commercial grade wind turbine proposed at the Camelot Drive turbine site.

2. The Camelot Drive site could, in our opinion, accommodate a commercial grade (scale) turbine slightly larger than the originally proposed 80 meter AAER A-1500, thereby potentially increasing the energy production on the site. Additional permitting with Town and State agencies may be needed.

3. The completed wind energy modeling, cost analysis and financial summaries resulted in favorable economics for all four turbines evaluated. The AAER A-1650 appears to provide the most favorable financial benefits.

V. RECOMMENDATIONS

1. Meet to discuss/review the results of this updated analysis, particularly the options for a larger more efficient turbine on the site.

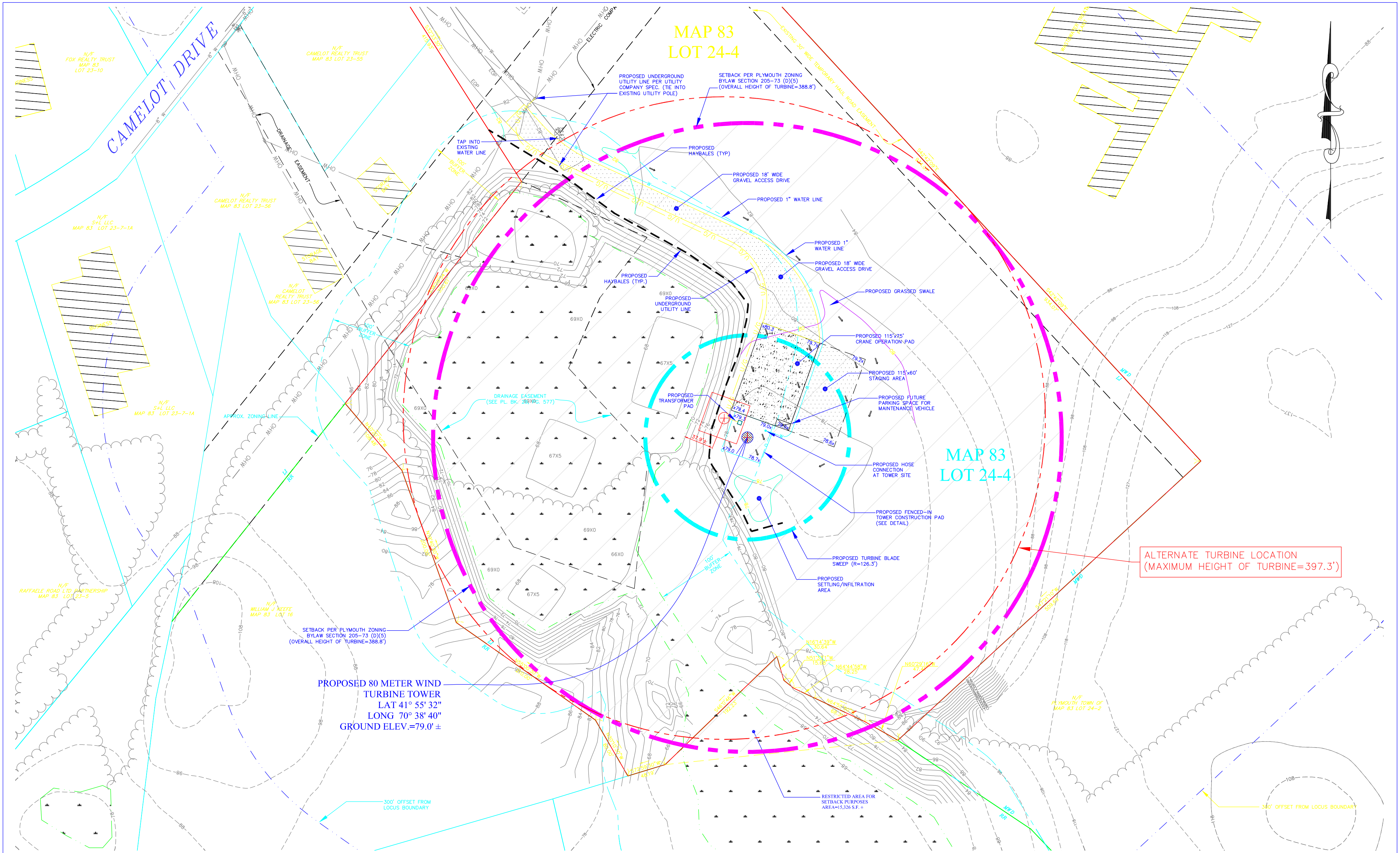
2. Meet with the project attorney to discuss the permitting modifications associated with a larger turbine on the site.

3. Continue to pursue electrical utility connection permits.

4. Obtain accountant recommendations regarding tax incentive programs for turbine funding and revise the RET Screen financial models accordingly.

5. Identify the framework for obtaining project funding and establish a project schedule for turbine procurement and project construction.

6. Identify the preferred Power Purchase Agreements with receiving electrical customers on the NStar utility grid, including the Town of Plymouth.



4D Atlantic® DESIGN ENGINEERS, L.L.C. P.O. Box 1051, Sandwich, MA 02563 (508) 888 - 9282	Designed by : Drawn by : Checked by : Survey chk. by : Approved by :	SCALE SCALE 1" = 50' 0 25 50 100	DATE	NO. BY DATE REVISION	APPLICANT BALBONI, LLC 74-1 CAMELOT DRIVE PLYMOUTH, MA 02360

ALTERNATE TURBINE LOCATION PLAN
FOR
CAMELOT DRIVE WIND PROJECT
LOT 24-4, MAP 83, PLYMOUTH, MA
MARCH 12, 2009

Sheet 1 of 1
JOB NUMBER 2572.0

Atlantic® DESIGN ENGINEERS, L.L.C. P.O. Box 1051, Sandwich, MA 02563 (508) 888 – 9282	Designed by : ______ Drawn by : ______ Checked by : ______ Survey chk. by : ______ Approved by : ______	SCALE SCALE 1" = 300' 0 150 300 600	DATE

NO.	BY	DATE	REVISION

PREPARED FOR
BALBONI, LLC
74-1 CAMELOT DRIVE
PLYMOUTH, MASSACHUSETTS

AERIAL PLAN
FOR
BALBONI, LLC
PLYMOUTH, MASSACHUSETTS
MARCH 6, 2009

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APPENDIX A
Financial Summaries

125 Camelot Drive Comprehensive Financial Summary: 20% Down										
Turbine Model	Turbine Hub Height (Meters)	Annual Renewable Energy Delivered (kWh)	Capital Construction Cost	Debt Service	Operation and Maintenance Costs	FCM, PTC + REC Earnings	Annual Energy Revenue	Annual Life Cycle Savings	Average Raw Production Cost per kWh	Average Net Cost per kWh With FCP + RECs)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
AAER A-1500	80	3,998,000	$4,219,072	$394,330	$40,241	$308,768	$719,728	$568,351	$0.0692	$0.0384
AAER A-1650	80	4,651,000	$4,479,904	$418,708	$42,998	$354,528	$837,233	$695,424	$0.0633	$0.0328
Vestas V-82	80	4,532,000	$4,916,340	$459,499	$46,762	$349,958	$815,740	$630,896	$0.0712	$0.0403
Gamesa G80	78	4,604,000	$5,326,464	$497,831	$55,125	$369,316	$828,669	$609,721	$0.0769	$0.0448

(5) = RE Production Credit Income + GHG Reduction Income

(6) = Energy Delivered * ($/ kWh)

(8) = [{(3)+(4)}*15 years]+[10 years*(4)]/[(1)*25]

(9) = [{(3)+(4)}*15 years]+[10 years*(4)] - [10 years*(5)] / [(1)*25 years]

AAER A-1650
80 Meter

The following financial summaries have been calculated using the following:

- **20% down**
- **8% overall interest rate**
- **15 Year payback**
- **Avoided cost of energy is assumed to be a net metering value of 18 cents per kilowatt hour**

- ISO New England Forward Capacity payments are included under the title of “Renewable Energy Production Credit” on the RetScreen® Financial Summary page. The rate for a 1,650 kilowatt nameplate capacity turbine producing 4,651,000 kilowatt hours annually is assumed to be 1.5 cents per kilowatt hour using a rate of $3.60 per month for a duration of 10 years.
- Renewable Energy Credits are included under title of “GHG Emission Reduction Credit” on the RetScreen® Financial Summary page. The average rate is assumed to be 4.0 cents per kilowatt hour or $115 per ton of CO_2 removed from the atmosphere. Contract lengths vary from 1-10 years. For this financial model, the duration of this incentive is set to 25 years.
- Production Tax Credits (PTCs) are also included under the title of “Renewable Energy Production Credit” on the RetScreen® Financial Summary page. The current rate for PTCs is currently 2.1 cents per kilowatt hour for a duration of ten years.
- Inflation rate and the discount rate are set at an annual increase of 2.5%.
- Forward capacity market payment, REPI payment and energy cost escalation rate are set at an annual increase of 0%.

RETScreen® Financial Summary - Wind Energy Project

Annual Energy Balance

Project name		Camelot A-1650 80 Meter			
Project location		Plymouth, MA			
Renewable energy delivered	MWh	4,651	Net GHG reduction	t_{CO2}/yr	1,627
Excess RE available	MWh	-			
Firm RE capacity	kW	-			
Grid type		Central-grid	Net GHG emission reduction - 25 yrs	t_{CO2}	40,670

Financial Parameters

Avoided cost of energy	$/kWh	0.1800	Debt ratio	%	80.0%
RE production credit	$/kWh	0.036	Debt interest rate	%	8.0%
RE production credit duration	yr	10	Debt term	yr	15
RE credit escalation rate	%	0.0%			
GHG emission reduction credit	$/$t_{CO2}$	115.0	Income tax analysis?	yes/no	No
GHG reduction credit duration	yr	25			
GHG credit escalation rate	%	0.0%			
Energy cost escalation rate	%	0.0%			
Inflation	%	2.5%			
Discount rate	%	2.5%			
Project life	yr	25			

Project Costs and Savings

Initial Costs				**Annual Costs and Debt**		
Feasibility study	1.7%	$	76,000	O&M	$	42,998
Development	8.3%	$	373,000			
Engineering	4.4%	$	195,000	Debt payments - 15 yrs	$	418,708
Energy equipment	59.4%	$	2,662,000	**Annual Costs and Debt - Total**	**$**	**461,706**
Balance of plant	13.2%	$	590,000			
Miscellaneous	13.0%	$	583,904	**Annual Savings or Income**		
Initial Costs - Total	100.0%	**$**	**4,479,904**	Energy savings/income	$	837,233
				Capacity savings/income	$	-
Incentives/Grants		$		RE production credit income - 10 yrs	$	167,447
				GHG reduction income - 25 yrs	$	187,081
				Annual Savings - Total	**$**	**1,191,761**
Periodic Costs (Credits)						
Drive train		$	250,000	Schedule yr # 25		
Blades		$	120,000	Schedule yr # 25		
		$	-			
End of project life - Credit		$	-			

Financial Feasibility

			Calculate energy production cost?	yes/no	No
Pre-tax IRR and ROI	%	81.2%			
After-tax IRR and ROI	%	81.2%	Calculate GHG reduction cost?	yes/no	No
Simple Payback	yr	3.9			
Year-to-positive cash flow	yr	1.2	Project equity	$	895,981
Net Present Value - NPV	$	12,812,748	Project debt	$	3,583,923
Annual Life Cycle Savings	$	695,424	Debt payments	$/yr	418,708
Benefit-Cost (B-C) ratio	-	15.30	Debt service coverage	-	2.74

Yearly Cash Flows

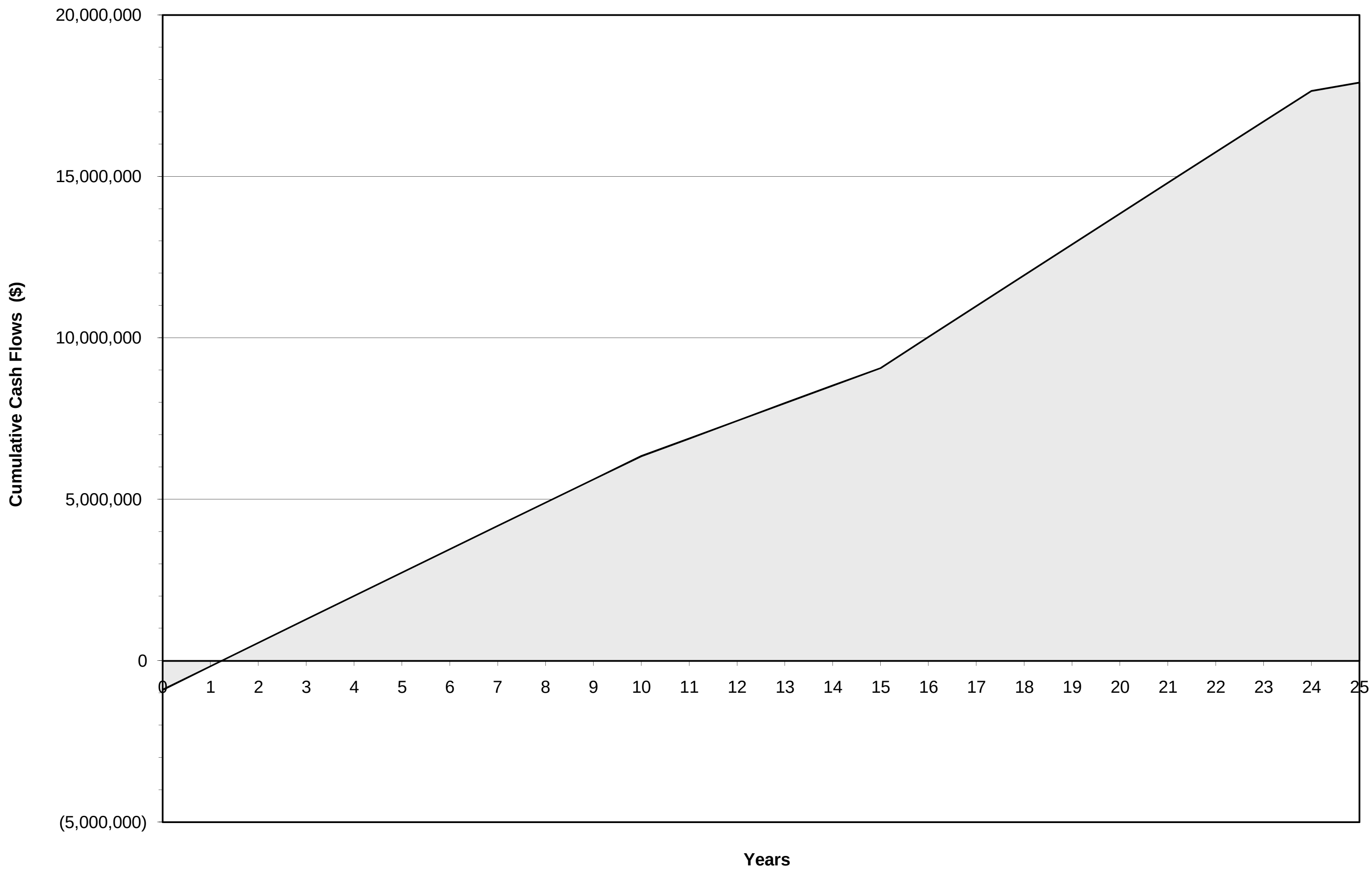
Year #	Pre-tax $	After-tax $	Cumulative $
0	(895,981)	(895,981)	(895,981)
1	728,980	728,980	(167,001)
2	727,878	727,878	560,877
3	726,749	726,749	1,287,626
4	725,591	725,591	2,013,218
5	724,405	724,405	2,737,622
6	723,189	723,189	3,460,811
7	721,942	721,942	4,182,753
8	720,664	720,664	4,903,417
9	719,354	719,354	5,622,772
10	718,012	718,012	6,340,784
11	549,189	549,189	6,889,973
12	547,779	547,779	7,437,752
13	546,333	546,333	7,984,085
14	544,852	544,852	8,528,937
15	543,333	543,333	9,072,270
16	960,484	960,484	10,032,753
17	958,888	958,888	10,991,642
18	957,253	957,253	11,948,894
19	955,576	955,576	12,904,470
20	953,858	953,858	13,858,328
21	952,096	952,096	14,810,424
22	950,291	950,291	15,760,715
23	948,440	948,440	16,709,155
24	946,543	946,543	17,655,698
25	258,640	258,640	17,914,338

RETScreen® Financial Summary - Wind Energy Project

Cumulative Cash Flows Graph

Wind Energy Project Cumulative Cash Flows
Camelot A-1650 80 Meter, Plymouth, MA

Renewable energy delivered (MWh/yr): 4,651 **Total Initial Costs: $ 4,479,904** **Net average GHG reduction (t_{CO2}/yr): 1,627**



IRR and ROI: 81.2% **Year-to-positive cash flow: 1.2 yr** **Net Present Value: $ 12,812,748**

AAER A-1500
80 Meter

The following financial summaries have been calculated using the following:

- **20% down**
- **8% overall interest rate**
- **15 Year payback**
- **Avoided cost of energy is assumed to be a net metering value of 18 cents per kilowatt hour**

- ISO New England Forward Capacity payments are included under the title of "Renewable Energy Production Credit" on the RetScreen® Financial Summary page. The rate for a 1,500 kilowatt nameplate capacity turbine producing 3,998,000 kilowatt hours annually is assumed to be 1.6 cents per kilowatt hour using a rate of $3.60 per month for a duration of 10 years.
- Renewable Energy Credits are included under title of "GHG Emission Reduction Credit" on the RetScreen® Financial Summary page. The average rate is assumed to be 4.0 cents per kilowatt hour or $115 per ton of CO_2 removed from the atmosphere. Contract lengths vary from 1-10 years. For this financial model, the duration of this incentive is set to 25 years.
- Production Tax Credits (PTCs) are also included under the title of "Renewable Energy Production Credit" on the RetScreen® Financial Summary page. The current rate for PTCs is currently 2.1 cents per kilowatt hour for a duration of ten years.
- Inflation rate and the discount rate are set at an annual increase of 2.5%.
- Forward capacity market payment, renewable energy credit payment and energy cost escalation rate are set at an annual increase of 0%.

RETScreen® Financial Summary - Wind Energy Project

Annual Energy Balance

Project name		Camelot A-1500 80 Meter			
Project location		Plymouth, MA			
Renewable energy delivered	MWh	3,998	Net GHG reduction	t_{CO2}/yr	1,398
Excess RE available	MWh	-			
Firm RE capacity	kW	-			
Grid type		Central-grid	Net GHG emission reduction - 25 yrs	t_{CO2}	34,962

Financial Parameters

Avoided cost of energy	$/kWh	0.1800	Debt ratio	%	80.0%
RE production credit	$/kWh	0.037	Debt interest rate	%	8.0%
RE production credit duration	yr	10	Debt term	yr	15
RE credit escalation rate	%	0.0%			
GHG emission reduction credit	$/$t_{CO2}$	115.0	Income tax analysis?	yes/no	No
GHG reduction credit duration	yr	25			
GHG credit escalation rate	%	0.0%			
Energy cost escalation rate	%	0.0%			
Inflation	%	2.5%			
Discount rate	%	2.5%			
Project life	yr	25			

Project Costs and Savings

Initial Costs				**Annual Costs and Debt**		
Feasibility study	1.8%	$	76,000	O&M	$	40,241
Development	7.5%	$	318,000			
Engineering	4.1%	$	175,000	Debt payments - 15 yrs	$	394,330
Energy equipment	60.3%	$	2,544,000	**Annual Costs and Debt - Total**	**$**	**434,571**
Balance of plant	13.2%	$	555,000			
Miscellaneous	13.1%	$	551,072	**Annual Savings or Income**		
Initial Costs - Total	100.0%	**$**	**4,219,072**	Energy savings/income	$	719,728
				Capacity savings/income	$	-
Incentives/Grants		$	-	RE production credit income - 10 yrs	$	147,944
				GHG reduction income - 25 yrs	$	160,824
				Annual Savings - Total	**$**	**1,028,496**
Periodic Costs (Credits)						
Drive train		$	250,000	Schedule yr # 25		
Blades		$	120,000	Schedule yr # 25		
		$	-			
End of project life - Credit		$	-			

Financial Feasibility

			Calculate energy production cost?	yes/no	No
Pre-tax IRR and ROI	%	70.0%			
After-tax IRR and ROI	%	70.0%	Calculate GHG reduction cost?	yes/no	No
Simple Payback	yr	4.3			
Year-to-positive cash flow	yr	1.4	Project equity	$	843,814
Net Present Value - NPV	$	10,416,237	Project debt	$	3,375,258
Annual Life Cycle Savings	$	565,351	Debt payments	$/yr	394,330
Benefit-Cost (B-C) ratio	-	13.34	Debt service coverage	-	2.50

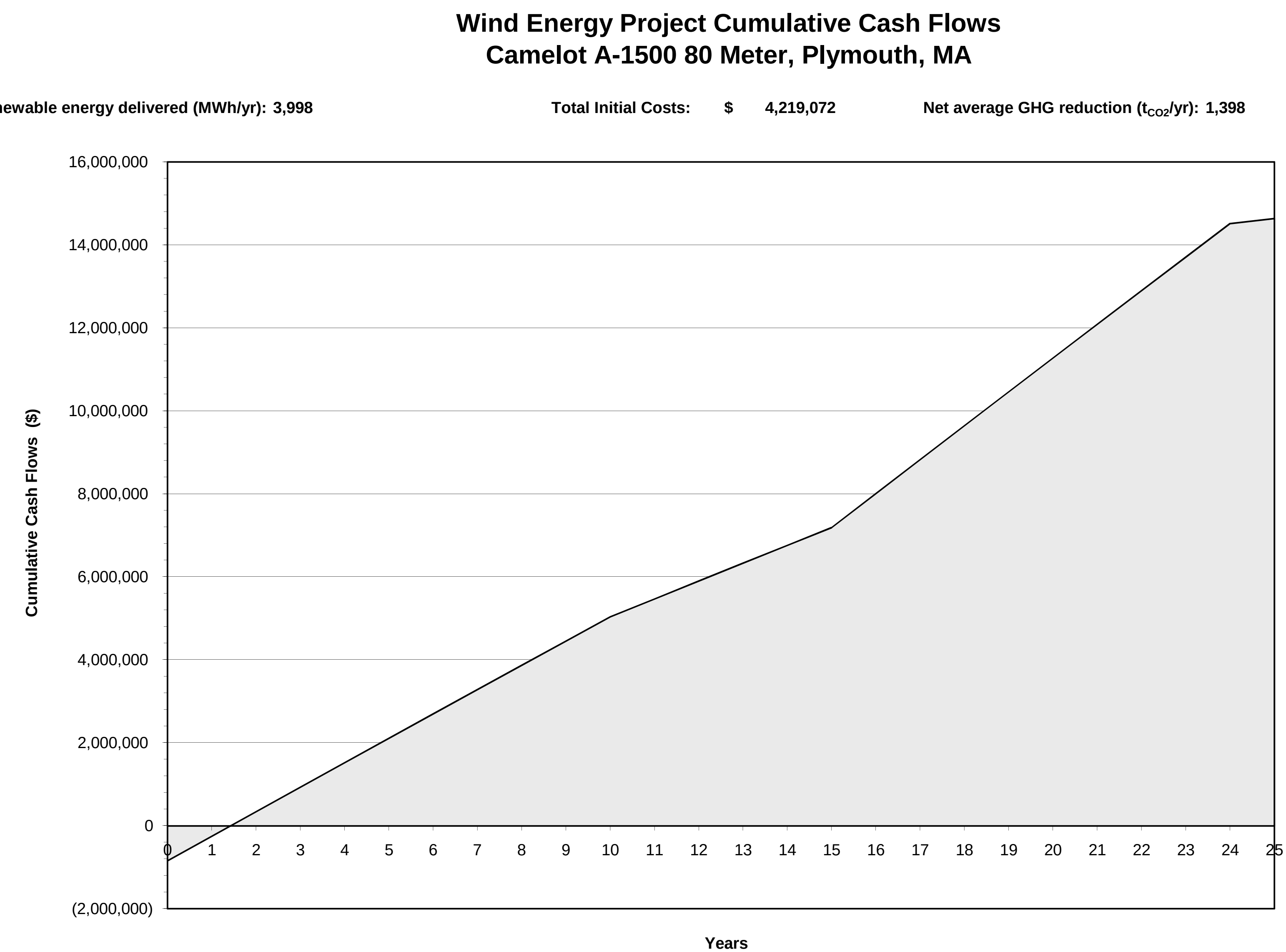
Yearly Cash Flows

Year #	Pre-tax $	After-tax $	Cumulative $
0	(843,814)	(843,814)	(843,814)
1	592,918	592,918	(250,896)
2	591,887	591,887	340,991
3	590,830	590,830	931,822
4	589,747	589,747	1,521,569
5	588,636	588,636	2,110,205
6	587,498	587,498	2,697,703
7	586,332	586,332	3,284,035
8	585,136	585,136	3,869,171
9	583,910	583,910	4,453,080
10	582,654	582,654	5,035,734
11	433,422	433,422	5,469,156
12	432,102	432,102	5,901,258
13	430,749	430,749	6,332,006
14	429,362	429,362	6,761,368
15	427,940	427,940	7,189,309
16	820,813	820,813	8,010,122
17	819,320	819,320	8,829,442
18	817,789	817,789	9,647,230
19	816,220	816,220	10,463,450
20	814,612	814,612	11,278,062
21	812,963	812,963	12,091,025
22	811,273	811,273	12,902,298
23	809,541	809,541	13,711,840
24	807,766	807,766	14,519,606
25	119,987	119,987	14,639,593

RETScreen® Financial Summary - Wind Energy Project

Cumulative Cash Flows Graph

Renewable energy delivered (MWh/yr): 3,998 | **Total Initial Costs: $ 4,219,072** | **Net average GHG reduction (t_{CO2}/yr): 1,398**



IRR and ROI: 70% | **Year-to-positive cash flow: 1.4 yr** | **Net Present Value: $ 10,416,237**

Vestas V82
80 Meter

The following financial summaries have been calculated using the following:

- **20% down**
- **8% overall interest rate**
- **15 Year payback**
- **Avoided cost of energy is assumed to be a net metering value of 18 cents per kilowatt hour**

- ISO New England Forward Capacity payments are included under the title of "Renewable Energy Production Credit" on the RetScreen® Financial Summary page. The rate for a 1,650 kilowatt nameplate capacity turbine producing 4,532,000 kilowatt hours annually is assumed to be 1.6 cents per kilowatt hour using a rate of $3.60 per month for a duration of 10 years.
- Renewable Energy Credits are included under title of "GHG Emission Reduction Credit" on the RetScreen® Financial Summary page. The average rate is assumed to be 4.0 cents per kilowatt hour or $115 per ton of CO_2 removed from the atmosphere. Contract lengths vary from 1-10 years. For this financial model, the duration of this incentive is set to 25 years.
- Production Tax Credits (PTCs) are also included under the title of "Renewable Energy Production Credit" on the RetScreen® Financial Summary page. The current rate for PTCs is currently 2.1 cents per kilowatt hour for a duration of ten years.
- Inflation rate and the discount rate are set at an annual increase of 2.5%.
- Forward capacity market payment, REPI payment and energy cost escalation rate are set at an annual increase of 0%.

RETScreen® Financial Summary - Wind Energy Project

Annual Energy Balance

Project name		Camelot V82 80 Meter			
Project location		Plymouth, MA			
Renewable energy delivered	MWh	4,532	Net GHG reduction	t_{CO2}/yr	1,585
Excess RE available	MWh	-			
Firm RE capacity	kW	-			
Grid type		Central-grid	Net GHG emission reduction - 25 yrs	t_{CO2}	39,626

Financial Parameters

Avoided cost of energy	$/kWh	0.1800	Debt ratio	%	80.0%
RE production credit	$/kWh	0.037	Debt interest rate	%	8.0%
RE production credit duration	yr	10	Debt term	yr	15
RE credit escalation rate	%	0.0%			
GHG emission reduction credit	$/$t_{CO2}$	115.0	Income tax analysis?	yes/no	No
GHG reduction credit duration	yr	25			
GHG credit escalation rate	%	0.0%			
Energy cost escalation rate	%	0.0%			
Inflation	%	2.5%			
Discount rate	%	2.5%			
Project life	yr	25			

Project Costs and Savings

Initial Costs				**Annual Costs and Debt**		
Feasibility study	1.5%	$	76,000	O&M	$	46,762
Development	8.0%	$	393,000			
Engineering	4.3%	$	212,500	Debt payments - 15 yrs	$	459,499
Energy equipment	60.6%	$	2,981,000	**Annual Costs and Debt - Total**	**$**	**506,261**
Balance of plant	12.5%	$	615,000			
Miscellaneous	13.0%	$	638,840	**Annual Savings or Income**		
Initial Costs - Total	100.0%	**$**	**4,916,340**	Energy savings/income	$	815,740
				Capacity savings/income	$	-
Incentives/Grants		$	-	RE production credit income - 10 yrs	$	167,680
				GHG reduction income - 25 yrs	$	182,278
				Annual Savings - Total	**$**	**1,165,698**
Periodic Costs (Credits)						
Drive train		$	265,000	Schedule yr # 25		
Blades		$	125,000	Schedule yr # 25		
		$	-			
End of project life - Credit		$	-			

Financial Feasibility

			Calculate energy production cost?	yes/no	No
Pre-tax IRR and ROI	%	66.7%			
After-tax IRR and ROI	%	66.7%	Calculate GHG reduction cost?	yes/no	No
Simple Payback	yr	4.4			
Year-to-positive cash flow	yr	1.5	Project equity	$	983,268
Net Present Value - NPV	$	11,623,863	Project debt	$	3,933,072
Annual Life Cycle Savings	$	630,896	Debt payments	$/yr	459,499
Benefit-Cost (B-C) ratio	-	12.82	Debt service coverage	-	2.43

Yearly Cash Flows

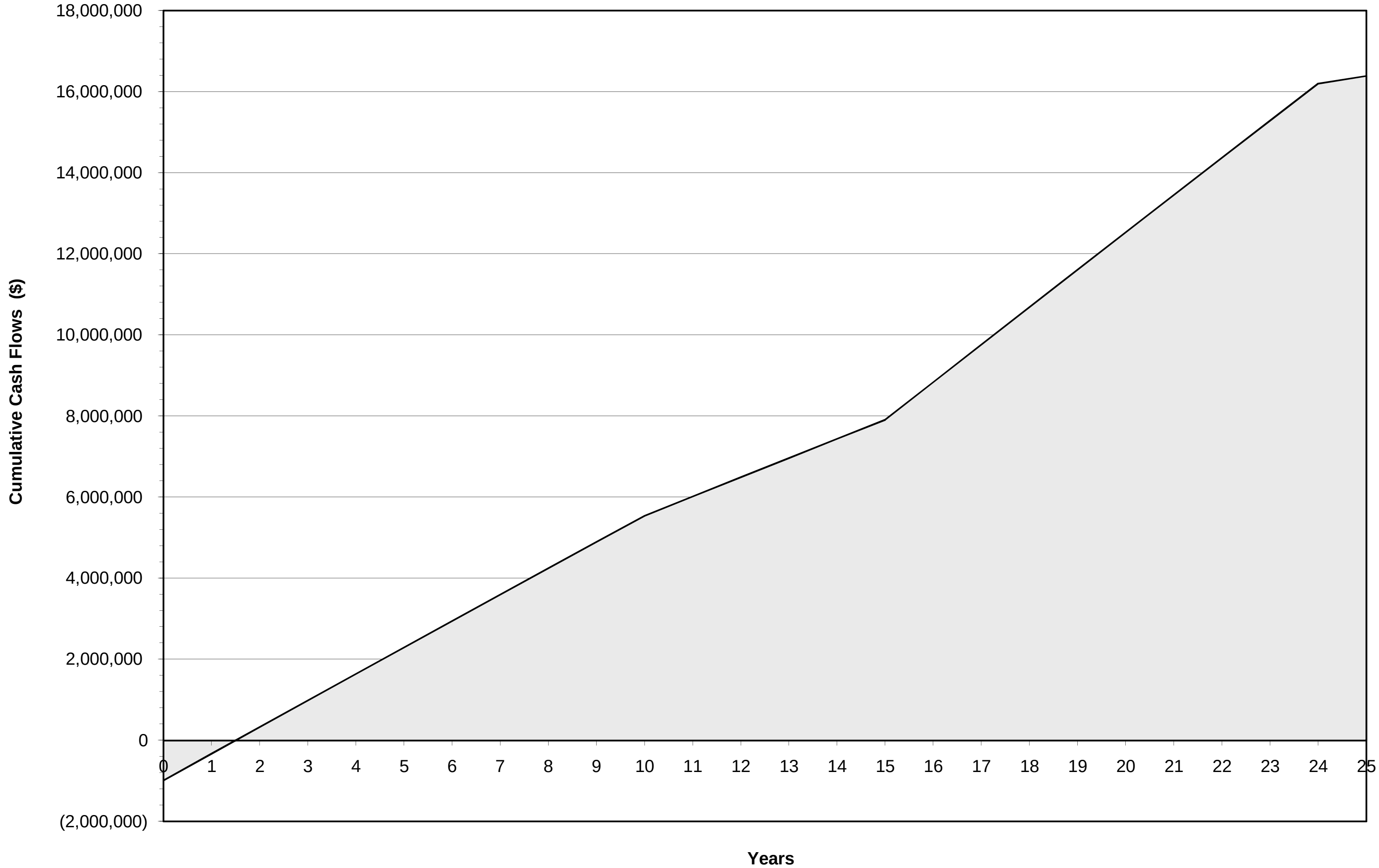
Year #	Pre-tax $	After-tax $	Cumulative $
0	(983,268)	(983,268)	(983,268)
1	658,268	658,268	(325,000)
2	657,070	657,070	332,070
3	655,842	655,842	987,912
4	654,583	654,583	1,642,494
5	653,292	653,292	2,295,786
6	651,970	651,970	2,947,756
7	650,614	650,614	3,598,370
8	649,224	649,224	4,247,594
9	647,800	647,800	4,895,394
10	646,340	646,340	5,541,734
11	477,164	477,164	6,018,898
12	475,630	475,630	6,494,527
13	474,057	474,057	6,968,585
14	472,446	472,446	7,441,031
15	470,794	470,794	7,911,825
16	928,600	928,600	8,840,425
17	926,865	926,865	9,767,289
18	925,086	925,086	10,692,375
19	923,262	923,262	11,615,637
20	921,394	921,394	12,537,031
21	919,478	919,478	13,456,509
22	917,514	917,514	14,374,023
23	915,502	915,502	15,289,525
24	913,439	913,439	16,202,964
25	188,286	188,286	16,391,250

RETScreen® Financial Summary - Wind Energy Project

Cumulative Cash Flows Graph

Wind Energy Project Cumulative Cash Flows
Camelot V82 80 Meter, Plymouth, MA

Renewable energy delivered (MWh/yr): 4,532 **Total Initial Costs:** $ 4,916,340 **Net average GHG reduction (t_{CO2}/yr):** 1,585



IRR and ROI: 66.7% **Year-to-positive cash flow:** 1.5 yr **Net Present Value:** $ 11,623,863

Gamesa G80
78 Meter

The following financial summaries have been calculated using the following:

- **20% down**
- **8% overall interest rate**
- **15 Year payback**
- **Avoided cost of energy is assumed to be a net metering value of 18 cents per kilowatt hour**

- ISO New England Forward Capacity payments are included under the title of “Renewable Energy Production Credit” on the RetScreen® Financial Summary page. The rate for a 2,000 kilowatt nameplate capacity turbine producing 4,604,000 kilowatt hours annually is assumed to be 1.9 cents per kilowatt hour using a rate of $3.60 per month for a duration of 10 years.
- Renewable Energy Credits are included under title of “GHG Emission Reduction Credit” on the RetScreen® Financial Summary page. The average rate is assumed to be 4.0 cents per kilowatt hour or $115 per ton of CO_2 removed from the atmosphere. Contract lengths vary from 1-10 years. For this financial model, the duration of this incentive is set to 25 years.
- Production Tax Credits (PTCs) are also included under the title of “Renewable Energy Production Credit” on the RetScreen® Financial Summary page. The current rate for PTCs is currently 2.1 cents per kilowatt hour for a duration of ten years.
- Inflation rate and the discount rate are set at an annual increase of 2.5%.
- Forward capacity market payment, REPI payment and energy cost escalation rate are set at an annual increase of 0%.

RETScreen® Financial Summary - Wind Energy Project

Annual Energy Balance

Project name		Camelot G80 78 Meter 2000 kw			
Project location		Plymouth, MA			
Renewable energy delivered	MWh	4,604	Net GHG reduction	t_{CO2}/yr	1,610
Excess RE available	MWh	-			
Firm RE capacity	kW	-			
Grid type		Central-grid	Net GHG emission reduction - 25 yrs	t_{CO2}	40,254

Financial Parameters

Avoided cost of energy	$/kWh	0.1800	Debt ratio	%	80.0%
RE production credit	$/kWh	0.040	Debt interest rate	%	8.0%
RE production credit duration	yr	10	Debt term	yr	15
RE credit escalation rate	%	0.0%			
GHG emission reduction credit	$/$t_{CO2}$	115.0	Income tax analysis?	yes/no	No
GHG reduction credit duration	yr	25			
GHG credit escalation rate	%	0.0%			
Energy cost escalation rate	%	0.0%			
Inflation	%	2.5%			
Discount rate	%	2.5%			
Project life	yr	25			

Project Costs and Savings

Initial Costs				**Annual Costs and Debt**		
Feasibility study	1.4%	$	76,000	O&M	$	55,125
Development	7.9%	$	423,000			
Engineering	4.3%	$	230,000	Debt payments - 15 yrs	$	497,831
Energy equipment	60.5%	$	3,222,000	**Annual Costs and Debt - Total**	**$**	**552,956**
Balance of plant	12.9%	$	685,000			
Miscellaneous	13.0%	$	690,464	**Annual Savings or Income**		
Initial Costs - Total	100.0%	**$**	**5,326,464**	Energy savings/income	$	828,669
				Capacity savings/income	$	-
Incentives/Grants		$	-	RE production credit income - 10 yrs	$	184,149
				GHG reduction income - 25 yrs	$	185,167
				Annual Savings - Total	**$**	**1,197,984**
Periodic Costs (Credits)						
Drive train		$	300,000	Schedule yr # 25		
Blades		$	150,000	Schedule yr # 25		
		$	-			
End of project life - Credit		$	-			

Financial Feasibility

			Calculate energy production cost?	yes/no	No
Pre-tax IRR and ROI	%	60.1%			
After-tax IRR and ROI	%	60.1%	Calculate GHG reduction cost?	yes/no	No
Simple Payback	yr	4.7			
Year-to-positive cash flow	yr	1.7	Project equity	$	1,065,293
Net Present Value - NPV	$	11,233,726	Project debt	$	4,261,171
Annual Life Cycle Savings	$	609,721	Debt payments	$/yr	497,831
Benefit-Cost (B-C) ratio	-	11.55	Debt service coverage	-	2.29

Yearly Cash Flows

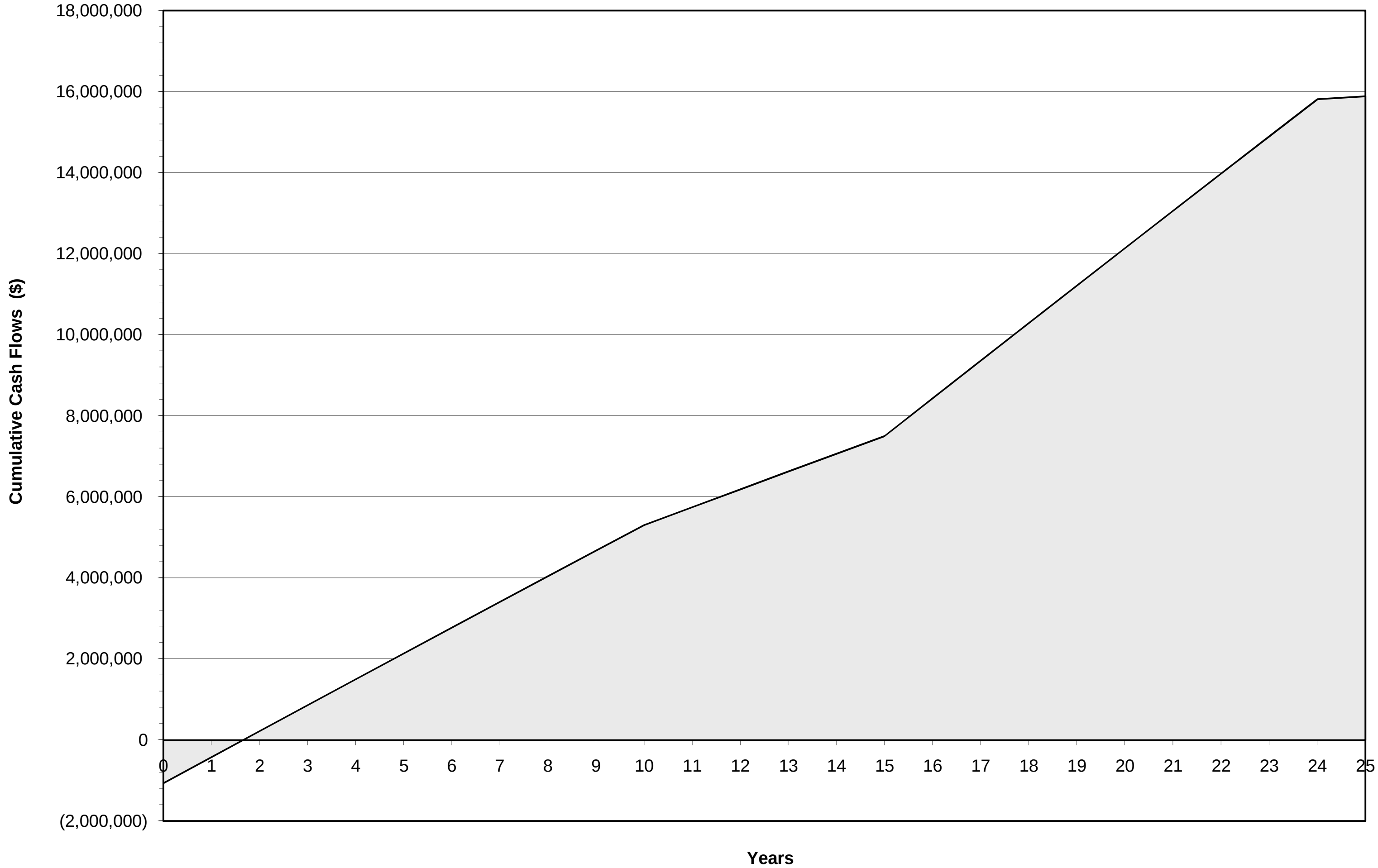
Year #	Pre-tax $	After-tax $	Cumulative $
0	(1,065,293)	(1,065,293)	(1,065,293)
1	643,651	643,651	(421,642)
2	642,238	642,238	220,596
3	640,790	640,790	861,386
4	639,306	639,306	1,500,692
5	637,785	637,785	2,138,477
6	636,226	636,226	2,774,703
7	634,627	634,627	3,409,330
8	632,989	632,989	4,042,320
9	631,310	631,310	4,673,630
10	629,589	629,589	5,303,219
11	443,676	443,676	5,746,895
12	441,868	441,868	6,188,764
13	440,015	440,015	6,628,778
14	438,115	438,115	7,066,893
15	436,168	436,168	7,503,061
16	932,002	932,002	8,435,064
17	929,957	929,957	9,365,020
18	927,860	927,860	10,292,880
19	925,710	925,710	11,218,590
20	923,507	923,507	12,142,097
21	921,249	921,249	13,063,346
22	918,934	918,934	13,982,280
23	916,562	916,562	14,898,842
24	914,130	914,130	15,812,972
25	77,362	77,362	15,890,334

RETScreen® Financial Summary - Wind Energy Project

Cumulative Cash Flows Graph

Wind Energy Project Cumulative Cash Flows
Camelot G80 78 Meter 2000 kw, Plymouth, MA

Renewable energy delivered (MWh/yr): 4,604 **Total Initial Costs: $ 5,326,464** **Net average GHG reduction (t_{CO2}/yr): 1,610**



IRR and ROI: 60.1% **Year-to-positive cash flow: 1.7 yr** **Net Present Value: $ 11,233,726**

APPENDIX B

Energy Models, Cost Analysis, and Greenhouse Gas Emissions

AAER A-1650
80 Meter

*__The following cost summary estimates have been calculated **without** the following assumptions:__*

- Site Investigation
- Wind Resource Assessment
- GHG Baseline Study and Monitoring Plan
- Land Rights
- GHG Validation and Registration
- Project financing
- Tenders and Contracting
- Substation(s)
- Training
- Land Lease
- Property Taxes
- GHG Monitoring and Verification
- Community Benefits

*__The following financial summaries have been calculated **using** the following assumptions:__*

- Feasibility studies expenses at 76,000
- Development expenses at $373,000
- Engineering expenses at $195,000
- The price of an AAER A-1650 turbine at $2,400,000
- Transporting turbine and parts at $190,000
- Foundation construction and design expenses at $200,000.
- Turbine erection expenses at $150,000
- Road construction expenses at $100,000.
- Transmission line construction and expenses at $100,000.
- Travel and accommodation during the initial development of the project set to $4,000. Annual travel expenses are set to $3,000.

*The values assumed in the following cost summaries are preliminary estimates and may not reflect the true current values of the cost analysis.

RETScreen® Energy Model - Wind Energy Project

Training & Support

Units: Metric

Site Conditions		Estimate	Notes/Range
Project name		**Camelot A-1650 80 Meter**	See Online Manual
Project location		**Plymouth, MA**	
Wind data source		Wind speed	
Nearest location for weather data		Meteorological Tower	See Weather Database
Annual average wind speed	m/s	6.7	
Height of wind measurement	m	80.0	3.0 to 100.0 m
Wind shear exponent	-	0.25	0.10 to 0.40
Wind speed at 10 m	m/s	4.0	
Average atmospheric pressure	kPa	101.0	60.0 to 103.0 kPa
Annual average temperature	°C	11	-20 to 30 °C

System Characteristics		Estimate	Notes/Range
Grid type	-	Central-grid	
Wind turbine rated power	kW	1650	Complete Equipment Data sheet
Number of turbines	-	1	
Wind plant capacity	kW	1,650	
Hub height	m	80.0	6.0 to 100.0 m
Wind speed at hub height	m/s	6.7	
Wind power density at hub height	W/m²	353	
Array losses	%	5%	0% to 20%
Airfoil soiling and/or icing losses	%	1%	1% to 10%
Other downtime losses	%	2%	2% to 7%
Miscellaneous losses	%	2%	2% to 6%

Annual Energy Production		Estimate Per Turbine	Estimate Total	Notes/Range
Wind plant capacity	kW	1,650	1,650	
	MW	1.650	1.650	
Unadjusted energy production	MWh	5,049	5,049	
Pressure adjustment coefficient	-	1.00	1.00	0.59 to 1.02
Temperature adjustment coefficient	-	1.02	1.02	0.98 to 1.15
Gross energy production	MWh	5,149	5,149	
Losses coefficient	-	0.90	0.90	0.75 to 1.00
Specific yield	kWh/m²	925	925	150 to 1,500 kWh/m²
Wind plant capacity factor	%	32%	32%	20% to 40%
Renewable energy delivered	MWh	4,651	**4,651**	
	GJ	16,745	16,745	
				Complete Cost Analysis sheet

Version 3.2

NRCan/CETC - Varennes

RETScreen® Cost Analysis - Wind Energy Project

Type of analysis: Feasibility | Currency: $ | Cost references: None

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
Feasibility Study							
Site investigation	p-d	0.0	$ -	$ -		-	-
Wind resource assessment	met tower	0	$ -	$ -		-	-
Environmental assessment	p-d	1.0	$ 35,000	$ 35,000		-	-
Preliminary design	p-d	1.0	$ 15,000	$ 15,000		-	-
Detailed cost estimate	p-d	1.0	$ 10,000	$ 10,000		-	-
GHG baseline study and MP	project	1	$ -	$ -		-	-
Report preparation	p-d	1.0	$ 10,000	$ 10,000		-	-
Project management	p-d	1.0	$ 5,000	$ 5,000		-	-
Travel and accommodation	p-trip	1	$ 1,000	$ 1,000		-	-
Other - Feasibility study	Cost	1	$ -	$ -		-	-
Sub-total:				**$ 76,000**	1.7%		
Development							
PPA negotiation	p-d	1.0	$ 50,000	$ 50,000		-	-
Permits and approvals	p-d	1.0	$ 120,000	$ 120,000		-	-
Land rights	project	0	$ -	$ -		-	-
Land survey	p-d	1.0	$ 20,000	$ 20,000		-	-
GHG validation and registration	project	0	$ -	$ -		-	-
Project financing	p-d	0.0	$ -	$ -		-	-
Legal and accounting	p-d	1.0	$ 120,000	$ 120,000		-	-
Project management	p-yr	1.00	$ 60,000	$ 60,000		-	-
Travel and accommodation	p-trip	1	$ 3,000	$ 3,000		-	-
Other - Development	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 373,000**	8.3%		
Engineering							
Wind turbine(s) micro-siting	p-d	1.0	$ 15,000	$ 15,000		-	-
Mechanical design	p-d	1.0	$ 30,000	$ 30,000		-	-
Electrical design	p-d	1.0	$ 40,000	$ 40,000		-	-
Civil design	p-d	1.0	$ 45,000	$ 45,000		-	-
Tenders and contracting	p-d	0.0	$ -	$ -		-	-
Construction supervision	p-yr	1.00	$ 65,000	$ 65,000		-	-
Other - Engineering	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 195,000**	4.4%		
Energy Equipment							
Wind turbine(s)	kW	1,650	$ 1,455	$ 2,400,000		-	-
Spare parts	%	3.0%	$ 2,400,000	$ 72,000		-	-
Transportation	turbine	1	$ 190,000	$ 190,000		-	-
Other - Energy equipment	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 2,662,000**	59.4%		
Balance of Plant							
Wind turbine(s) foundation(s)	turbine	1	$ 200,000	$ 200,000		-	-
Wind turbine(s) erection	turbine	1	$ 150,000	$ 150,000		-	-
Road construction	mi	0.25	$ 400,000	$ 100,000		-	-
Transmission line	mi	0.25	$ 400,000	$ 100,000		-	-
Substation	project	0	$ -	$ -		-	-
Control and O&M building(s)	building	1	$ 40,000	$ 40,000		-	-
Transportation	project	0	$ -	$ -		-	-
Other - Balance of plant	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 590,000**	13.2%		
Miscellaneous							
Training	p-d	0.0	$ -	$ -		-	-
Commissioning	p-d	1.0	$ 20,000	$ 20,000		-	-
Contingencies	%	10%	$ 3,916,000	$ 391,600		-	-
Interest during construction	8.0%	12 month(s)	$ 4,307,600	$ 172,304		-	-
Sub-total:				**$ 583,904**	13.0%		
Initial Costs - Total				**$ 4,479,904**	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Land lease	project	0	$ -	$ -		-	-
Property taxes	project	0	$ -	$ -		-	-
Insurance premium	project	1	$ 10,000	$ 10,000		-	-
Transmission line maintenance	%	2.0%	$ 100,000	$ 2,000		-	-
Parts and labour	kWh	4,651,295	$ 0.005	$ 24,000		-	-
GHG monitoring and verification	project	0	$ -	$ -		-	-
Community benefits	project	0	$ -	$ -		-	-
Travel and accommodation	p-trip	2	$ 1,500	$ 3,000		-	-
General and administrative	%	5%	$ 39,000	$ 1,950		-	-
Other - O&M	Cost	0	$ -	$ -		-	-
Contingencies	%	5%	$ 40,950	$ 2,048		-	-
Annual Costs - Total				**$ 42,998**	100.0%		

Periodic Costs (Credits)		Period	Unit Cost	Amount		Interval Range	Unit Cost Range
Drive train	Cost	25 yr	$ 250,000	**$ 250,000**		-	-
Blades	Cost	25 yr	$ 120,000	**$ 120,000**		-	-
				$ -		-	-
End of project life	Credit	-	$ -	**$ -**			

Go to GHG Analysis sheet

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Wind Energy Project

Use GHG analysis sheet?	Yes	Type of analysis:	Standard
Potential CDM project?	No		

Background Information

Project Information

				Global Warming Potential of GHG		
Project name	Camelot A-1650 80 Meter	Project capacity	1.65 MW	21	tonnes CO_2 = 1 tonne CH_4	(IPCC 1996)
Project location	Plymouth, MA	Grid type	Central-grid	310	tonnes CO_2 = 1 tonne N_2O	(IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Coal	12.0%	94.6	0.0020	0.0030	35.0%	12.0%	1.117
Natural gas	33.0%	56.1	0.0030	0.0010	45.0%	12.0%	0.513
Nuclear	28.0%	0.0	0.0000	0.0000	30.0%		0.000
Large hydro	8.0%	0.0	0.0000	0.0000	100.0%		0.000
#6 oil	10.0%	77.4	0.0030	0.0020	30.0%		0.937
Wind	6.0%	0.0	0.0000	0.0000	100.0%		0.000
Solar	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Biomass	1.0%	0.0	0.0320	0.0040	25.0%		0.028
Small hydro	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Electricity mix	100%	109.4	0.0056	0.0028		5.4%	0.397

Does baseline change during project life? No

Proposed Case Electricity System (Wind Energy Project)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Electricity system							
Wind	100.0%	0.0	0.0000	0.0000	100.0%	12.0%	0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (tCO2/MWh)	Proposed case GHG emission factor (tCO2/MWh)	End-use annual energy delivered (MWh)	Gross annual GHG emission reduction (t_{CO2})	GHG credits transaction fee (%)	Net annual GHG emission reduction (t_{CO2})
Electricity system	0.397	0.000	4,093	1,627	0.0%	**1,627**

Complete Financial Summary sheet

AAER A-1500
80 Meter

*<u>The following cost summary estimates have been calculated **without** the following assumptions:</u>*

- Site Investigation
- Wind Resource Assessment
- GHG Baseline Study and Monitoring Plan
- Land Rights
- GHG Validation and Registration
- Project financing
- Tenders and Contracting
- Substation(s)
- Training
- Land Lease
- Property Taxes
- GHG Monitoring and Verification
- Community Benefits

*<u>The following financial summaries have been calculated **using** the following assumptions:</u>*

- Feasibility studies expenses at 76,000
- Development expenses at $318,000
- Engineering expenses at $175,000
- The price of an AAER A-1500 turbine at $2,300,000
- Transporting turbine and parts at $175,000
- Foundation construction and design expenses at $175,000.
- Turbine erection expenses at $140,000
- Road construction expenses at $100,000.
- Transmission line construction and expenses at $100,000.
- Travel and accommodation during the initial development of the project set to $4,000. Annual travel expenses are set to $3,000.

*The values assumed in the following cost summaries are preliminary estimates and may not reflect the true current values of the cost analysis.

RETScreen® Energy Model - Wind Energy Project

Training & Support

Units: Metric

Site Conditions		Estimate	Notes/Range
Project name		**Camelot A-1500 80 Meter**	See Online Manual
Project location		**Plymouth, MA**	
Wind data source		Wind speed	
Nearest location for weather data		Meteorological Tower	See Weather Database
Annual average wind speed	m/s	6.7	
Height of wind measurement	m	80.0	3.0 to 100.0 m
Wind shear exponent	-	0.25	0.10 to 0.40
Wind speed at 10 m	m/s	4.0	
Average atmospheric pressure	kPa	101.0	60.0 to 103.0 kPa
Annual average temperature	°C	11	-20 to 30 °C

System Characteristics		Estimate	Notes/Range
Grid type	-	Central-grid	
Wind turbine rated power	kW	1500	➡ Complete Equipment Data sheet
Number of turbines	-	1	
Wind plant capacity	kW	1,500	
Hub height	m	80.0	6.0 to 100.0 m
Wind speed at hub height	m/s	6.7	
Wind power density at hub height	W/m²	353	
Array losses	%	5%	0% to 20%
Airfoil soiling and/or icing losses	%	1%	1% to 10%
Other downtime losses	%	2%	2% to 7%
Miscellaneous losses	%	2%	2% to 6%

Annual Energy Production		Estimate Per Turbine	Estimate Total	Notes/Range
Wind plant capacity	kW	1,500	1,500	
	MW	1.500	1.500	
Unadjusted energy production	MWh	4,340	4,340	
Pressure adjustment coefficient	-	1.00	1.00	0.59 to 1.02
Temperature adjustment coefficient	-	1.02	1.02	0.98 to 1.15
Gross energy production	MWh	4,427	4,427	
Losses coefficient	-	0.90	0.90	0.75 to 1.00
Specific yield	kWh/m²	859	859	150 to 1,500 kWh/m²
Wind plant capacity factor	%	30%	30%	20% to 40%
Renewable energy delivered	MWh	3,998	**3,998**	
	GJ	14,395	14,395	

Complete Cost Analysis sheet

RETScreen® Cost Analysis - Wind Energy Project

Type of analysis: Feasibility | Currency: $ | Cost references: None

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
Feasibility Study							
Site investigation	p-d	0.0		$ -		-	-
Wind resource assessment	met tower	0		$ -		-	-
Environmental assessment	p-d	1.0	$ 35,000	$ 35,000		-	-
Preliminary design	p-d	1.0	$ 15,000	$ 15,000		-	-
Detailed cost estimate	p-d	1.0	$ 10,000	$ 10,000		-	-
GHG baseline study and MP	project	1		$ -		-	-
Report preparation	p-d	1.0	$ 10,000	$ 10,000		-	-
Project management	p-d	1.0	$ 5,000	$ 5,000		-	-
Travel and accommodation	p-trip	1	$ 1,000	$ 1,000		-	-
Other - Feasibility study	Cost	0		$ -		-	-
Sub-total:				**$ 76,000**	1.8%		
Development							
PPA negotiation	p-d	1.0	$ 50,000	$ 50,000		-	-
Permits and approvals	p-d	1.0	$ 100,000	$ 100,000		-	-
Land rights	project	1		$ -		-	-
Land survey	p-d	1.0	$ 15,000	$ 15,000		-	-
GHG validation and registration	project	0		$ -		-	-
Project financing	p-d	0.0		$ -		-	-
Legal and accounting	p-d	1.0	$ 100,000	$ 100,000		-	-
Project management	p-yr	1.00	$ 50,000	$ 50,000		-	-
Travel and accommodation	p-trip	1	$ 3,000	$ 3,000		-	-
Other - Development	Cost	1		$ -		-	-
Sub-total:				**$ 318,000**	7.5%		
Engineering							
Wind turbine(s) micro-siting	p-d	1.0	$ 10,000	$ 10,000		-	-
Mechanical design	p-d	1.0	$ 25,000	$ 25,000		-	-
Electrical design	p-d	1.0	$ 37,500	$ 37,500		-	-
Civil design	p-d	1.0	$ 42,500	$ 42,500		-	-
Tenders and contracting	p-d	1.0		$ -		-	-
Construction supervision	p-yr	1.00	$ 60,000	$ 60,000		-	-
Other - Engineering	Cost	0		$ -		-	-
Sub-total:				**$ 175,000**	4.1%		
Energy Equipment							
Wind turbine(s)	kW	1,500	$ 1,533	$ 2,300,000		-	-
Spare parts	%	3.0%	$ 2,300,000	$ 69,000		-	-
Transportation	turbine	1	$ 175,000	$ 175,000		-	-
Other - Energy equipment	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 2,544,000**	60.3%		
Balance of Plant							
Wind turbine(s) foundation(s)	turbine	1	$ 175,000	$ 175,000		-	-
Wind turbine(s) erection	turbine	1	$ 140,000	$ 140,000		-	-
Road construction	mi	0.25	$ 400,000	$ 100,000		-	-
Transmission line	mi	0.25	$ 400,000	$ 100,000		-	-
Substation	project	0	$ -	$ -		-	-
Control and O&M building(s)	building	1	$ 40,000	$ 40,000		-	-
Transportation	project	0	$ -	$ -		-	-
Other - Balance of plant	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 555,000**	13.2%		
Miscellaneous							
Training	p-d	0.0	$ -	$ -		-	-
Commissioning	p-d	1.0	$ 20,000	$ 20,000		-	-
Contingencies	%	10%	$ 3,688,000	$ 368,800		-	-
Interest during construction	8.0%	12 month(s)	$ 4,056,800	$ 162,272		-	-
Sub-total:				**$ 551,072**	13.1%		
Initial Costs - Total				**$ 4,219,072**	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Land lease	project	0	$ -	$ -		-	-
Property taxes	project	0	$ -	$ -		-	-
Insurance premium	project	1	$ 9,500	$ 9,500		-	-
Transmission line maintenance	%	2.0%	$ 100,000	$ 2,000		-	-
Parts and labour	kWh	3,998,486	$ 0.006	$ 22,000		-	-
GHG monitoring and verification	project	0	$ -	$ -		-	-
Community benefits	project	0	$ -	$ -		-	-
Travel and accommodation	p-trip	2	$ 1,500	$ 3,000		-	-
General and administrative	%	5%	$ 36,500	$ 1,825		-	-
Other - O&M	Cost	0	$ -	$ -		-	-
Contingencies	%	5%	$ 38,325	$ 1,916		-	-
Annual Costs - Total				**$ 40,241**	100.0%		

Periodic Costs (Credits)		Period	Unit Cost	Amount	Interval Range	Unit Cost Range
Drive train	Cost	25 yr	$ 250,000	**$ 250,000**	-	-
Blades	Cost	25 yr	$ 120,000	**$ 120,000**	-	-
				$ -	-	-
End of project life	Credit	-	$ -	**$ -**		

Go to GHG Analysis sheet

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Wind Energy Project

Use GHG analysis sheet? Yes | Type of analysis: Standard
Potential CDM project? No

Background Information

Project Information

Project name	Camelot A-1500 80 Meter	Project capacity	1.50 MW		
Project location	Plymouth, MA	Grid type	Central-grid		

Global Warming Potential of GHG

21	tonnes CO_2 =	1 tonne CH_4	(IPCC 1996)
310	tonnes CO_2 =	1 tonne N_2O	(IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Coal	12.0%	94.6	0.0020	0.0030	35.0%	12.0%	1.117
Natural gas	33.0%	56.1	0.0030	0.0010	45.0%	12.0%	0.513
Nuclear	28.0%	0.0	0.0000	0.0000	30.0%		0.000
Large hydro	8.0%	0.0	0.0000	0.0000	100.0%		0.000
#6 oil	10.0%	77.4	0.0030	0.0020	30.0%		0.937
Wind	6.0%	0.0	0.0000	0.0000	100.0%		0.000
Solar	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Biomass	1.0%	0.0	0.0320	0.0040	25.0%		0.028
Small hydro	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Electricity mix	100%	109.4	0.0056	0.0028		5.4%	0.397

Does baseline change during project life? No

Proposed Case Electricity System (Wind Energy Project)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Electricity system							
Wind	100.0%	0.0	0.0000	0.0000	100.0%	12.0%	0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (tCO2/MWh)	Proposed case GHG emission factor (tCO2/MWh)	End-use annual energy delivered (MWh)	Gross annual GHG emission reduction (t_{CO2})	GHG credits transaction fee (%)	Net annual GHG emission reduction (t_{CO2})
Electricity system	0.397	0.000	3,519	1,398	0.0%	**1,398**

Complete Financial Summary sheet

Vestas V82
80 Meter

The following cost summary estimates have been calculated ***without*** *the following assumptions:*

- Site Investigation
- Wind Resource Assessment
- GHG Baseline Study and Monitoring Plan
- Land Rights
- GHG Validation and Registration
- Project financing
- Tenders and Contracting
- Substation(s)
- Training
- Land Lease
- Property Taxes
- GHG Monitoring and Verification
- Community Benefits

The following financial summaries have been calculated ***using*** *the following assumptions:*

- Feasibility studies expenses at 76,000
- Development expenses at $393,000
- Engineering expenses at $212,500
- The price of a Vestas V82 turbine at $2,700,000
- Transporting turbine and parts at $200,000
- Foundation construction and design expenses at $215,000.
- Turbine erection expenses at $160,000
- Road construction expenses at $100,000.
- Transmission line construction and expenses at $100,000.
- Travel and accommodation during the initial development of the project set to $4,000. Annual travel expenses are set to $3,000.

*The values assumed in the following cost summaries are preliminary estimates and may not reflect the true current values of the cost analysis.

RETScreen® Energy Model - Wind Energy Project

Training & Support

Units: Metric

Site Conditions		Estimate	Notes/Range
Project name		**Camelot V82 80 Meter**	See Online Manual
Project location		**Plymouth, MA**	
Wind data source		Wind speed	
Nearest location for weather data		Meteorological Tower	See Weather Database
Annual average wind speed	m/s	6.7	
Height of wind measurement	m	80.0	3.0 to 100.0 m
Wind shear exponent	-	0.25	0.10 to 0.40
Wind speed at 10 m	m/s	4.0	
Average atmospheric pressure	kPa	101.0	60.0 to 103.0 kPa
Annual average temperature	°C	11	-20 to 30 °C

System Characteristics		Estimate	Notes/Range
Grid type	-	Central-grid	
Wind turbine rated power	kW	1650	Complete Equipment Data sheet
Number of turbines	-	1	
Wind plant capacity	kW	1,650	
Hub height	m	80.0	6.0 to 100.0 m
Wind speed at hub height	m/s	6.7	
Wind power density at hub height	W/m²	353	
Array losses	%	5%	0% to 20%
Airfoil soiling and/or icing losses	%	1%	1% to 10%
Other downtime losses	%	2%	2% to 7%
Miscellaneous losses	%	2%	2% to 6%

Annual Energy Production		Estimate Per Turbine	Estimate Total	Notes/Range
Wind plant capacity	kW	1,650	1,650	
	MW	1.650	1.650	
Unadjusted energy production	MWh	4,919	4,919	
Pressure adjustment coefficient	-	1.00	1.00	0.59 to 1.02
Temperature adjustment coefficient	-	1.02	1.02	0.98 to 1.15
Gross energy production	MWh	5,017	5,017	
Losses coefficient	-	0.90	0.90	0.75 to 1.00
Specific yield	kWh/m²	858	858	150 to 1,500 kWh/m²
Wind plant capacity factor	%	31%	31%	20% to 40%
Renewable energy delivered	MWh	4,532	**4,532**	
	GJ	16,315	16,315	

Complete Cost Analysis sheet

Version 3.2 NRCan/CETC - Varennes

RETScreen® Cost Analysis - Wind Energy Project

Type of analysis: Feasibility | Currency: $ | Cost references: None

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
Feasibility Study							
Site investigation	p-d	0.0	$ -	$ -		-	-
Wind resource assessment	met tower	0	$ -	$ -		-	-
Environmental assessment	p-d	1.0	$ 35,000	$ 35,000		-	-
Preliminary design	p-d	1.0	$ 15,000	$ 15,000		-	-
Detailed cost estimate	p-d	1.0	$ 10,000	$ 10,000		-	-
GHG baseline study and MP	project	0	$ -	$ -		-	-
Report preparation	p-d	1.0	$ 10,000	$ 10,000		-	-
Project management	p-d	50.0	$ 100	$ 5,000		-	-
Travel and accommodation	p-trip	1	$ 1,000	$ 1,000		-	-
Other - Feasibility study	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 76,000**	1.5%		
Development							
PPA negotiation	p-d	1.0	$ 50,000	$ 50,000		-	-
Permits and approvals	p-d	1.0	$ 120,000	$ 120,000		-	-
Land rights	project	0	$ -	$ -		-	-
Land survey	p-d	1.0	$ 20,000	$ 20,000		-	-
GHG validation and registration	project	0	$ -	$ -		-	-
Project financing	p-d	0.0	$ -	$ -		-	-
Legal and accounting	p-d	1.0	$ 130,000	$ 130,000		-	-
Project management	p-yr	1.00	$ 70,000	$ 70,000		-	-
Travel and accommodation	p-trip	1	$ 3,000	$ 3,000		-	-
Other - Development	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 393,000**	8.0%		
Engineering							
Wind turbine(s) micro-siting	p-d	1.0	$ 17,500	$ 17,500		-	-
Mechanical design	p-d	1.0	$ 35,000	$ 35,000		-	-
Electrical design	p-d	1.0	$ 45,000	$ 45,000		-	-
Civil design	p-d	1.0	$ 47,500	$ 47,500		-	-
Tenders and contracting	p-d	0.0	$ -	$ -		-	-
Construction supervision	p-yr	1.00	$ 67,500	$ 67,500		-	-
Other - Engineering	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 212,500**	4.3%		
Energy Equipment							
Wind turbine(s)	kW	1,650	$ 1,636	$ 2,700,000		-	-
Spare parts	%	3.0%	$ 2,700,000	$ 81,000		-	-
Transportation	turbine	1	$ 200,000	$ 200,000		-	-
Other - Energy equipment	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 2,981,000**	60.6%		
Balance of Plant							
Wind turbine(s) foundation(s)	turbine	1	$ 215,000	$ 215,000		-	-
Wind turbine(s) erection	turbine	1	$ 160,000	$ 160,000		-	-
Road construction	mi	0.25	$ 400,000	$ 100,000		-	-
Transmission line	mi	0.25	$ 400,000	$ 100,000		-	-
Substation	project		$ -	$ -		-	-
Control and O&M building(s)	building	1	$ 40,000	$ 40,000		-	-
Transportation	project		$ -	$ -		-	-
Other - Balance of plant	Cost		$ -	$ -		-	-
Sub-total:				**$ 615,000**	12.5%		
Miscellaneous							
Training	p-d			$ -		-	-
Commissioning	p-d	1.0	$ 20,000	$ 20,000		-	-
Contingencies	%	10%	$ 4,297,500	$ 429,750		-	-
Interest during construction	8.0%	12 month(s)	$ 4,727,250	$ 189,090		-	-
Sub-total:				**$ 638,840**	13.0%		
Initial Costs - Total				**$ 4,916,340**	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Land lease	project	0	$ -	$ -		-	-
Property taxes	project	0	$ -	$ -		-	-
Insurance premium	project	1	$ 11,000	$ 11,000		-	-
Transmission line maintenance	%	2.0%	$ 100,000	$ 2,000		-	-
Parts and labour	kWh	4,531,888	$ 0.006	$ 26,414		-	-
GHG monitoring and verification	project	0	$ -	$ -		-	-
Community benefits	project	0	$ -	$ -		-	-
Travel and accommodation	p-trip	2	$ 1,500	$ 3,000		-	-
General and administrative	%	5%	$ 42,414	$ 2,121		-	-
Other - O&M	Cost	0	$ -	$ -		-	-
Contingencies	%	5%	$ 44,535	$ 2,227		-	-
Annual Costs - Total				**$ 46,762**	100.0%		

Periodic Costs (Credits)		Period	Unit Cost	Amount	Interval Range	Unit Cost Range
Drive train	Cost	25 yr	$ 265,000	**$ 265,000**	-	-
Blades	Cost	25 yr	$ 125,000	**$ 125,000**	-	-
				$ -	-	-
End of project life	Credit	-	$ -	**$ -**		*Go to GHG Analysis sheet*

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Wind Energy Project

Use GHG analysis sheet?	Yes	Type of analysis:	Standard
Potential CDM project?	No		

Background Information

Project Information				Global Warming Potential of GHG			
Project name	Camelot V82 80 Meter	Project capacity	1.65 MW	21	tonnes CO_2 =	1 tonne CH_4	(IPCC 1996)
Project location	Plymouth, MA	Grid type	Central-grid	310	tonnes CO_2 =	1 tonne N_2O	(IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Coal	12.0%	94.6	0.0020	0.0030	35.0%	12.0%	1.117
Natural gas	33.0%	56.1	0.0030	0.0010	45.0%	12.0%	0.513
Nuclear	28.0%	0.0	0.0000	0.0000	30.0%		0.000
Large hydro	8.0%	0.0	0.0000	0.0000	100.0%		0.000
#6 oil	10.0%	77.4	0.0030	0.0020	30.0%		0.937
Wind	6.0%	0.0	0.0000	0.0000	100.0%		0.000
Solar	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Biomass	1.0%	0.0	0.0320	0.0040	25.0%		0.028
Small hydro	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Electricity mix	100%	109.4	0.0056	0.0028		5.4%	0.397

Does baseline change during project life? No

Proposed Case Electricity System (Wind Energy Project)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Electricity system							
Wind	100.0%	0.0	0.0000	0.0000	100.0%	12.0%	0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (tCO2/MWh)	Proposed case GHG emission factor (tCO2/MWh)	End-use annual energy delivered (MWh)	Gross annual GHG emission reduction (t_{CO2})	GHG credits transaction fee (%)	Net annual GHG emission reduction (t_{CO2})
Electricity system	0.397	0.000	3,988	1,585	0.0%	**1,585**

Complete Financial Summary sheet

Gamesa G80
78 Meter

*The following cost summary estimates have been calculated **without** the following assumptions:*

- Site Investigation
- Wind Resource Assessment
- GHG Baseline Study and Monitoring Plan
- Land Rights
- GHG Validation and Registration
- Project financing
- Tenders and Contracting
- Substation(s)
- Training
- Land Lease
- Property Taxes
- GHG Monitoring and Verification
- Community Benefits

*The following financial summaries have been calculated **using** the following assumptions:*

- Feasibility studies expenses at 76,000
- Development expenses at $423,000
- Engineering expenses at $230,000
- The price of an Gamesa G80 turbine at $2,900,000
- Transporting turbine and parts at $235,000
- Foundation construction and design expenses at $240,000.
- Turbine erection expenses at $180,000
- Road construction expenses at $100,000.
- Transmission line construction and expenses at $100,000.
- Travel and accommodation during the initial development of the project set to $4,000. Annual travel expenses are set to $3,000.

*The values assumed in the following cost summaries are preliminary estimates and may not reflect the true current values of the cost analysis.

RETScreen® Energy Model - Wind Energy Project

Training & Support

Units: Metric

Site Conditions		Estimate	Notes/Range
Project name		**Camelot G80 78 Meter 2000 kw**	See Online Manual
Project location		**Plymouth, MA**	
Wind data source		Wind speed	
Nearest location for weather data		Meteorological Tower	See Weather Database
Annual average wind speed	m/s	6.7	
Height of wind measurement	m	80.0	3.0 to 100.0 m
Wind shear exponent	-	0.25	0.10 to 0.40
Wind speed at 10 m	m/s	4.0	
Average atmospheric pressure	kPa	101.0	60.0 to 103.0 kPa
Annual average temperature	°C	11	-20 to 30 °C

System Characteristics		Estimate	Notes/Range
Grid type	-	Central-grid	
Wind turbine rated power	kW	2000	Complete Equipment Data sheet
Number of turbines	-	1	
Wind plant capacity	kW	2,000	
Hub height	m	78.0	6.0 to 100.0 m
Wind speed at hub height	m/s	6.7	
Wind power density at hub height	W/m²	330	
Array losses	%	5%	0% to 20%
Airfoil soiling and/or icing losses	%	1%	1% to 10%
Other downtime losses	%	2%	2% to 7%
Miscellaneous losses	%	2%	2% to 6%

Annual Energy Production		Estimate Per Turbine	Estimate Total	Notes/Range
Wind plant capacity	kW	2,000	2,000	
	MW	2.000	2.000	
Unadjusted energy production	MWh	4,997	4,997	
Pressure adjustment coefficient	-	1.00	1.00	0.59 to 1.02
Temperature adjustment coefficient	-	1.02	1.02	0.98 to 1.15
Gross energy production	MWh	5,097	5,097	
Losses coefficient	-	0.90	0.90	0.75 to 1.00
Specific yield	kWh/m²	916	916	150 to 1,500 kWh/m²
Wind plant capacity factor	%	26%	26%	20% to 40%
Renewable energy delivered	MWh	4,604	**4,604**	
	GJ	16,573	16,573	
				Complete Cost Analysis sheet

Version 3.2

NRCan/CETC - Varennes

RETScreen® Cost Analysis - Wind Energy Project

Type of analysis: Feasibility | Currency: $ | Cost references: None

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
Feasibility Study							
Site investigation	p-d	0.0	$ -	$ -		-	-
Wind resource assessment	met tower	0	$ -	$ -		-	-
Environmental assessment	p-d	1.0	$ 35,000	$ 35,000		-	-
Preliminary design	p-d	1.0	$ 15,000	$ 15,000		-	-
Detailed cost estimate	p-d	1.0	$ 10,000	$ 10,000		-	-
GHG baseline study and MP	project	0	$ -	$ -		-	-
Report preparation	p-d	1.0	$ 10,000	$ 10,000		-	-
Project management	p-d	1.0	$ 5,000	$ 5,000		-	-
Travel and accommodation	p-trip	1	$ 1,000	$ 1,000		-	-
Other - Feasibility study	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 76,000**	1.4%		
Development							
PPA negotiation	p-d	1.0	$ 50,000	$ 50,000		-	-
Permits and approvals	p-d	1.0	$ 130,000	$ 130,000		-	-
Land rights	project	0	$ -	$ -		-	-
Land survey	p-d	1.0	$ 20,000	$ 20,000		-	-
GHG validation and registration	project	0	$ -	$ -		-	-
Project financing	p-d	0.0	$ -	$ -		-	-
Legal and accounting	p-d	1.0	$ 140,000	$ 140,000		-	-
Project management	p-yr	1.00	$ 80,000	$ 80,000		-	-
Travel and accommodation	p-trip	1	$ 3,000	$ 3,000		-	-
Other - Development	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 423,000**	7.9%		
Engineering							
Wind turbine(s) micro-siting	p-d	1.0	$ 20,000	$ 20,000		-	-
Mechanical design	p-d	1.0	$ 40,000	$ 40,000		-	-
Electrical design	p-d	1.0	$ 50,000	$ 50,000		-	-
Civil design	p-d	1.0	$ 50,000	$ 50,000		-	-
Tenders and contracting	p-d	0.0	$ -	$ -		-	-
Construction supervision	p-yr	1.00	$ 70,000	$ 70,000		-	-
Other - Engineering	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 230,000**	4.3%		
Energy Equipment							
Wind turbine(s)	kW	2,000	$ 1,450	$ 2,900,000		-	-
Spare parts	%	3.0%	$ 2,900,000	$ 87,000		-	-
Transportation	turbine	1	$ 235,000	$ 235,000		-	-
Other - Energy equipment	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 3,222,000**	60.5%		
Balance of Plant							
Wind turbine(s) foundation(s)	turbine	1	$ 240,000	$ 240,000		-	-
Wind turbine(s) erection	turbine	1	$ 180,000	$ 180,000		-	-
Road construction	mi	0.25	$ 400,000	$ 100,000		-	-
Transmission line	mi	0.25	$ 400,000	$ 100,000		-	-
Substation	project	0	$ -	$ -		-	-
Control and O&M building(s)	building	1	$ 65,000	$ 65,000		-	-
Transportation	project	0	$ -	$ -		-	-
Other - Balance of plant	Cost	0	$ -	$ -		-	-
Sub-total:				**$ 685,000**	12.9%		
Miscellaneous							
Training	p-d	0.0	$ -	$ -		-	-
Commissioning	p-d	1.0	$ 20,000	$ 20,000		-	-
Contingencies	%	10%	$ 4,656,000	$ 465,600		-	-
Interest during construction	8.0%	12 month(s)	$ 5,121,600	$ 204,864		-	-
Sub-total:				**$ 690,464**	13.0%		
Initial Costs - Total				**$ 5,326,464**	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Land lease	project	0	$ -	$ -		-	-
Property taxes	project	0	$ -	$ -		-	-
Insurance premium	project	1	$ 15,000	$ 15,000		-	-
Transmission line maintenance	%	2.0%	$ 100,000	$ 2,000		-	-
Parts and labour	kWh	4,603,715	$ 0.007	$ 30,000		-	-
GHG monitoring and verification	project	0	$ -	$ -		-	-
Community benefits	project	0	$ -	$ -		-	-
Travel and accommodation	p-trip	2	$ 1,500	$ 3,000		-	-
General and administrative	%	5%	$ 50,000	$ 2,500		-	-
Other - O&M	Cost	0	$ -	$ -		-	-
Contingencies	%	5%	$ 52,500	$ 2,625		-	-
Annual Costs - Total				**$ 55,125**	100.0%		

Periodic Costs (Credits)		Period	Unit Cost	Amount		Interval Range	Unit Cost Range
Drive train	Cost	25 yr	$ 300,000	**$ 300,000**		-	-
Blades	Cost	25 yr	$ 150,000	**$ 150,000**		-	-
				$ -		-	-
End of project life	Credit	-	$ -	**$ -**			

Go to GHG Analysis sheet

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Wind Energy Project

Use GHG analysis sheet?	Yes	Type of analysis:	Standard
Potential CDM project?	No		

Background Information

Project Information

				Global Warming Potential of GHG		
Project name	Camelot G80 78 Meter 2000 kw	Project capacity	2.00 MW	21	tonnes CO_2 = 1 tonne CH_4	(IPCC 1996)
Project location	Plymouth, MA	Grid type	Central-grid	310	tonnes CO_2 = 1 tonne N_2O	(IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Coal	12.0%	94.6	0.0020	0.0030	35.0%	12.0%	1.117
Natural gas	33.0%	56.1	0.0030	0.0010	45.0%	12.0%	0.513
Nuclear	28.0%	0.0	0.0000	0.0000	30.0%		0.000
Large hydro	8.0%	0.0	0.0000	0.0000	100.0%		0.000
#6 oil	10.0%	77.4	0.0030	0.0020	30.0%		0.937
Wind	6.0%	0.0	0.0000	0.0000	100.0%		0.000
Solar	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Biomass	1.0%	0.0	0.0320	0.0040	25.0%		0.028
Small hydro	1.0%	0.0	0.0000	0.0000	100.0%		0.000
Electricity mix	100%	109.4	0.0056	0.0028		5.4%	0.397

Does baseline change during project life? No

Proposed Case Electricity System (Wind Energy Project)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Electricity system							
Wind	100.0%	0.0	0.0000	0.0000	100.0%	12.0%	0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (tCO2/MWh)	Proposed case GHG emission factor (tCO2/MWh)	End-use annual energy delivered (MWh)	Gross annual GHG emission reduction (t_{CO2})	GHG credits transaction fee (%)	Net annual GHG emission reduction (t_{CO2})
Electricity system	0.397	0.000	4,051	1,610	0.0%	**1,610**

Complete Financial Summary sheet

APPENDIX C

Turbine Specifications and Equipment Data

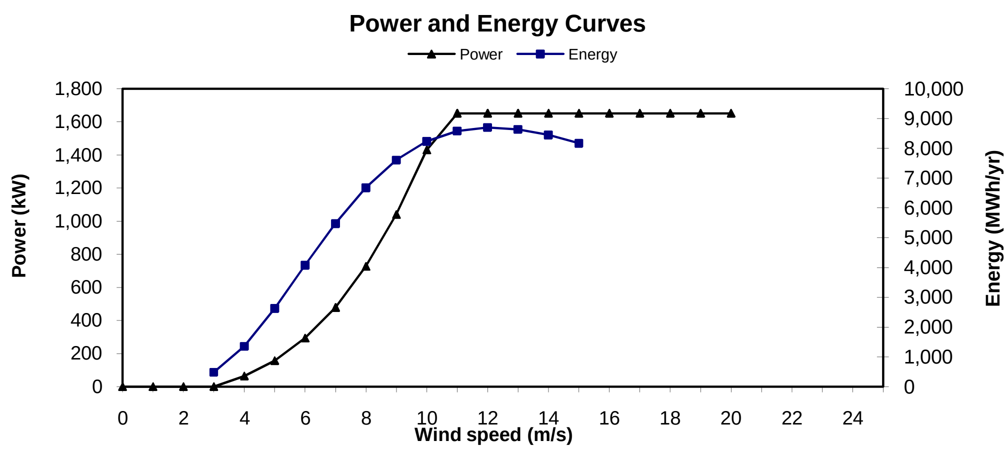
AAER A-1650
80 Meter

RETScreen® Equipment Data - Wind Energy Project

Wind Turbine Characteristics		Estimate	Notes/Range
Wind turbine rated power	kW	1650	See Product Database
Hub height	m	80.0	6.0 to 100.0 m
Rotor diameter	m	80	7 to 80 m
Swept area	m²	5,027	35 to 5,027 m²
Wind turbine manufacturer		AAER	
Wind turbine model		A-1650/80	
Energy curve data source	-	Standard	Rayleigh wind distribution
Shape factor	-	2.0	

Wind Turbine Production Data

Wind speed (m/s)	Power curve data (kW)	Energy curve data (MWh/yr)
0	0.0	-
1	0.0	-
2	0.0	-
3	0.0	479.8
4	64.0	1,348.1
5	157.0	2,619.0
6	293.0	4,068.0
7	478.0	5,468.7
8	726.0	6,671.8
9	1,039.0	7,597.6
10	1,429.0	8,224.3
11	1,651.0	8,573.6
12	1,651.0	8,691.2
13	1,651.0	8,630.2
14	1,651.0	8,440.4
15	1,651.0	8,163.6
16	1,651.0	-
17	1,651.0	-
18	1,651.0	-
19	1,651.0	-
20	1,651.0	-
21	-	-
22	-	-
23	-	-
24	-	-
25	-	-



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Energy Model sheet

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Auteur / Author :
AAER Inc. – Martin Venne P.Eng

Produit par / Produced by :
Stéphane Fournier

Approuvé par / Approved by :
Robert Guillemette, P.Eng

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A-1650
Wind Turbine Generator

Main Specifications

AAER Inc. – Siège Social / Corporate Offices
80 boulevard de l'Aéroport,
Bromont, Québec Canada J2L 1S9

Tél / Phone +1 450 534 5155
Sans Frais / Tollfree + 1 866 265 1045
Télécopie / Fax +1 450 534 5156
www.aaer.ca

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0	2007-08-28	Martin Venne P.Eng	New document	Robert Guillemette, P.Eng
1	2008-02-12	SF	Update of the power curve	Robert Guillemette, P.Eng
2	2008-06-27	Mireille Focquet	Document updated according to new template and graphic standards – Update of the power curve	Robert Guillemette, P.Eng
3	2008-07-11	Stéphane Fournier	Power curve update for LM and AB. Details on blade class.	Robert Guillemette, P.Eng
4				
5				
6				
7				

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101 Overall View of the WEC 5
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108 Mechanical Brake 7
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100 General

This document contains a description of the A-1650|77|70, its design and its main components.

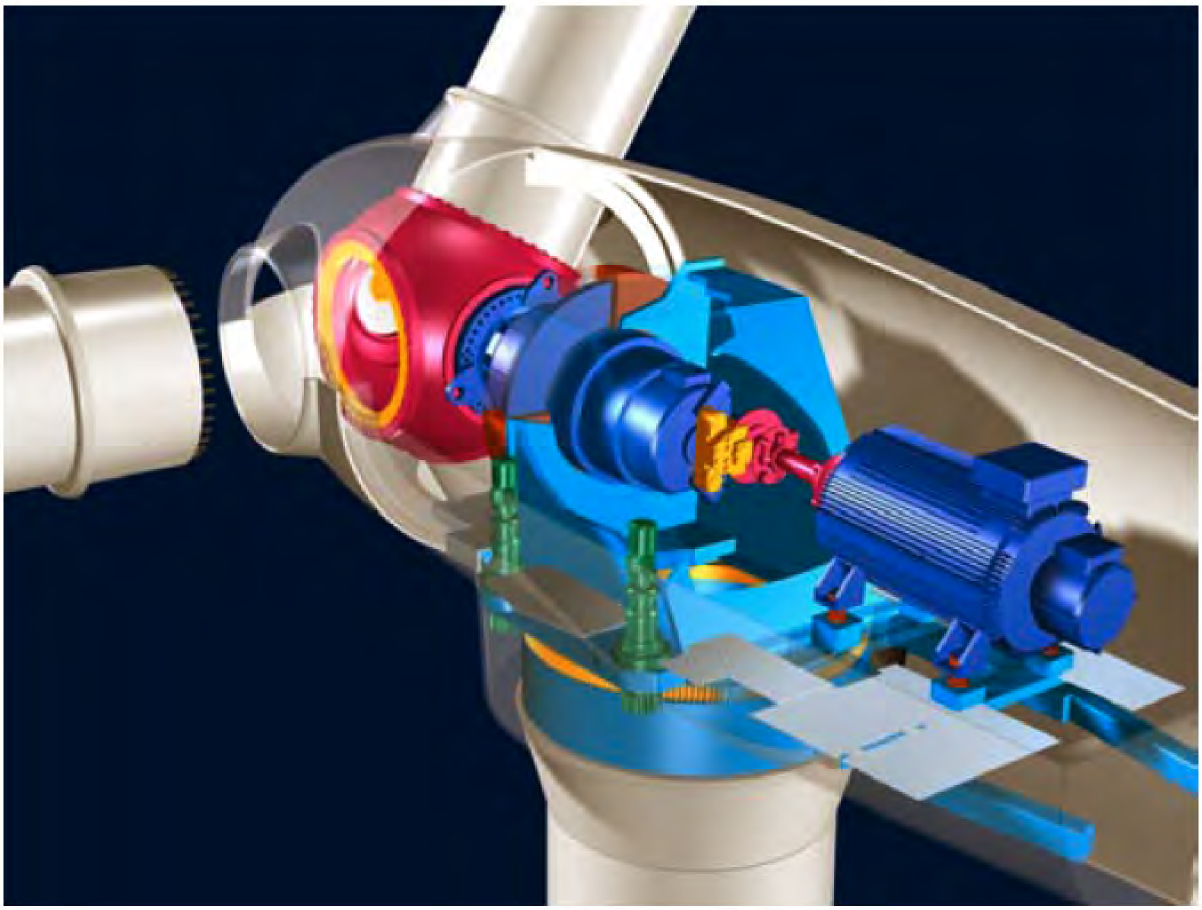
Unless clearly required in the supply contract for the components, all statements made in this specification are valid without reservation. If individual items of the specification are dealt with differently in the contract, the remaining contents remain unaffected and continue to be valid without reservation.

The valid versions of standards, regulations and rules as well as the latest state of technological development are always decisive for the completion of works. If there is more than one standard, regulation or rule for one subject-matter, the strictest version must always be applied for the completion of works.

In the case of geometrical representations approved drawings have validity over a description of these dimensions.

Note: The A-1650-70/77 is based on the WT1650/77/70 from Windtec which is an upgrade of the PWE-1500-70/77 from Pfleiderer.

101 Overall View of the WEC



102 Rotor

The wind energy converter A-1650-70/77 has a three-bladed upwind rotor. Its rotational speed is limited by blade pitch control. The advantage of pitch control lies in the lower peak loads at high wind speeds. The wind energy converter is subject to substantially lower dynamic loads, especially at sites with high turbulence intensity (onshore). The rotor offers high operational reliability and longer service life with minimal maintenance effort due to its enhanced pitch-control system.

103 Pitch System

The blades can be turned out of the rotor plane by about 90 degrees and therefore act as aerodynamically brakes. During normal operation the pitch motors hold the rotor blades in a defined position via the ring gear (pitch bearing) mounted to the blade root. The aerodynamic brake is applied by varying the rotor blade pitch by means of motors. In the event of a fault (e.g. grid loss), the pitch motor is powered by a battery system and can therefore still control the pitch. Consequently the wind energy converter is completely safe (“fail safe design”). If one pitch drive cannot be activated (e.g. broken cable, broken power supply to hub), the other two blades can still be turned into feathering position. Furthermore the “safety lock”- system always allows the blades to turn into feathering position in case of overall pitch drive fault. Therefore the wind energy converter is automatically stopped at any time, even without any power supply to the hub.

104 Rotor Hub

The cast iron rotor hub is attached to the integral drive train with a flange. The three pitch drives are easily to be maintained as they are mounted within the hub aside the blade root flanges.

105 Integral Drive Train

The integral drive train is a patented WINDTEC development incorporating rotor shaft and gearbox as a unit. The hub is bolted with the rotor flange.
The gearbox is a three-stage gear with two planetary reduction stages and one parallel shaft gear stage. The helical-tooth planetary stages and the helical-tooth parallel-shaft stage are optimized with shape and tooth trace compensation. To compensate loads, the planetary stage sun wheels are self adjusting. The gearbox is forced lubricated. The gear oil temperature is monitored by a sensor and automatically cooled by a separate oil-air cooler with filter unit in the nacelle, in case the permissible oil temperature is exceeded. Labyrinth seals ensure a perfect seal and are wear-resistant.
The rotor controller cables are fed through the stationary hollow shaft into the hub. A rotor lock at the input shaft enables the drive train to be mechanically locked for maintenance purposes.

106 Coupling

The gearbox and the generator are linked by a flexible shaft which compensates alignment tolerances.

107 Generator and Power Electronics

The wind energy converter is equipped with a double-fed three-phase induction generator. The advanced power electronics (IGBT converter) ensures that the generator works with high efficiency over the entire speed range.
A heating winding is installed to prevent damage to the generator due to damp. In addition, there are sensors to monitor the temperature in the generator. The generator and the power electronics are cooled by a water-air heat exchanger.

108 Mechanical Brake

The mechanical brake is a disc brake fitted with a calliper and mounted at the high-speed shaft of the gearbox. When the brake is released, the hydraulic system is pressurized. To activate the brake, the oil pressure in the calliper is reduced by means of solenoid valves and the brake pads are pressed against the disc by springs. An intelligent braking system controls the braking sequence. The brake can be released by pressurizing the hydraulic circuit again.

109 Main Frame

The welded main frame transfers the loads from the integral drive train to the yaw system and holds the generator and control cabinet over the bolted cantilever.

110 Yaw System

The yaw system consists of an external ring gear which is bolted to the top flange of the tower plus a slide bearing. The yaw system is driven by four converter-fed electrical motors with a gearbox and a pinion mounted onto the base plate of the mainframe. The yaw motor brake keeps the wind energy converter in a fixed position until it has to be realigned with the actual wind direction. The motor brakes are released when the nacelle is turned. The yaw actuators also keep the nacelle in a fixed position, even at high eccentric wind loads.

111 Control System

The control system of the WEC is based on an industrial type PLC system. By use of the display in the nacelle cabinet i.e. the status of the WEC can be seen. The control system of the WEC is located in special cabinets, mounted in the hub and the nacelle.

112 Tower

A conical tubular steel tower with internally screwed top flange for high maintenance safety is designed for this wind energy converter. Inside the tower is a ladder for accessing the nacelle, equipped with a climbing protection system to prevent a fall down. It also includes an optional elevator to facilitate technician access specially for higher heights. The tower contains also working platforms at the flange connections, resting platforms in each tower section and is equipped with working and emergency lightning. The steel door at the tower base is burglar proofed.

113 Technical data

Operating data

Type, model	…………………	A-1650
Cut-in wind speed	…………………	3.5 m/s
Rated wind speed	…………………	12.0 m/s
Cut-out wind speed	…………………	20 m/s
Calculation Guidelines	…………………	Germanischer Lloyd
Type class	…………………	TC IIA
System life	…………………	20 years

Temperatures

Without cold weather package

Ambient temperature during operation	…………………	-15 °C to 30 °C
Ambient temperature without operation	…………………	-25 °C to 40 °C

> Re-cut temperature (low) ……………………………… -13 °C
> Re-cut temperature (high) …………………………….. 28 °C

With cold weather package

Ambient temperature during operation	…………………	-30 °C to 40 °C
Ambient temperature without operation	…………………	-40 °C to 40 °C

> Re-cut temperature (low) ……………………………… -28 °C
> Re-cut temperature (high) …………………………….. 38 °C

Rotor

Number of rotor blades	…………………	3
Rotor axis	…………………	horizontal
Position relative to tower	…………………	upwind
Rotor diameter	…………………	70m, 77m
Speed range	…………………	11.3 rpm – 20 rpm
Rated speed	…………………	18.23 rpm
Direction of rotation (looking downwind)	…………………	Clockwise
Power control method	…………………	Blade pitching
Rotor axis tilt angle	…………………	4.5 deg

Rotor blade

Blade length	…………………	34m, 37.5m
Chord length at blade tip	…………………	0.02 m
Max chord length	…………………	3.061 m
Blade root diameter	…………………	1885 mm

Sweep angle	....	0.6 deg
Cone angle	....	0 deg
Material	....	Epoxy glass fiber
Lightning conductor	....	Integrated
Manufacturer	....	TC IIA LM Glassfiber 37.3P2 TC IIA AeroBlade AB37.3 TC IIA AAER 37.5 TC I AAER 34

Rotor blade pitch drive

Maximum pitch rate limit	....	9 deg/s
Type of blade bearing	....	Double row ball bearing
Manufacturer pitch drives	....	WINDTEC

Drive train

Rated drive torque	....	930 kNm
Maximum static torque	....	3300 kNm
Type of gearing	....	planetary / parallel shaft gear
Transmission ratio	....	1 : ≈96
Gear lubrication	....	forced lubrication
Oil capacity	....	660 l
Connection gear/generator	....	flexible coupling

Supporting machine parts

Hub type	....	rigid
Hub material	....	Cast iron EN-GJS-400-18U-LT
Mainframe type	....	Welded structure
Mainframe material	....	Steel S355

Braking systems

Operational brake	....	Blade pitching
Type of construction	....	gear / servomotor
Mechanical brake	....	disc brake
Activation	....	passive

Generator and power electronics

Generator type	....	Double fed induction generator
Converter type	....	IGBT, 4 quadrants
Rated power	....	1650 kW
Rated voltage	....	3~ / 690 V AC / 60 Hz
Power factor	....	Standard 1.0
Torque control	....	Field vector control
Generator manufacturer	....	ELIN Motoren Gmbh
Converter manufacturer	....	AAER/Windtec

Nacelle housing

Type of construction	………………….	closed
Material	………………….	Polyester resin / Glass fiber

Yaw system

Type of wind direction alignment	………………….	active
Type of yaw bearing	………………….	slide bearing
Drive unit	………………….	gear motor
Number of drive unit	………………….	4
Brake	………………….	friction in the slide bearing plus motor brake

Control system

Type of construction	………………….	PLC, free programmable
Remote monitoring	………………….	by modem
Manufacturer	………………….	WINDTEC

Tower

Type of construction	………………….	conical tubular steel tower
Tower height	………………….	65m, 80m, 100m
Corrosion protection	………………….	protective paint

114 View of Nacelle

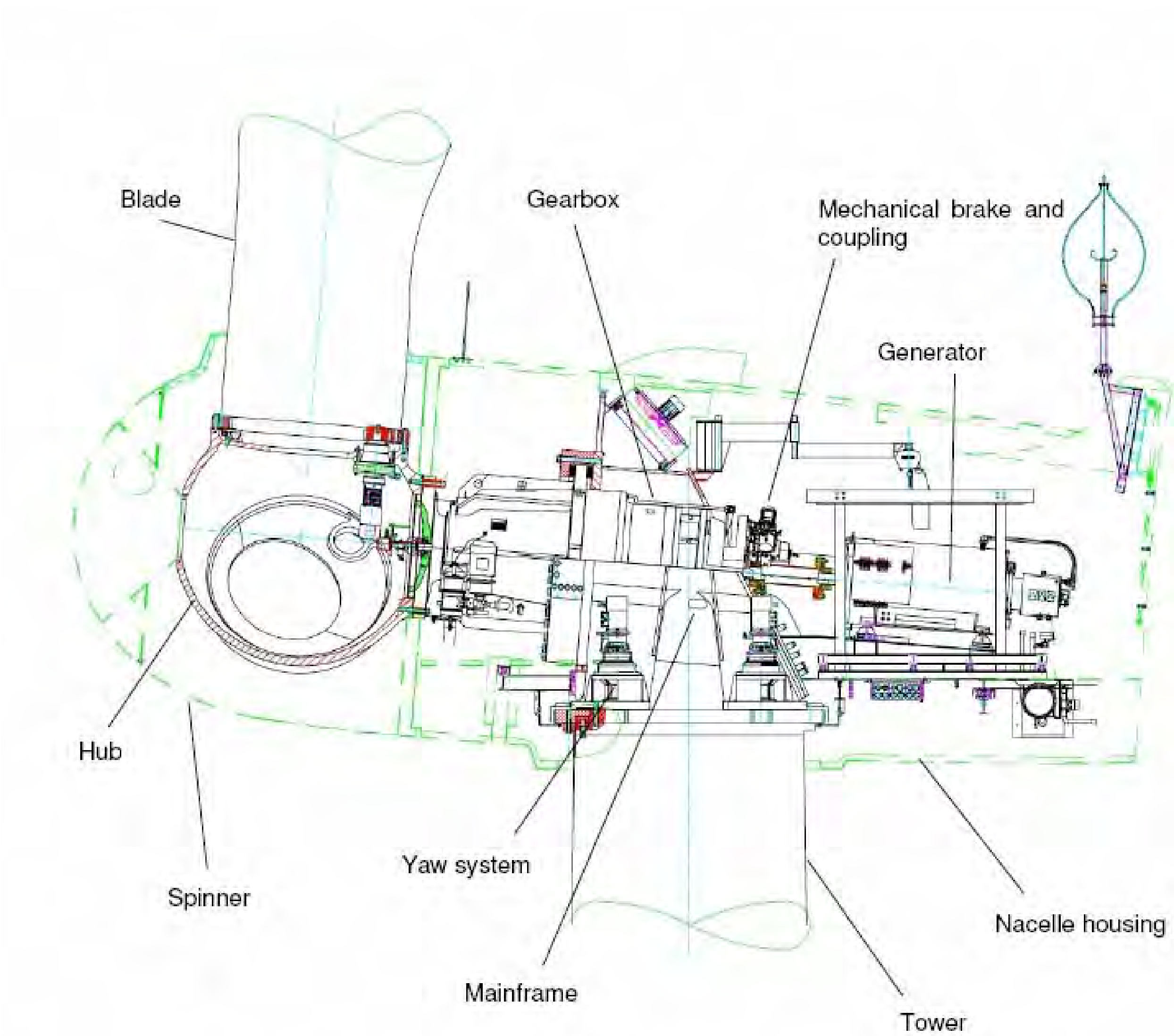


Fig. 114-1: Nacelle components

115 Power Curve, Power Coefficient & Thrust Coefficient

A-1650 / 77

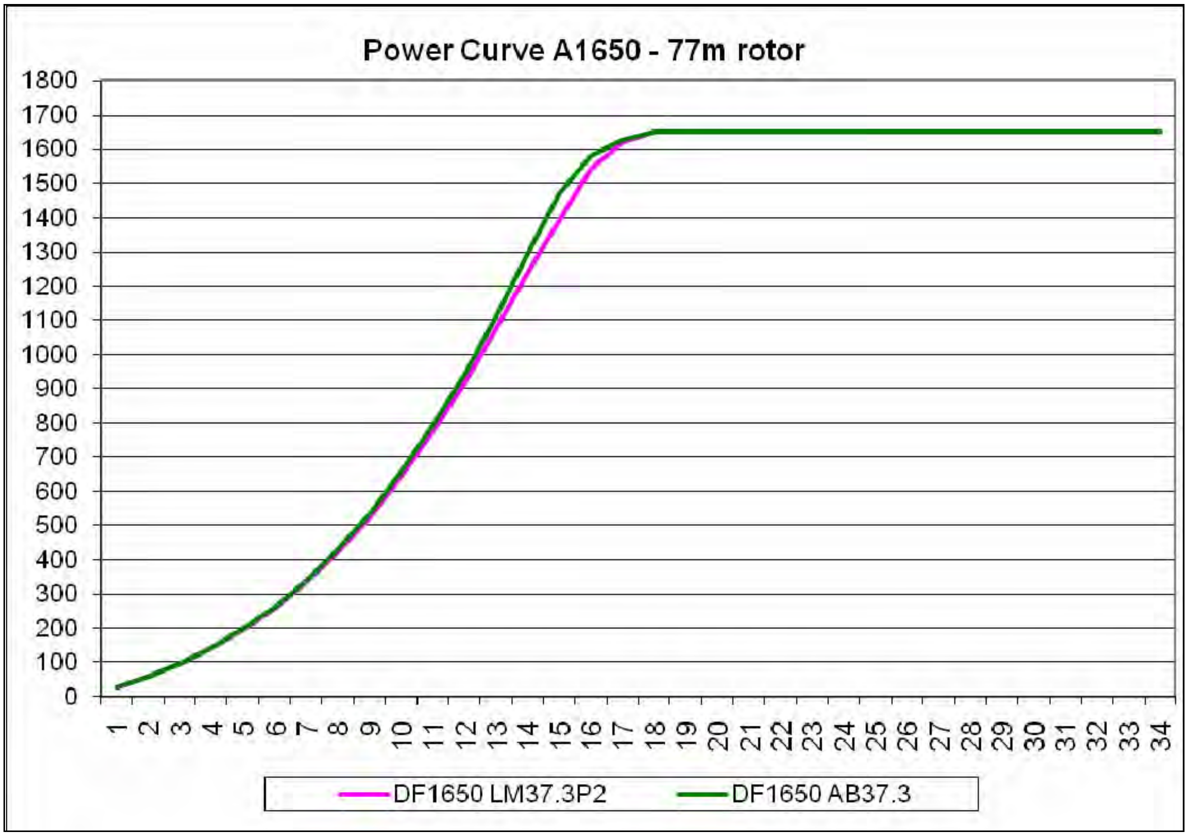
Power data for Air density of 1,225 kg/m³

A1650 LM37.3P2

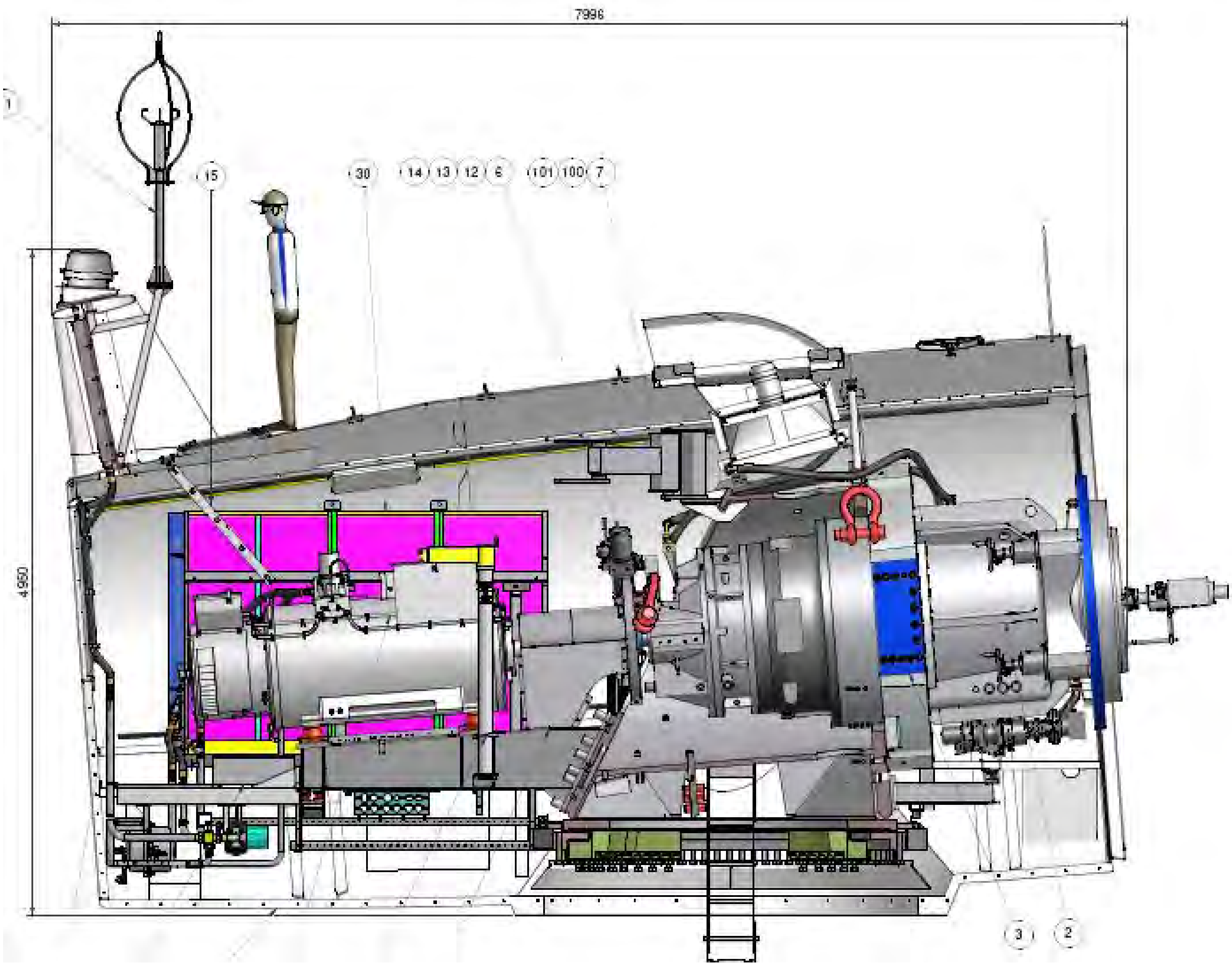
wind speed [m/s]	el. Power [kW]	cT	cP
3,5	26	0,376	0,831
4,0	57	0,431	0,832
4,5	95	0,461	0,822
5,0	141	0,476	0,804
5,5	195	0,479	0,806
6,0	258	0,479	0,793
6,5	334	0,479	0,794
7,0	422	0,479	0,795
7,5	525	0,479	0,796
8,0	642	0,479	0,797
8,5	774	0,479	0,798
9,0	919	0,478	0,801
9,5	1075	0,474	0,787
10,0	1237	0,467	0,748
10,5	1396	0,454	0,723
11,0	1541	0,439	0,681
11,5	1620	0,408	0,569
12,0	1651	0,362	0,476
12,5	1651	0,321	0,406
13,0	1651	0,285	0,353
13,5	1651	0,255	0,310
14,0	1651	0,228	0,275
14,5	1651	0,205	0,246
15,0	1651	0,186	0,221
15,5	1651	0,168	0,200
16,0	1651	0,153	0,181
16,5	1651	0,139	0,165
17,0	1651	0,127	0,151
17,5	1651	0,117	0,139
18,0	1651	0,107	0,128
18,5	1651	0,099	0,118
19,0	1651	0,091	0,109
19,5	1651	0,084	0,101
20,0	1651	0,078	0,094

A1650 AB37.3

wind speed [m/s]	el. Power [kW]	cT	cP
3,5	28	0,376	0,831
4,0	58	0,431	0,832
4,5	97	0,461	0,822
5,0	144	0,476	0,804
5,5	199	0,479	0,806
6,0	264	0,479	0,793
6,5	341	0,479	0,794
7,0	432	0,479	0,795
7,5	537	0,479	0,796
8,0	658	0,479	0,797
8,5	793	0,479	0,798
9,0	943	0,478	0,801
9,5	1112	0,474	0,787
10,0	1294	0,467	0,748
10,5	1471	0,454	0,723
11,0	1579	0,439	0,681
11,5	1625	0,408	0,569
12,0	1651	0,362	0,476
12,5	1651	0,321	0,406
13,0	1651	0,285	0,353
13,5	1651	0,255	0,310
14,0	1651	0,228	0,275
14,5	1651	0,205	0,246
15,0	1651	0,186	0,221
15,5	1651	0,168	0,200
16,0	1651	0,153	0,181
16,5	1651	0,139	0,165
17,0	1651	0,127	0,151
17,5	1651	0,117	0,139
18,0	1651	0,107	0,128
18,5	1651	0,099	0,118
19,0	1651	0,091	0,109
19,5	1651	0,084	0,101
20,0	1651	0,078	0,094


Power Curve A1650 - 77m rotor
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34
DF1650 LM37.3P2
DF1650 AB37.3

116 Cross section of the Nacelle



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Auteur / Author :
AAER Inc.

Produit par / Produced by :
Philippe Terrier, ing.jr

Approuvé par / Approved by :
Robert Guillemette, ing

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Modèle / Template AQ-003 Ingénierie / Engineering

Power curve

A-1650 - 80

AAER Inc. – Siège Social / Corporate Offices
80 boulevard de l'Aéroport,
Bromont, Québec Canada J2L 1S9

Tél / Phone +1 450 534 5155
Sans Frais / Tollfree + 1 866 265 1045
Télécopie / Fax +1 450 534 5156
www.aaer.ca

Révisions du document attaché
Revisions of the attached document

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1				
2				
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Turbine: A-1650
Rotor size: 80 meters
Wind class: TCIII (maximum average speed: 7.5 m/s

A-1650 / Power (kW)	
Wind Speed (m/s)	Air density : 1.225kg/m3)
1	0
2	0
3	0
3,5	30
4	64
4,5	106
5	157
5,5	219
6	293
6,5	378
7	478
7,5	594
8	726
8,5	873
9	1 039
9,5	1 225
10	1 429
10,5	1 581
11	1 651
11,5	1 651
12	1 651
20	1 651

AAER A-1500
80 Meter

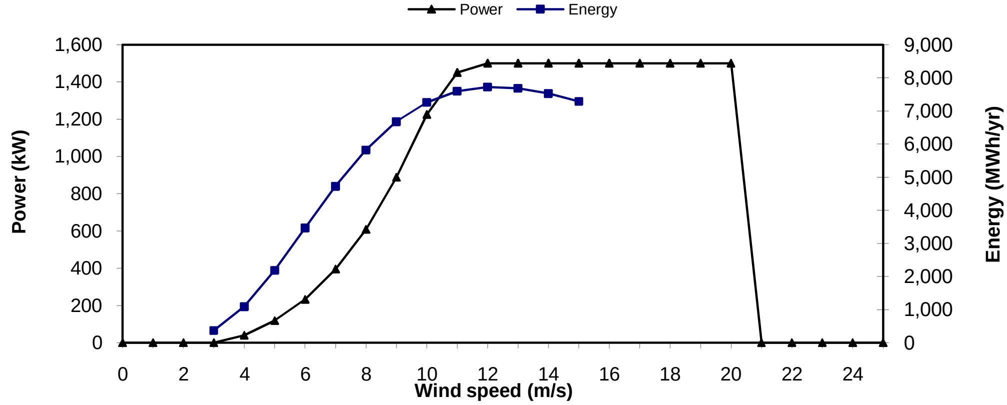
RETScreen® Equipment Data - Wind Energy Project

Wind Turbine Characteristics		Estimate	Notes/Range
Wind turbine rated power	kW	1500	See Product Database
Hub height	m	80.0	6.0 to 100.0 m
Rotor diameter	m	77	7 to 80 m
Swept area	m²	4,657	35 to 5,027 m²
Wind turbine manufacturer		AAER	
Wind turbine model		1500k	
Energy curve data source	-	Standard	Rayleigh wind distribution
Shape factor	-	2.0	

Wind Turbine Production Data

Wind speed (m/s)	Power curve data (kW)	Energy curve data (MWh/yr)
0	0.0	-
1	0.0	-
2	0.0	-
3	0.0	363.6
4	40.0	1,083.7
5	118.0	2,178.5
6	232.0	3,458.2
7	395.0	4,717.8
8	608.0	5,814.6
9	887.0	6,668.9
10	1,225.0	7,255.7
11	1,450.0	7,591.6
12	1,500.0	7,716.5
13	1,500.0	7,678.0
14	1,500.0	7,520.9
15	1,500.0	7,283.2
16	1,500.0	-
17	1,500.0	-
18	1,500.0	-
19	1,500.0	-
20	1,500.0	-
21	0.0	-
22	0.0	-
23	0.0	-
24	0.0	-
25	0.0	-

Power and Energy Curves

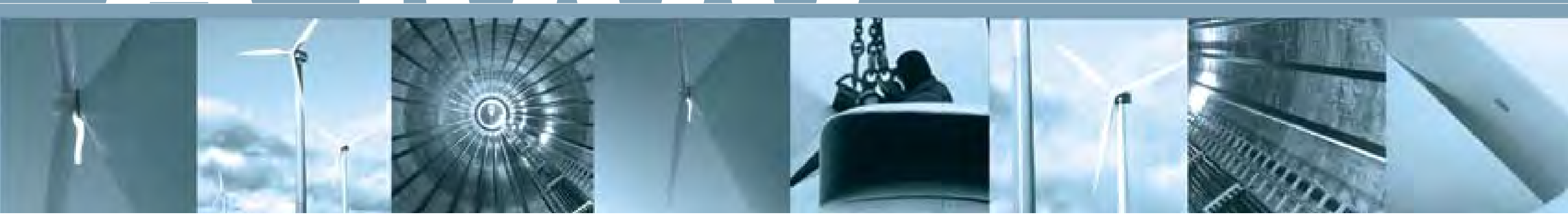


Return to
Energy Model sheet

A-1500

1500 kW Wind Turbine

Advanced technologies for high performance



A breath of fresh AAER

www.aaer.ca

A-1500 Wind Turbine

High performance resulting from:

- **Maximum operating reliability** through multiple redundant pitch systems.
- **Optimized variable speed system:** An intelligent torque control ensuring constantly high power output.
- **Compact and robust power unit** for a longer durability.
- **Speed and torque controlled drive train** to avoid unnecessary stress on components.
- **Maximum availability** through a continuous and sophisticated decentralized control system.
- **Germanischer Lloyld certified:** High standard achievement.

General description

The A-1500 is a three-bladed, horizontal axis wind turbine that was specifically developed for an efficient utilization of wind energy at onshore locations. It has an optimized variable speed system and full span pitch control. This means that it can be operated at optimum aerodynamic efficiency throughout the whole operational range. At wind speed of 12.0 m/s the machine reaches its rated output. The combination of both electrical torque control and pitch control allows the wind turbine to be operated from 12.0 through 25.0 m/s with an almost constant power output.

The A-1500 also features a specially configured power unit where the rotor bedding and rotor form a compact unit. Through this integrated design, the power unit is rigid and far less susceptible to vibrations.

aaER wind energy™

Technical description*

Rotor

Diameter, m (see note 1)	70 / 77
Swept area, m^2	3.848 / 4.657
Rotational speed, rpm	11.0-22.0 / 9.7-19.0
Wind class	I-II / II-III
Number of rotor blades	3
Power regulation	Pitch
Pitch system type	Gearbox & servo motor

Brake System

Primary braking system	Full span blade feathering
Service / Emergency brake	Disk brake

Tower

Hub Height, m	65, 80

Generator

Type of generator	Wound rotor induction generator
Rated power, kW	1500
Rated voltage, V	690
Frequency, Hz	50 or 60
Rated power Output, kVA	1670
Type of inverter	IGBT, 4-quadrant
Power factor (cos ø)	Controllable
Grid soft start connection	Converter controlled
Harmonic Distorsion	Imperceptible

Gearbox

Type of gearbox	Planetary & Helical

Control System

Type of construction	PLC, free programmable

Yaw System

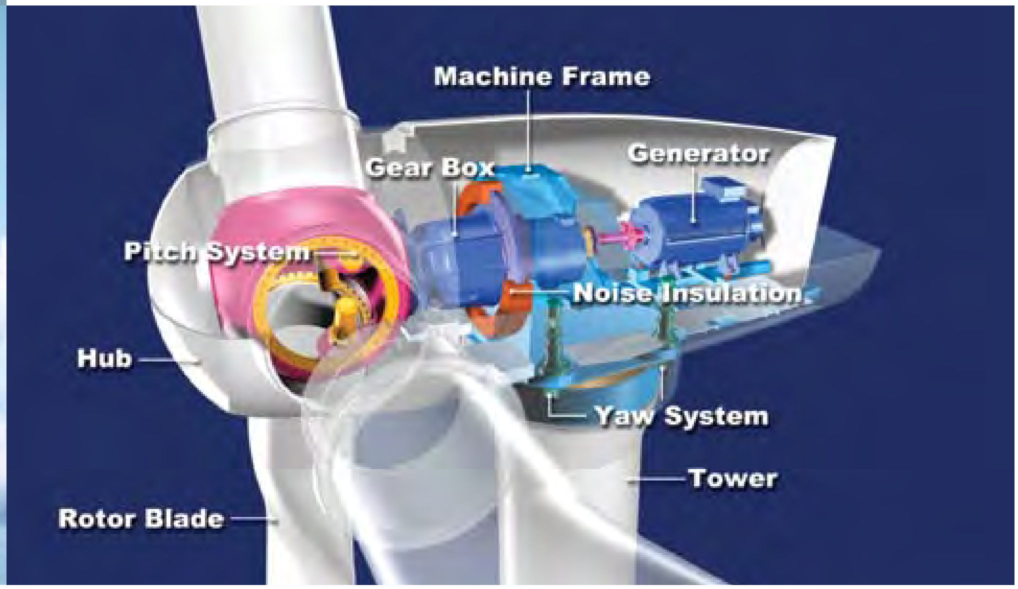
Type of bearing	Sliding bearing
Type of drive	Gear motor
Number of drive units	4

Note 1: The A-1500 is also available with a 64m rotor.
Please contact AAER for further technical information.

*All specifications subject to change without notice.
Please contact AAER for complete and latest technical specification.

A-1500:
A Powerful Wind Turbine!

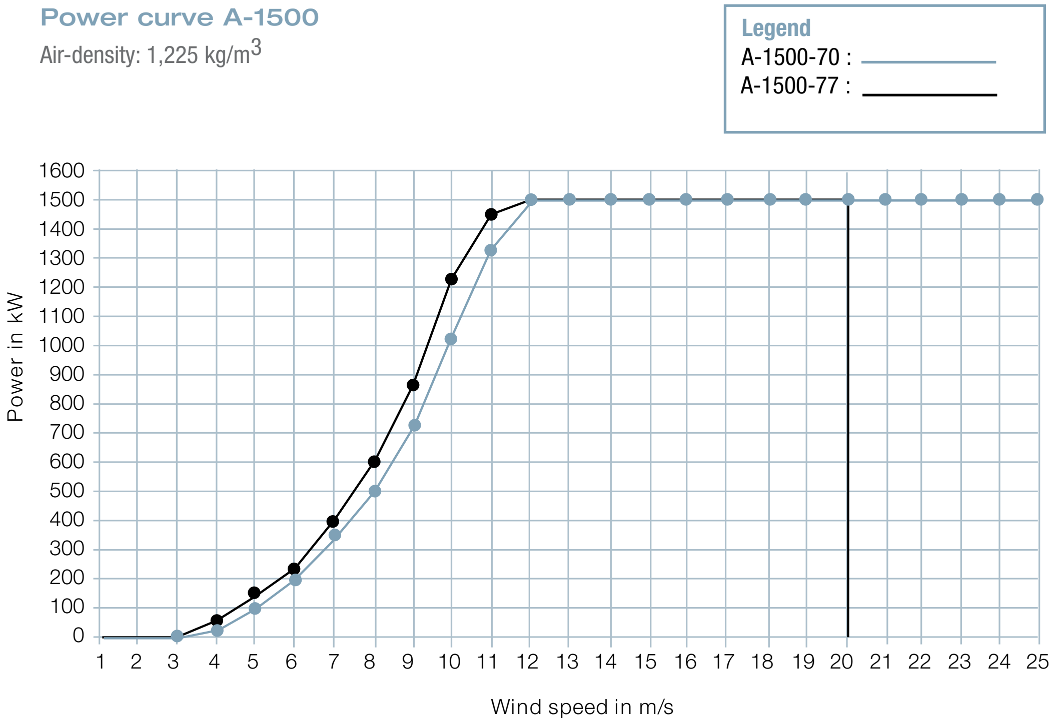
Wind Turbine mechanical scheme



v [m/s]	Rotor 70 m	Rotor 77 m
1	0	0
2	0	0
3	0	0
4	34	40
5	99	118
6	193	232
7	329	395
8	507	608
9	739	887
10	1021	1225
11	1334	1450
12	1500	1500
13	1500	1500
14	1500	1500
15	1500	1500
16	1500	1500
17	1500	1500
18	1500	1500
19	1500	1500
20	1500	1500
21	1500	-
22	1500	-
23	1500	-
24	1500	-
25	1500	-
Cut-in	3.0 m/s	3,0 m/s
Cut-out	25.0 m/s	20.0 m/s

Power curve A-1500

Air-density: 1,225 kg/m^3



Typical power curve. All data according to our best knowledge and subject to change.

AAER Inc. (TSXV: AAE)
Head office and plant
80, boulevard de l'Aéroport
Bromont, Québec
Canada, J2L 1S9
T: +1.450.534.5155
F: +1.450.534.5156
Toll free Fax: +1.866.265.1045
(North America only)
info@aaer.ca

AAER Inc.
Offices
530-14, Place du commerce
Montréal, Québec
Canada H3E 1T5
T +1.514.448.5155
F +1.514.448.5156
Toll free Fax: +1.866.265.1045
(North America only)
info@aaer.ca

AAER USA
4801 Woodway Drive
Suite 300 East
Houston, Texas 77056
United States
T +1.866.448.5155
F +1.866.265.1045
info@aaer.ca

AAER Europe
6 Avenue Neil Armstrong
33692 Mérignac Cedex
France
T +33 5.56.18.11.76
F +33 5.56.18.91.11
info@aaer.ca

REV B EN 16.04.2007

aaer wind energy™

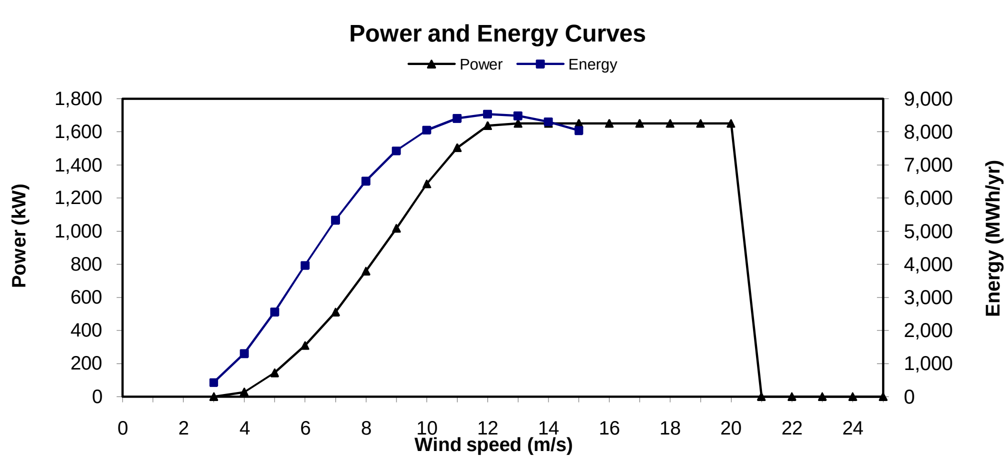
Vestas V-82
80 Meter

RETScreen® Equipment Data - Wind Energy Project

Wind Turbine Characteristics		Estimate	Notes/Range
Wind turbine rated power	kW	1650	See Product Database
Hub height	m	80.0	6.0 to 100.0 m
Rotor diameter	m	82	7 to 80 m
Swept area	m²	5,281	35 to 5,027 m²
Wind turbine manufacturer		Vestas	
Wind turbine model		Vestas V82-1.65 MW	
Energy curve data source	-	Standard	Rayleigh wind distribution
Shape factor	-	2.0	

Wind Turbine Production Data

Wind speed (m/s)	Power curve data (kW)	Energy curve data (MWh/yr)
0	-	-
1	-	-
2	-	-
3	0.0	426.4
4	28.0	1,300.9
5	144.0	2,553.9
6	309.0	3,963.6
7	511.0	5,328.3
8	758.0	6,509.1
9	1,017.0	7,425.5
10	1,285.0	8,052.1
11	1,504.0	8,406.8
12	1,637.0	8,533.0
13	1,650.0	8,482.0
14	1,650.0	8,302.6
15	1,650.0	8,036.0
16	1,650.0	-
17	1,650.0	-
18	1,650.0	-
19	1,650.0	-
20	1,650.0	-
21	0.0	-
22	0.0	-
23	0.0	-
24	0.0	-
25	0.0	-



Return to
Energy Model sheet

V82-1.65 MW

Creating more from less

Vestas®

No.1 in Modern Energy

Optimised for low and medium winds

With its large rotor and powerful generator, the V82 is an excellent performing turbine for sites with low and medium wind conditions. Our hydraulic Active-Stall® technology ensures that the rotor gathers the maximum power from the prevailing wind, while minimising loads and controlling output. Active-Stall® provides failsafe protection in all conditions and, above its rated wind speed, maintains a steady output of 1.65 MW. With the V82, we have designed a wind turbine that offers unparalleled performance at a cost-effective price.

Grid compliance

As wind turbines capture more of the electricity market each year, they have an increasingly significant role to play in grid management. Fortunately, the V82 meets most grid demands, and with the installation of our advanced grid compliance system, the V82 will actually help stabilise the grid. The turbine can run at full capacity during grid disturbances. Vestas grid support features full load and static phase compensation to enhance reactive power regulation and thus keep the power factor in range. Moreover, our grid support provides continuous active and reactive power regulation to maintain voltage balance in the grid, as well as fault ride-through in the event of disturbances.

High reliability

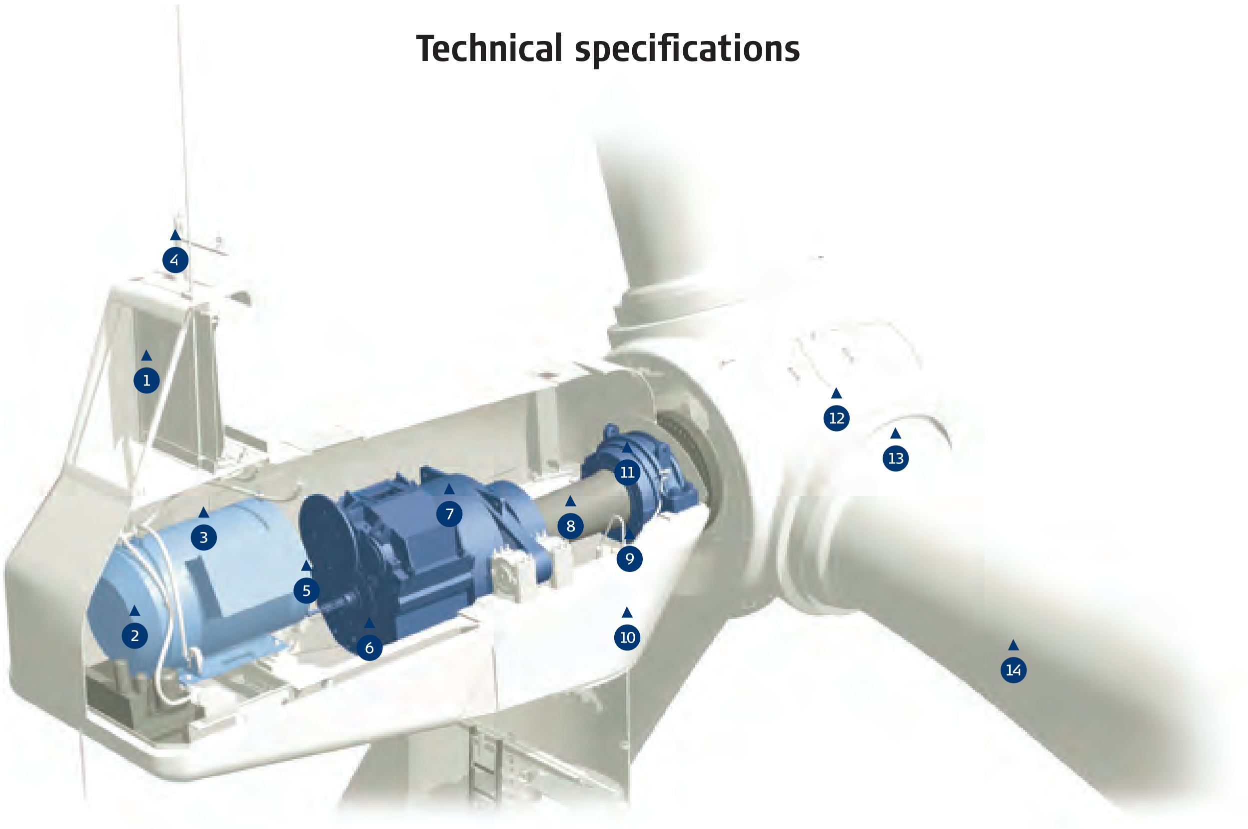
Det Norske Veritas (DNV) has certified the V82 as meeting the strictest standards in the wind industry. Aided by a simple design, which makes service and maintenance easier than most other turbines in the megawatt class, it has a high degree of operational availability. In addition, the nacelle is based on the thoroughly tested design of previous models. To date, more than 1,400 wind turbines featuring this platform design have been installed on sites with conditions ranging from arctic to tropical.

Proven Performance

Wind power plants require substantial investments, and the process can be very complex. To assist in the evaluation and purchasing process, Vestas has identified three factors that are critical to wind turbine quality: energy production, power quality and sound level.

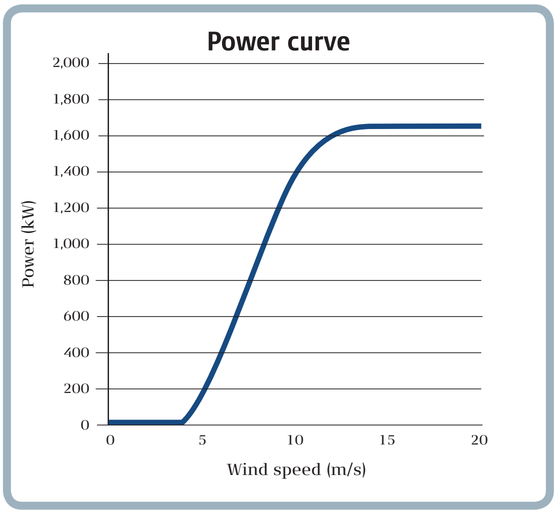
We spend months testing and documenting these performance areas for all Vestas turbines. When we are finally satisfied, we ask an independent testing organisation to verify the results – a practice we call Proven Performance. At Vestas we do not just talk about quality. We prove it.

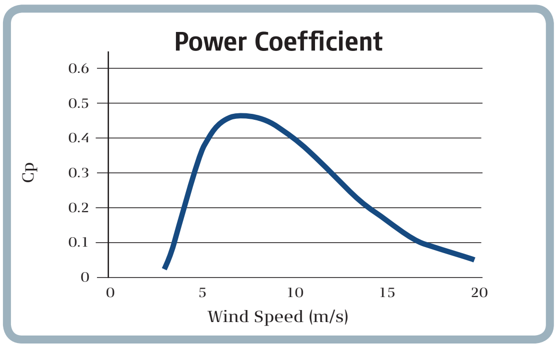
Technical specifications

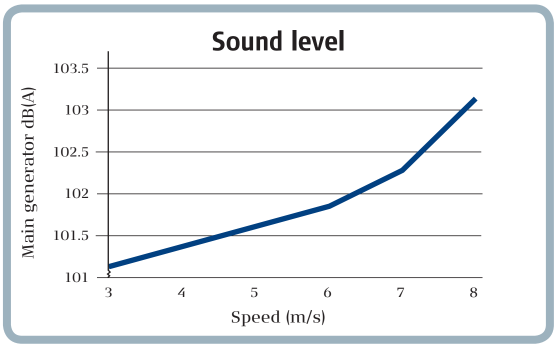


Example of tower internal configuration.

1. Cooler
2. Generator
3. Nacelle controller
4. Anemometer windvanes
5. Coupling
6. Mechanical brake
7. Gearbox
8. Main shaft
9. Yaw gears
10. Machine foundation
11. Main bearing
12. Hub controller
13. Pitch system
14. Blade
15. Main panel
16. Phase compensation
17. Ground controller







Rotor

Diameter:	82 m
Area swept:	5,281 m²
Nominal revolutions:	14.4 rpm
Number of blades:	3
Power regulation:	Active-Stall®
Air brake:	Full blade pitch by three separate hydraulic pitch cylinders.

Tower

50Hz, 230V:	Hub height (approx.) 78 m
60Hz, 110V:	Hub height (approx.) 70 m, 80 m

Operational data

Cut- in wind speed:	3.5 m/s
Nominal wind speed:	13 m/s
Cut-out wind speed (10 minutes):	20 m/s

Generator

Type:	Asynchronous water cooled
Nominal output:	1,650 kW
Operational data:	50/60 Hz 690/600V

Gearbox

Type:	Planetary/helical stages

Control

Type:	Microprocessor-based monitoring of all turbine functions with the option of remote monitoring. Output regulation and optimisation via Active-Stall®.

Weight

Nacelle:	52 t
Rotor:	43 t
Towers:	
50Hz, 230V	
Hub height:	IEC IIA
78 m	115 t
60Hz, 110V	
Hub height:	IEC IIA
70 m	105 t
80 m	125 t

t = metric tonnes.

All specifications subject to change without notice.

Creating more from less

With the V82 wind turbine, Vestas has created a turbine well suited for large wind farms, where grid compliance issues are solved at the substation level. This means that investments in grid equipment at the turbine level can be avoided.

The V82 is an extremely competitive turbine in its class in areas with low and medium winds. A stall-regulated wind turbine, it has been optimised for sites with an average wind speed of just 6.5 m/s at hub height, while a breeze of as little as 3.5 m/s is all that is needed to start production. The V82 operates in ambient temperatures ranging from -30 to +40 celsius degrees.

Vestas Wind Systems A/S
Alsvej 21
8900 Randers
Denmark
Tel. +45 97 30 00 00
Fax +45 97 30 00 01
vestas@vestas.com
www.vestas.com

To see a complete list of our sales and service units, visit www.vestas.com

01/08 UK

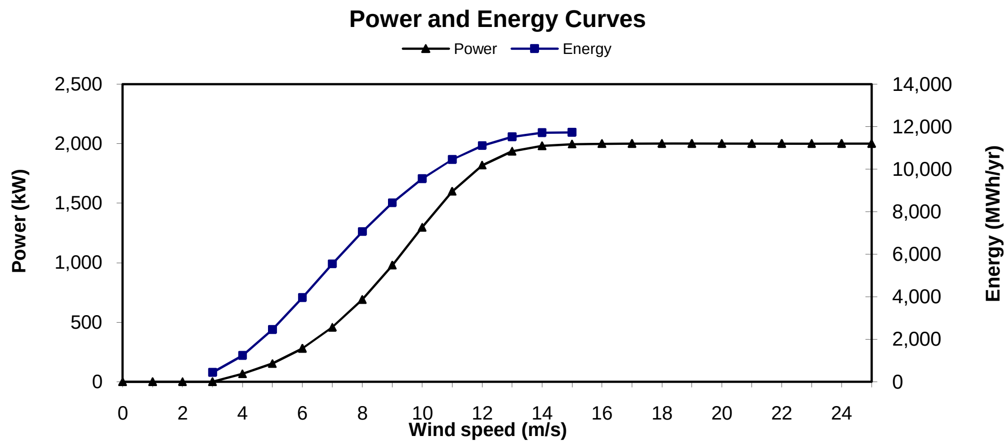
Gamesa G80
78 Meter

RETScreen® Equipment Data - Wind Energy Project

Wind Turbine Characteristics		Estimate	Notes/Range
Wind turbine rated power	kW	2000	See Product Database
Hub height	m	78.0	6.0 to 100.0 m
Rotor diameter	m	80	7 to 80 m
Swept area	m²	5,027	35 to 5,027 m²
Wind turbine manufacturer		Gamesa	
Wind turbine model		G80 2000	
Energy curve data source	-	Custom	Weibull wind distribution
Shape factor	-	2.1	1.0 to 3.0

Wind Turbine Production Data

Wind speed (m/s)	Power curve data (kW)	Energy curve data (MWh/yr)
0	0.0	-
1	0.0	-
2	0.0	-
3	0.0	435.1
4	66.3	1,232.6
5	152.0	2,451.1
6	280.0	3,953.2
7	457.0	5,540.0
8	690.0	7,055.2
9	978.0	8,407.6
10	1,296.0	9,547.3
11	1,598.0	10,447.0
12	1,818.0	11,098.4
13	1,935.0	11,511.3
14	1,980.0	11,710.1
15	1,995.0	11,728.0
16	1,999.0	-
17	2,000.0	-
18	2,000.0	-
19	2,000.0	-
20	2,000.0	-
21	2,000.0	-
22	2,000.0	-
23	2,000.0	-
24	2,000.0	-
25	2,000.0	-



Return to Energy Model sheet

Gamesa
G80-2.0 MW

Gamesa

Benefits

Maximum unit power with excellent performance for high winds

- Class IA/WZII/WZIII.
- Pitch and variable speed technology to maximize energy production.
- Production of lighter blades using fiberglass and prepreg method.
- Compliance with the main international Grid Codes.
- Aerodynamic design and Gamesa NRS® control system to minimize noise emissions.
- Gamesa SGIPE: Remote monitoring and control system with Web access.

G80-2.0 MW

Rotor

Diameter	80 m
Swept area	5,027 m²
Rotational speed	9.0 - 19.0 rpm
Rotational direction	Clock Wise (front view)
Weight (incl. Hub)	Approx. 38 T
Top head mass	Approx. 108 T

Blades

Number of blades	3
Length	39 m
Airfoils	NACA 63.XXX + FFA-W3
Material	Glass fiber reinforced with epoxy resin
Total blade weight	6,500 kg

Tubular Tower

Modular type	Height	Weight
3 sections	60 m	127 T
3 sections	67 m	145 T
4 sections	78 m	201 T
5 sections	100 m	283 T

Gearbox

Type	1 planetary stage / 2 parallel stages
Ratio	1:100.5 (50 Hz) 1:120.5 (60 Hz)
Cooling	Oil pump with oil cooler
Oil heater	2.2 kW

Generator 2.0 MW

Type	Doubly-fed machine
Rated power	2.0 MW
Voltage	690 V ac
Frequency	50 Hz / 60 Hz
Protecction class	IP 54
Number of poles	4
Rotational speed	900:1,900 rpm (rated 1,680 rpm) (50 Hz) 1,080:2,280 rpm (rated 2,016 rpm) (60 Hz)
Rated Stator Current	1,500 A @ 690 V
Power factor (standard)	0.98 CAP - 0.96 IND at partial loads and 1 at nominal power.*
Power factor (optional)	0.95 CAP - 0.95 IND throughout the power range.*

* Power factor at generator output terminals, at low voltage side before transformer input terminals.

Mechanical design

Drive train with main shaft supported by two spherical bearings that transmit the side loads directly to the frame by means of the bearing housing. This prevents the gearbox from receiving additional loads, reducing malfunctions and facilitating its service.

Brake

Aerodynamic primary brake by means of full-feathering blades. In addition, a hydraulically-activated mechanical disc brake for emergencies is mounted on the gearbox high speed shaft.

Lightning protection

The Gamesa G80-2.0 MW wind turbine generator uses the "total lightning protection" system, in accordance with standard IEC 61024-1. This system conducts the lightning from both sides of the blade tip down to the root joint and from there across the nacelle and tower structure to the grounding system located in the foundations. As a result, the blade and sensitive electrical components are protected from damage.

Control System

The Generator is a doubly fed machine (DFM), whose speed and power is controlled through IGBT converters and PWM (Pulse Width Modulation) electronic control.

Benefits:

- Active and reactive power control.
- Low harmonic content and minimal losses.
- Increased efficiency and production.
- Prolonged working life of the turbine.

Gamesa SGIPE

Gamesa SGIPE and its new generation Gamesa WindNet® (wind farm control systems), developed by Gamesa, that allow realtime operation and remote control of wind turbines, meteorological mast and electrical substation via satellite-terrestrial network. Modular design with control tools for active and reactive energy, noise, shadows and wake effects. TCP/IP architecture with a Web interface.

SMP Predictive Maintenance System

Predictive Maintenance System for the early detection of potential deterioration or malfunctions in the wind turbine's main components.

Benefits:

- Reduction in major corrective measures.
- Increase in the machine's availability and working life.
- Preferential terms in negotiations with insurance companies
- Integration within the control system.

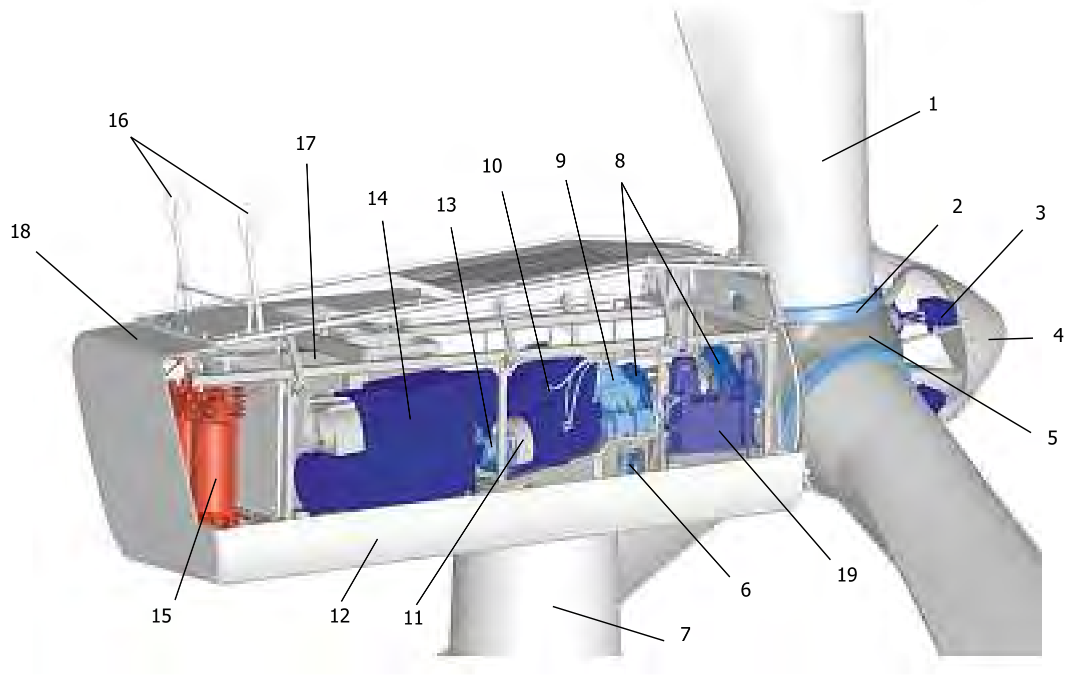
Noise control

Aerodynamic blade tip and mechanical component design minimize noise emissions. In addition, Gamesa has developed the Gamesa NRS® noise control system, which permits programming the noise emissions according to criteria such as date, time or wind direction. This achieves the goals of local regulation compliance as well as maximum production.

Grid connection

Gamesa's doubly-fed wind turbines and Active Crowbar and over sized converter technologies ensure the compliance with the most demanding grid connection requirements.
Low voltage ride-through capability and dynamic regulation of active and reactive power.

1. Blade
2. Blade bearing
3. Hydraulic pitch actuator
4. Hub cover
5. Hub
6. Active yaw control
7. Tower
8. Main shaft with two bearing houses
9. Shock absorbers
10. Gearbox
11. Main disc brake
12. Nacelle support frame
13. Transmission: High speed shaft
14. Doubly fed generator
15. Transformer
16. Anemometer and wind vane
17. Top controller
18. Nacelle cover
19. Hydraulic unit

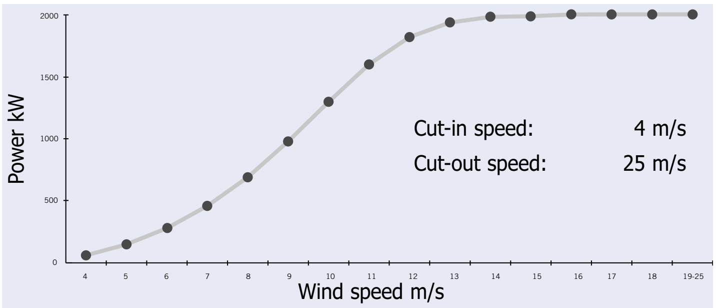


Power Curve Gamesa G80-2.0 MW

(for an air density of 1.225 kg/m³)

Power curve calculation based on NACA 63.XXX and FFA-W3 airfoils.

Calculation parameters: 50 Hz grid frequency; tip angle pitch regulated; 10% turbulence intensity and a variable rotor speed ranging from 9.0 - 19.0 rpm.



SPEED (m/s)	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19-25
POWER (kW)	66.3	152.0	280.0	457.0	690.0	978.0	1,296.0	1,598.0	1,818.0	1,935.0	1,980.0	1,995.0	1,999.0	2,000.0	2,000.0	2,000.0

Gamesa

C/ Ciudad de la Innovación, 9-11
31621 Sarriguren (Spain)
Tel: +34 948 771000
Fax: +34 948 165039
info@gamesacorp.com
www.gamesacorp.com

GERMANY
Wailandtstrasse 7
63741 Aschaffenburg
Tel: +49 (0) 6021 15 09 0
Fax: +49 (0) 6021 15 09 199
E-mail: germany.wind@gamesacorp.com

DENMARK
Vejlsøvej 51
8600 Silkeborg
Tel: +45 87 229205 / 9204
Fax: +45 87 229201

FRANCE
Parc Mail — Bâtiment G
6 Allée Irène Joliot Curie
69791 Saint Priest
Tel: +33 (0) 472 79 47 09
Fax: +33 (0) 478 90 05 41

GREECE
3, Pampouki Street
154 51 Neo Psichiko
Athens
Tel: +30 21 06753300
Fax: +30 21 06753305

ITALY
Via Pio Emanuelli,1
Corpo B, 2° piano
00143 Rome
Tel: +39 0651531036
Fax: +39 0651530911

PORTUGAL
Edificio D. Joâo II
PARQUE DAS NAÇOES
Av. D. Joâo II, lote 1.06.2.3–7º B
1990-090 Lisbon
Tel: +351 21 898 92 00
Fax: +351 21 898 92 99

UNITED KINGDOM
Rowan House Hazell Drive
NEWPORT South Wales NP10 8FY
Tel: +44 1633 654 140
Fax: +44 1633 654 147

UNITED STATES
1 Ben Fairless Drive - Ste. 2
Fairless Hills, PA 19030
Tel: +1 215 736 8165
Fax: +1 215 736 3985

CHINA
Room 605,
CBD International Building
N.° 16, Yong An Dong Li,
Chaoyang District
Beijing 100022
P.R. China
Tel.: +86 10 6567 9888
Fax: +86 10 6566 9666

JAPAN
Daiwa Jisho Building 4F – 411
74-1 Naka-ku,
Yamashita-cho
Yokohama-city 231-0023
Kanagawa
Tel: +81 45 680 50 80
Fax: +81 45 680 50 81

Printed date: August 2008

APPENDIX D

Final MAC And FAA Determinations

FAA Determination of No Hazard to Air Navigation- Proposed Structure Height: 394’ AGL

Federal Aviation Administration
Air Traffic Airspace Branch, ASW-520
2601 Meacham Blvd.
Fort Worth, TX 76137-0520

Aeronautical Study No.
2008-WTE-3623-OE
Prior Study No.
2008-WTE-1998-OE

Issued Date: 01/11/2009

Ron Files
Atlantic Design Engineering, LLC.
37 Pleasant Street
Sagamore Beach, MA 02561

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure:	Wind Turbine Balboni Turbine #1 -revised
Location:	Plymouth, MA
Latitude:	41-55-46.00N NAD 83
Longitude:	70-38-37.00W
Heights:	361 feet above ground level (AGL)
	446 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

As a condition to this Determination, the structure is marked and/or lighted in accordance with FAA Advisory circular 70/7460-1 K Change 2, Obstruction Marking and Lighting, white paint/synchronized red lights - Chapters 4,12&13(Turbines).

It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be completed and returned to this office any time the project is abandoned or:

_____ At least 10 days prior to start of construction (7460-2, Part I)
__X__ Within 5 days after the construction reaches its greatest height (7460-2, Part II)

This determination expires on 01/11/2011 unless:

(a) extended, revised or terminated by the issuing office.
(b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

Additional wind turbines or met towers proposed in the future may cause a cumulative effect on the national airspace system. This determination is based, in part, on the foregoing description which includes specific coordinates and heights . Any changes in coordinates will void this determination. Any future construction or alteration requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (770) 909-4329. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2008-WTE-3623-OE.

Signature Control No: 603154-107765044 (DNE -WT)
Michael Blaich
Specialist

Jordan Hospital
Private Use Heliport
41 55 47 / 70 38 34
Site #1
41 55 32 / 70 38 40
Site #2
384' AMSL
PLYMOUTH
HARBOR
Plymouth Rock
Coles Hill
National Monument
Watson Hill
Holmes Point
Poverty Point
Manters Pt
Jabez Corner
Jordan Hospital
County Farm
Chiltonville
Plymouth-Carver High Sch
Little Pond
Lout Pond
Cranberry Bogs
Cooks Pd
Harlow Pd
Goose Pond
Grassy Pd
Little South Pond
Great South Pond
South Triangle Pond
Russell Millpond
South Pond
Pinnacle Hill
Plymouth-Carver Jr High Sch
Gravel Pits
INTERCHANGE 39
INTERCHANGE 40
No Bottom Pond
Arms House Pond
Morton High Sch
Mt Pleasant Sch
Substation

Massachusetts Aeronautics Commission Airspace Review- Proposed Structure Height: 394’ AGL

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF TRANSPORTATION
MASSACHUSETTS AERONAUTICS COMMISSION

EOT

DEVAL L. PATRICK
GOVERNOR

TIMOTHY P. MURRAY
LIEUTENANT GOVERNOR

BERNARD COHEN
SECRETARY AND CHAIR

September 2, 2008

Simon Thomas, PE
Atlantic Design
P.O. Box 1051
Sagamore Beach, MA 02563

RE: MAC File No 08-PYM-V0361-02, Turbine (Atlantic Design), Plymouth
MAC File No 08-PYM-V0361-03, Turbine (Atlantic Design), Plymouth

Dear Mr. Thomas:

Enclosed is a copy of the final determination by the Massachusetts Aeronautics Commission (MAC) on your *Request for Airspace Review* of the above referenced proposal. The MAC's assistance is offered pursuant to the aviation law requirements of the Commonwealth.

Please note that although the proposal is not subject to further action required by MAC laws or regulations, this office may offer additional comments after considering FAA's determination of its impact to a public use airport or NAVAID facility through the aeronautical study process.

This project does not violate MAC laws or regulations.

If you have any questions, please feel free to contact me at 617-973-8891, or email me at joanne.ruddy@mac.state.ma.us

Sincerely,

Joanne M. Ruddy

Joanne M. Ruddy
Airport Engineer

Enclosed: Airspace Review Form

The Commonwealth of Massachusetts

AERONAUTICS COMMISSION
REQUEST FOR AIRSPACE REVIEW

For Office Use Only

- [X] Airspace Analysis [signature]
- [ ] Comments Received
- [ ] AirportIQ Updated

MAC File No: 08-PYM-V0361-02 FAA File No.: (For reference only)

Notice is required by 780 CMR (Code of Massachusetts Regulations) 111.7, Hazzards to air navigation. Parsuant to Massachusetts Genral Law (MGL) Chapter 90, Section 35B, the Massachusetts Aeronautics Commission (MAC) agrees to perform an AIRSPACE ANALYSIS and render a determination for the project listed below.
IMPORTANT: All shaded areas must be completed.

Sponsor (include name, address, telephone number):

Last Name	Suffix	First Name
Thomas	PE	Simon
Company:	Telephone: (508) 888-9282	
Address: P.O. Box 1051	City: Sagamore Bea; State: M; Zip Code: 02563-	Email: ron.files@yahoo.com

Sponsor Representative (same data if applicable):

Last Name	Suffix	First Name
Thomas	PE	Simon
Company:	Telephone: (508) 888-9282	
Address: P.O. Box 1051	City: Sagamore Bea; State: M; Zip Code: 02563-	Email: ron.files@yahoo.com

Project Description (please type or print clearly):

Turbine (Atlantic Design)

This notice is for a proposed 361' (AGL) AAER wind turbine capable of producing 1500 kW of electricity. It is located east of Camelot Drive and south of Route 3 in Plymouth, MA. This site location is the northern location of the two proposed turbine sites.

Location, Height, Elevation Data:

Nearest City, State: Plymouth

	Degrees	Minutes	Seconds
Latitude	41°	55'	47"
Longitude	70°	38'	34"

Datum: [X] NAD 83 [ ] NAD 27

Site elevation above MSL (ft.): 74 msl
Maximum height above ground (ft): 361 agl
Maximum elevation above MSL (ft): 435 msl

[ ] REQUIRED: Attach 8 1/2 x 11 inch map (e.g. USGS Quad Sheet) showing location of project.

Nearest Public-Use Aviation Facility: Plymouth Municipal Airport

Print or type, below, the name of person filing this request for review	Signature	Date
		8/11/2008

*************** DO NOT WRITE BELOW THIS LINE - FOR MAC OFFICE USE ONLY ***************

MAC's AIRSPACE ANALYSIS concludes the following:

Closest Runway: 33 Distance from RW end 3.8 NM Offset from RW CL: 3.3 NM [ ] Left [X] Right

- [ ] Project violates MGL Ch. 90, 35B by ____ ft. [Runway Horizontal Plane - 3,000' x 2 Statute Miles, 150' above RW]
- [ ] Project violates MGL Ch. 90, 35B by ____ ft. [Runway Horizontal Plane - 3,000' x 3,000' @ 20:1 slope]
- [ ] Project violates 702 CMR, 5.03(1)(a) by ____ ft. [Runway Horizontal Plane / Land - 500' x 10,000' @ 20:1 slope]
- [ ] Project violates 702 CMR, 5.03(2)(a) by ____ ft. [Runway Horizontal Plane / Water - 500' x 10,000' @ 20:1 slope]
- [X] Project does not violate MAC Airspace Laws or Regs.

MAC hereby issues the following DETERMINATION:

[ ] Permit is required* pursuant to MGL Ch. 90, 35B, for: [ ] Runway Horizontal Plane [ ] Runway Approach Plane

* Sponsor must submit a separate written request for a MAC Airspace Permit. Request should be addressed to MAC Chief Legal Counsel, Massachusetts Aeronautics Commission, 10 Park Plaza, Room 3510, MA 02116-3966

[X] Permit is not required pursuant to MGL Ch. 90, 35B [ ] No violations of Laws or Regs. [ ] Ch. 90 violation = 30' agl

[X] MAC had the following additional concerns:

- [ ] FAA Standards
- [ ] Noise
- [ ] Traffic Pattern
- [ ] Wildlife
- [X] VFR Route
- [ ] Other

RT3 IS A VFR ROUTE! FOR A 361' TURBINE TOWER, IT IS IMPERATIVE & STRONGLY RECOMMEND THAT TOWER BE EQUIPPED WITH FAA REGULATION OBSTRUCTION LIGHTING & OBSTRUCTION MARKING!

This determination is based on the foregoing description of the proposed project including the location, height and elevation data provided bt the Sponsor. Any changes in the data provided to the MAC from that which is shown herein will render this determination null and void and will necessitate a new request for review.

[signature]
Mgr of Airport Engineering, Massachusetts Aeronautics Commission

9/2/08
Date

The Commonwealth of Massachusetts

AERONAUTICS COMMISSION
REQUEST FOR AIRSPACE REVIEW

For Office Use Only
- [X] Airspace Analysis SMR
- [ ] Comments Received
- [ ] AirportIQ Updated

MAC File No: 08-PYM-V0394-03 FAA File No.: ______ (For reference only)

Notice is required by 780 CMR (Code of Massachusetts Regulations) 111.7, Hazzards to air navigation. Parsuant to Massachusetts Genral Law (MGL) Chapter 90, Section 35B, the Massachusetts Aeronautics Commission (MAC) agrees to perform an AIRSPACE ANALYSIS and render a determination for the project listed below.
IMPORTANT: All shaded areas must be completed.

Sponsor (include name, address, telephone number):

Last Name	Suffix	First Name
Thomas		Simon
Company	Telephone	
	(508) 888-9282	
Address	City / State / Zip Code	
P.O. Box 1051	Sagamore Bea / M / 02563-	
	Email: ron.files@yahoo.com	

Sponsor Representative (same data if applicable):

Last Name	Suffix	First Name
Thomas		Simon
Company	Telephone	
	(508) 888-9282	
Address	City / State / Zip Code	
P.O. Box 1051	Sagamore Bea / M / 02563-	
	Email: ron.files@yahoo.com	

Project Description (please type or print clearly):

Turbine (Atlantic Design)

This notice is for a proposed 394' (AGL) AAER wind turbine capable of producing 1500 kW of electricity. It is located east of Camelot Drive and south of Route 3 in Plymouth, MA. This site location is the southern location of the two proposed turbine sites.

Location, Height, Elevation Data:

Nearest City, State: Plymouth

	Degrees	Minutes	Seconds
Latitude	41°	55'	32"
Longitude	70°	38'	40"

Datum: [X] NAD 83 [ ] NAD 27

Site elevation above MSL (ft.): 77 msl
Maximum height above ground (ft): 394 agl
Maximum elevation above MSL (ft): 471 msl

[ ] REQUIRED: Attach 8 1/2 x 11 inch map (e.g. USGS Quad Sheet) showing location of project.

Nearest Public-Use Aviation Facility: Plymouth Municipal Airport

Print or type, below, the name of person filing this request for review	Signature	Date
		8/11/2008

*************** DO NOT WRITE BELOW THIS LINE - FOR MAC OFFICE USE ONLY ***************

MAC's AIRSPACE ANALYSIS concludes the following:

Closest Runway: 33 Distance from RW end 3.6NM Offset from RW CL: 3.1NM [ ] Left [X] Right

- [ ] Project violates MGL Ch. 90, 35B by ______ ft. [Runway Horizontal Plane - 3,000' x 2 Statute Miles, 150' above RW]
- [ ] Project violates MGL Ch. 90, 35B by ______ ft. [Runway Horizontal Plane - 3,000' x 3,000' @ 20:1 slope]
- [ ] Project violates 702 CMR, 5.03(1)(a) by ______ ft. [Runway Horizontal Plane / Land - 500' x 10,000' @ 20:1 slope]
- [ ] Project violates 702 CMR, 5.03(2)(a) by ______ ft. [Runway Horizontal Plane / Water - 500' x 10,000' @ 20:1 slope]
- [X] Project does not violate MAC Airspace Laws or Regs.

MAC hereby issues the following DETERMINATION:

[ ] Permit is required* pursuant to MGL Ch. 90, 35B, for: [ ] Runway Horizontal Plane [ ] Runway Approach Plane

* Sponsor must submit a separate written request for a MAC Airspace Permit. Request should be addressed to MAC Chief Legal Counsel, Massachusetts Aeronautics Commission, 10 Park Plaza, Room 3510, MA 02116-3966

[X] Permit is not required pursuant to MGL Ch. 90, 35B [ ] No violations of Laws or Regs. [ ] Ch. 90 violation = 30' agl

[X] MAC had the following additional concerns:

- [ ] FAA Standards [ ] Noise
- [ ] Traffic Pattern [ ] Wildlife
- [X] VFR Route [ ] Other

RT3 IS A VFR ROUTE! FOR A 394' TURBINE TOWER, IT IS IMPERATIVE & STRONGLY recommended THAT TOWER BE EQUIPPED WITH FAA REGULATION OBSTRUCTION LIGHTING & OBSTRUCTION MARKING!

This determination is based on the foregoing description of the proposed project including the location, height and elevation data provided bt the Sponsor. Any changes in the data provided to the MAC from that which is shown herein will render this determination null and void and will necessitate a new request for review.

[signature]
Mgr of Airport Engineering, Massachusetts Aeronautics Commission

9/2/08
Date

APPENDIX E

Funding, Incentives, and Financial Assistance Information

Forward Capacity Market

New England Energy Innovation Collaborative

Forward Capacity Market

Capacity Market Basics

As a result of a settlement agreement approved by the Federal Energy Regulatory Commission (FERC), ISO New England is developing, and will soon administer, a Forward Capacity Market (FCM) for New England.

The intention of a capacity market is to increase electricity reliability in the region. A capacity market allows utilities and generators to dynamically price and allocate capacity. The hope is that such a market will encourage suppliers to build more capacity by offering them stable revenue streams on which they can finance electricity generation investments.

Why A Capacity Market? Market Failure and its Impacts

Basic economic theory predicts that a competitive electricity market will provide price signals that reflect changes in supply and demand. In a competitive electricity market, prices would allow consumers to make decisions easily and allow generators to decide whether investing in additional capacity is economical.

However, the current electricity market is not competitive; two limitations prevent the sending of appropriate price signals to consumers and producers:

Absence of Demand-Side Response:

- Since consumers pay a flat rate for electricity, they do not see the rise in wholesale prices when demand increases. In other words, there is no market mechanism by which they might reduce demand in response
- Consequently, when demand exceeds available capacity, price can rise indefinitely, with no corresponding increase in capacity or decrease in demand.
- As a result, regulators are forced to intervene and set shortage prices at a politically-acceptable low level.

Market Power:

- The inability of consumers to respond to rising demand incentivizes suppliers to exercise market power during periods of peak demand or shortage.
- Predictably, they withhold supply in order to take higher profits on the reduced output.

- Regulators intervene and high shortage prices are suppressed.

To address the electricity market's structural problems, regulators cap the spot energy market. As a result, wholesale spot market prices for energy fail to rise high enough during periods of peak demand to recover the fixed costs of existing generation or to motivate investments in new generation. The revenues that generators do not receive because peak prices are suppressed are often referred to as "missing revenues."

Forward Capacity Market (FCM) of New England

The FCM compensates for the structural limitations of the electricity market by reducing market power and increasing reliability. Capacity shortfalls occur when capacity cannot cover their fixed costs; capacity markets induce a particular level of investment by paying more than fixed-costs when there is a shortage of capacity, and less when there is surplus capacity. As such, capacity markets should make up for "missing revenues."

The first goal of the FCM is to purchase sufficient capacity for reliable system operation for a future year at competitive prices. The FCM is a three-year forward auction beginning in June 1, 2010, preceded by a Transition Period from December 2006 to May 31, 2010.

Sellers and Buyers

In the FCM, electricity retailers are obligated to ensure that there is enough capacity to meet the demand of their customers by purchasing capacity in the auction or supplying it themselves. Capacity is purchased three years in advance of the obligation to deliver, allowing a new supplier sufficient time to complete any new projects that clear in the auction and reducing the risk involved with developing new capacity.

- All capacity suppliers that clear in the FCM will receive payments in the delivery year based upon a single clearing price set in the auction.

- Suppliers are obligated provide capacity for a specified period (1-5 years), and most sources must be available during shortage hours.

- During shortage hours, suppliers will receive revenues large enough to off-set their variable costs and a portion of their fixed costs.

- Suppliers receiving capacity payments will not receive wind-fall profits during high-priced shortage hours because they will be assessed a Peak Energy Rent (PER) deduction against those capacity payments.

- Capacity buyers are utilities, marketers, or aggregators who provide electric power to a large number of end-use customers (also referred to as Load Serving Entities (LSEs)). All LSEs are responsible for purchasing a share of the region's capacity obligation, based on customers' historical use.

In today's restructured electricity markets, the high shortage prices required to induce new investment in capacity generation are generally suppressed by various market-power mitigation measures. The Forward Capacity Market will attempt to create efficient investment incentives by restoring the missing peak energy revenues. The structure of the three-year forward market will provide stability for financing, and longer time commitments for new capacity to reduce investor risk. The market-clearing price will reflect the true long-run costs of efficient capacity resources, sending robust price signals for investments in new generation and retirement of inefficient capacity.

For more information, visit:

ISO-New England: http://www.iso-ne.com/markets/othrmkts_data/fcm/index.html

Energy Legal Blog:
http://energylegalblog.com/archive/2006/03/14/Forward_Capacity_Market_Proposed_in_Lieu_of_LICAP_for_New_England.aspx

Modified Accelerated Cost Recovery System +Bonus Depreciation

Federal Incentives for Renewable Energy

Printable Version

Modified Accelerated Cost-Recovery System (MACRS) + Bonus Depreciation

Last DSIRE Review: 02/27/2008

Incentive Type:	Corporate Depreciation
Eligible Renewable/Other Technologies:	Solar Water Heat, Solar Space Heat, Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaics, Landfill Gas, Wind, Biomass, Renewable Transportation Fuels, Geothermal Electric, Fuel Cells, CHP/Cogeneration, Solar Hybrid Lighting, Direct Use Geothermal, Anaerobic Digestion, Microturbines
Applicable Sectors:	Commercial, Industrial
Authority 1:	26 USC § 168
Effective Date:	1986
Authority 2:	Economic Stimulus Act of 2008
Date Enacted:	2/13/2008
Effective Date:	12/31/2007
Expiration Date:	12/31/2008

Summary:

Under the federal Modified Accelerated Cost-Recovery System (MACRS), businesses may recover investments in certain property through depreciation deductions. The MACRS establishes a set of class lives for various types of property, ranging from three to 50 years, over which the property may be depreciated. For solar, wind and geothermal property placed in service after 1986, the current MACRS property class is five years. For certain biomass property, the MACRS property class life is seven years. Eligible biomass property generally includes assets used in the conversion of biomass to heat or to a solid, liquid or gaseous fuel, and to equipment and structures used to receive, handle, collect and process biomass in a waterwall, combustion system, or refuse-derived fuel system to create hot water, gas, steam and electricity.

The federal Energy Policy Act of 2005 (EPAct 2005) classified fuel cells, microturbines and solar hybrid lighting technologies as five-year property as well. The federal Economic Stimulus Act of 2008, enacted in February 2008, included a 50% bonus depreciation provision for eligible renewable-energy systems acquired and placed in service in 2008. To qualify for bonus depreciation, a project must satisfy these criteria:

- the property must have a recovery period of 20 years or less under normal federal tax depreciation rules;
- the original use of the property must commence with the taxpayer claiming the deduction;
- the property generally must be acquired during 2008; and
- the property must be placed in service during 2008 (or, in certain limited cases, in 2009).

If property meets these requirements, the owner is entitled to deduct 50% of the adjusted basis of the property in 2008. The remaining 50% of the adjusted basis of the property is depreciated over the ordinary depreciation schedule. The bonus depreciation rules do not override the depreciation limit applicable to projects qualifying for the federal business energy tax credit. Before calculating depreciation for such a project, including any bonus depreciation, the adjusted basis of the project must be reduced by one-half of the amount of the energy credit for which the project qualifies.

For more information on the federal MACRS, see *IRS Publication 946, IRS Form 4562: Depreciation and Amortization*, and *Instructions for Form 4562*. The IRS web site provides a search mechanism for forms and publications. Enter the relevant form, publication name or number, and click "GO" to receive the requested form or publication.

Contact:

Public Information - IRS
Internal Revenue Service
1111 Constitution Avenue, N.W.
Washington, DC 20224
Phone: (800) 829-1040
Web site: http://www.irs.gov

DSIRE Database of State Incentives for Renewables & Efficiency

Return to List of Incentives

FAQs I Summary Maps I Summary Tables I Search By I Glossary I Links

Net Metering Policies

Net Metering Policies

Net metering programs serve as an important incentive for consumer investment in renewable energy generation. Net metering enables customers to use their own generation to offset their consumption over a billing period by allowing their electric meters to turn backwards when they generate electricity in excess of their demand. This offset means that customers receive retail prices for the excess electricity they generate. Without net metering, a second meter is usually installed to measure the electricity that flows back to the provider, with the provider purchasing the power at a rate much lower than the retail rate.

Net metering is a low-cost, easily administered method of encouraging customer investment in renewable energy technologies. It increases the value of the electricity produced by renewable generation and allows customers to "bank" their energy and use it a different time than it is produced giving customers more flexibility and allowing them to maximize the value of their production. Providers may also benefit from net metering because when customers are producing electricity during peak periods, the system load factor is improved.

Currently, net metering is offered in more than 35 states (see the summary table and map below). For a more detailed description of state net metering policies and links to the authorizing legislation, see the DSIRE database, which is a project of the Interstate Renewable Energy Council funded by the U.S. DOE and managed by the North Carolina Solar Center.

Massachusetts

Massachusetts - Net Metering

Last DSIRE Review: 07/16/2008

Incentive Type:	Net Metering
Eligible Renewable/Other Technologies:	Solar Thermal Electric, Photovoltaics, Wind, Biomass, Hydroelectric, Geothermal Electric, Fuel Cells, Municipal Solid Waste, CHP/Cogeneration, Anaerobic Digestion, Other Distributed Generation Technologies
Applicable Sectors:	Commercial, Industrial, Residential, Nonprofit, Schools, Local Government, State Government, Fed. Government, Agricultural, Institutional
Limit on System Size:	"Class I" facilities: 60 kW "Class II" facilities: 1 MW "Class III" facilities: 2 MW
Limit on Overall Enrollment:	1% of each utility’s peak load

Treatment of Net Excess: Varies by system type and customer class

Utilities Involved: Investor-owned utilities

Interconnection Standards for Net Metering? Yes

Website: http://www.mtpc.org/cleanenergy/howto/interconnection/netppa.htm

Authority 1: M.G.L. ch. 164, § 1G (amended by S.B. 2768)

Authority 2: S.B. 2768

Date Enacted: 7/2/2008

Effective Date: 7/2/2008

Authority 3: 220 CMR 11.04

Effective Date: 1997

Summary:

Note: This record describes net metering in Massachusetts based on the statutory changes made by S.B. 2768, which was enacted July 2, 2008. However, the Massachusetts Department of Public Utilities (DPU) must first adopt new net-metering rules before these changes take effect (in practice). Under the current DPU rules, net metering is generally permitted for farm- renewable-energy systems and combined heat and power (CHP) systems up to 60 kilowatts (kW) in capacity. Please refer to the current rules for additional details. Contact the DPU for more information.

Net metering was originally authorized for renewable-energy systems and combined-heat-and-power (CHP) facilities with a generating capacity up to 30 kilowatts (kW) by the Massachusetts Department of Public Utilities in 1982. In 1997, the maximum individual system capacity was raised to 60 kW and customers were permitted to carry any net excess generation (NEG) -- credited at the "average monthly market price of generation" -- to the next bill.

In July 2008, net metering was significantly expanded by S.B. 2768, which established three separate categories of net-metering facilities. "Class I" facilities are generally defined as systems up to 60 kW in capacity. "Class II" facilities are generally defined as systems greater than 60 kW and up to one megawatt (MW) in capacity that generate electricity from agricultural products, solar energy or wind energy. "Class III" facilities are generally defined as systems greater than 1 MW and up to 2 MW in capacity that generate electricity from agricultural products, solar energy or wind energy.

The state's investor-owned utilities must offer net metering. Municipal utilities are not obligated to offer net metering, but they may do so voluntarily. (There are no electric cooperatives in Massachusetts.) The aggregate capacity of net metering is limited to 1% of each utility's peak load.*

The treatment of customer NEG varies by facility class and customer type. In general, for NEG at the end of a billing period, Class I solar and wind facilities, Class II facilities, and Class III facilities used by government customers receive credit that is slightly less than the utility's full retail rate. Class III facilities that are used by customers other than government entities do not receive credit for the distribution component of each kilowatt-hour of NEG. Credits may be carried forward to the next month indefinitely, and credits from Class I and Class II wind and solar facilities may be transferred to another customer of the same utility. Credits from Class III facilities may be transferred to other customers with the utility's permission.

Massachusetts also allows “neighborhood net metering” for neighborhood-based Class I, II or III facilities that are owned by (or serve the energy needs of) a group of 10 or more residential customers in a single neighborhood and served by a single utility. If a neighborhood facility has NEG at the end of a billing period, the credits are awarded to designated neighborhood customers that have an ownership interest in the facility. The amount of NEG attributed to each such customer is determined by the allocation provided by the neighborhood net metering facility. Credits may be carried forward to the next month indefinitely.

** For the purpose of calculating the aggregate capacity, the capacity of a net-metered solar facility is 80% of the facility's DC rating at standard test conditions (STC).*

Contact:

Barry Perlmutter
Massachusetts Department of Public Utilities
100 Cambridge Street, Room 1210
Boston, MA 02202
Phone: (617) 305-3659
Fax: (617) 723-8812
E-Mail: barry.perlmutter@state.ma.us
Web site: http://www.state.ma.us/dpu

Production Tax Credit (PTC)

Federal Incentives for Renewable Energy

Printable Version

Renewable Electricity Production Tax Credit (PTC)

Last DSIRE Review: 10/09/2008

Incentive Type: Corporate Tax Credit
Eligible Renewable/Other Technologies: Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste, Hydrokinetic Power (i.e., Flowing Water), Refined Coal, Indian Coal, Small Hydroelectric, Tidal Energy, Wave Energy, Ocean Thermal
Applicable Sectors: Commercial, Industrial
Amount: 2.0¢/kWh for wind, geothermal, closed-loop biomass; 1.0¢/kWh for other eligible technologies. Generally applies to first 10 years of operation.
Eligible System Size: Marine and Hydrokinetic: Minimum system size of 150 kW
Website: http://www.irs.gov/pub/irs-pdf/f8835.pdf
Authority 1: 26 USC § 45
Date Enacted: 1992
Expiration Date: 12/31/2008 for some portions
Authority 2: H.R. 1424: Div. B, Sec. 101 & 102 (The Energy Improvement and Extension Act of 2008)
Date Enacted: 10/03/2008
Effective Date: Varies
Expiration Date: Varies (see table below)

Summary:

The federal Renewable Electricity Production Tax Credit (PTC) is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. The PTC was originally enacted in 1992 but has been renewed and expanded numerous times, most recently by H.R. 1424 in October 2008. This legislation extended the in-service deadlines for all qualifying technologies except Indian coal; expanded the list of qualifying resources to include marine and hydrokinetic resources, such as wave, tidal, current, and ocean thermal; and made changes to the definitions of several qualifying resources and facilities.

The effective dates of these changes vary. Marine and hydrokinetic energy production is eligible as of the date the legislation was enacted (October 3, 2008), as is the incremental energy production associated with expansions of biomass facilities. A change in the definition of "trash facility" no longer requires that such facilities burn trash, and is also effective immediately. Two provisions, one which redefines the term "non-hydroelectric dam", and another which modifies the qualifying criteria for refined coal, will take effect December 31, 2008.

The tax credit amount is 1.5¢/kWh (in 1993 dollars and indexed for inflation) for some technologies, and half of that amount for most others. The rate for refined coal is $4.375/ton and the rate for Indian coal is $1.50/ton through 2009 and $2.00/ton thereafter. Both levels are adjusted for inflation annually. The rules governing the PTC are currently different for different types of resources and facilities. The table below outlines two of the most important characteristics of the tax credit -- in service deadline and credit amount -- as they apply to different facilties. The table includes changes made by H.R. 1424 (see History section for information on prior rules) and the inflation adjusted credit amounts are current for the 2007 tax year.

Resource Type	In Service Deadline	Credit Amount
Wind	December 31, 2009	2.0¢/kWh
Closed-loop Biomass	December 31, 2010	2.0¢/kWh
Open-loop Biomass	December 31, 2010	1.0¢/kWh
Geothermal Energy	December 31, 2010	2.0¢/kWh
Landfill Gas	December 31, 2010	1.0¢/kWh
Municipal Solid Waste	December 31, 2010	1.0¢/kWh
Qualified Hydroelectric	December 31, 2010	1.0¢/kWh

Marine and Hydrokinetic (150 kW or larger)*	December 31, 2011	1.0¢/kWh
Refined Coal	December 31, 2009	$5.877/ton
Indian Coal	December 31, 2008	$1.544/ton

The duration of the credit is generally 10 years after the date the facility is placed in service, but there are several exceptions:

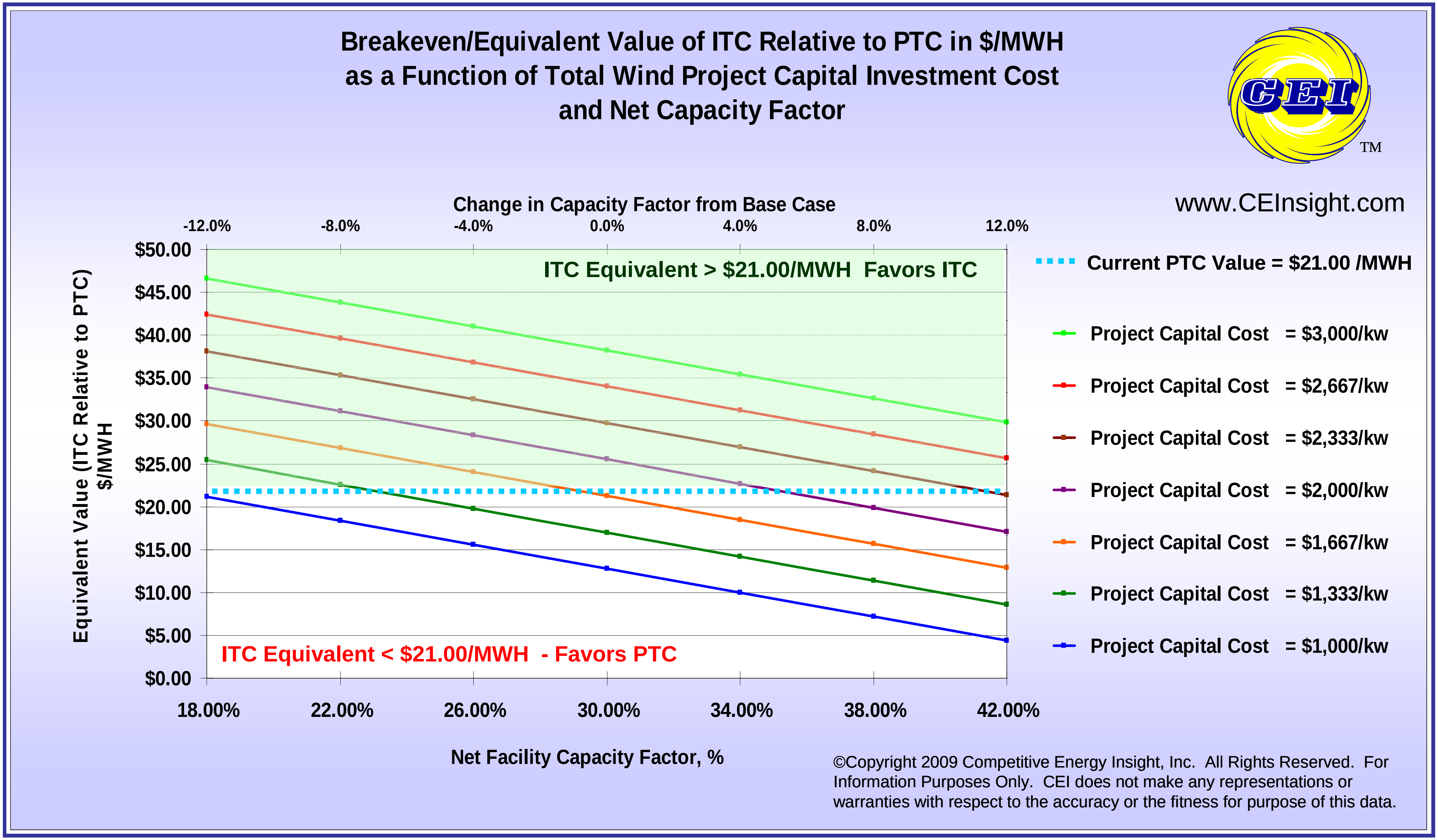
- Open-loop biomass, geothermal, small irrigation hydro, landfill gas, and municipal solid waste combustion facilities placed into service after October 22, 2004, and before enactment of EPAct 2005, on August 8, 2005, are only eligible for the credit for a five-year period.
- Open-loop biomass facilities that use cellulosic waste may receive the credit for five years after they are placed in service, with the beginning date set no earlier than January 1, 2005.
- Indian coal production facilities may receive the tax credit during for seven years after they are placed in service, with the beginning date set no earlier than January 1, 2006.

It is important to note that owners of geothermal projects who claim the federal business energy tax credit *may not* also claim the federal PTC. In addition, the tax credit is reduced for projects that receive other federal tax credits, grants, tax-exempt financing, or subsidized energy financing. A business can take the credit by completing Form 8835, "Renewable Electricity Production Credit," and Form 3800, "General Business Credit." For more information, contact IRS Telephone Assistance for Businesses at 1-800-829-4933.

History
As originally enacted by the Energy Policy Act of 1992, the PTC expired at the end of 2001, and was subsequently extended in March 2002 as part of the Job Creation and Worker Assistance Act of 2002 (H.R. 3090). The tax credit then expired at the end of 2003 and was not renewed until October 2004, as part of H.R. 1308, the Working Families Tax Relief Act of 2004, which extended the credit through December 31, 2005. The Energy Policy Act of 2005 (H.R. 6) modified the credit and extended it through December 31, 2007. In December 2006, the credit was extended for yet another year -- through December 31, 2008 -- by Section 201 of the Tax Relief and Health Care Act of 2006 (H.R. 6111).

Section 710 of the "American Jobs Creation Act of 2004" (H.R. 4520), expanded the PTC to include additional eligible resources -- geothermal energy, open-loop biomass, solar energy, small irrigation power, landfill gas, municipal solid waste combustion, and refined coal -- in addition to the formerly eligible wind energy, closed-loop biomass, and poultry-waste energy resources. The Energy Policy Act of 2005 (EPAct 2005) further expanded the credit to certain hydropower facilities and Indian coal (generally defined as coal reserves owned by an Indian tribe or that were held in trust by the U.S. government for the benefit of an Indian tribe). As a result of EPAct 2005, solar facilities placed into service after December 31, 2005, are no longer eligible for this incentive.

**H.R. 1424 added marine and hydrokinetic energy as eligible resource and removed "small irrigation power" as an eligible resource effective October 3, 2008. However, the definition of marine and hydrokinetic energy encompasses the resources that would have formerly been defined as small irrigation power facilities. Thus H.R. 1424 effectively extended the in-service deadline for small irrigation power facilities by 3 years, from the end of 2008 until the end of 2011.*



This single chart illustrates the relative value of the Investment Tax Credit (ITC) based on the "Breakeven" or "Equivalent" Net Present Value ($NPV_{10\%}$) of the cash flows of a wind project utilizing the ITC versus the same project utilizing the Production Tax Credits (PTCs). The chart is presented as a function of the Project Capital Cost ($/kw) and Net Capacity Factor (%). The dashed blue line (▪▪▪▪) shows the current value of the PTCs ($21/ MWH + esc.). Cases above this line (shaded in light green) favor the ITC because the "Equivalent" $NPV_{10\%}$ of the ITC and its associated depreciation benefits would be worth more than the $21/MWH PTC and its associated depreciation benefits. Cases below the dashed blue line (shaded in pink) favor the PTC because the NPV of its after-tax value and depreciation benefits are greater. Key assumptions include: i) reduction to the depreciable basis of the asset with the ITC, ii) escalation of the PTC, iii) 50% Bonus Depreciation and iv) a discount rate of 10% after-tax on a leveraged basis. This chart, along with complete "Bank Quality" analysis, reports and charts of "Project-Level" and "Partner Level" returns can be produced using the *EconExpert-Wind*™ Financial Model and the *EconExpert-Partnership Module*. Other premises entered into the *EconExpert* model in this analysis are shown on the next page.

Some important premises that are the basis for the chart on the previous page include:

Net Capacity Factor	analyzed from 18% to 42%
Capital Cost	analyzed from \$1000/kw to \$3000/kw net power production
Discount Rate for NPV	10%
State Income Tax Rate	5%
% Debt Financing / Term / Interest Rate	50% / 14 yrs / 7%
Federal Income Tax Rate	35%
Federal ITC Rate	30%
Percent of Capital that Qualifies for ITC	90%
PTC Start Rate	\$21.00
PTC Annual Escalation Rate	2%/yr (Rounds Annual to Nearest Whole \$)
Schedule	Start of Operations 12/2010
50% Bonus Depreciation	Yes
PTC Term	10 Years
% of Project at 5 Year MACRS Qualified	90% (A)
Reduction in Basis if ITC is Utilized	15% of (A) above
% of Applicable Fed. ITC / Depreciation Monetized	100%
% of Applicable Federal PTC Monetized	100%

Other project premises used in the model that were not influential in the "Project Level" ITC vs PTC comparison included operating costs, land lease rates, royalties, escalation rates, PPA rates, etc.

It is important to note that the comparative value of the ITC and PTC on a Net Present Value basis is not the only consideration to take into account when considering these alternative strategies. Other important considerations, all of which can be fully assessed in *EconExpert* include: i) the up-front receipt / lack of production risk associated with the ITC, ii) investor's appetite for tax benefits and risk, and iii) alternative business strategies for monetizing the ITCs, PTCs and accelerated depreciation benefits including Federal Grant Programs, Tax Limited Partnerships, Leases and Alternative Financing Approaches. What is most important is that now investors will have a menu of options to choose from when developing projects, improving the prospects for success and profitability, and that all of these options can be fully evaluated in *EconExpert* from the perspective of any stakeholder in the transaction.

For further information and for a demonstration of the *EconExpert* suite of advanced software tools for the analysis of investments in Renewable or Fossil Energy Projects, please visit our website at www.CEInsight.com , or contact us directly at:

Competitive Energy Insight, Inc. 12025 Blue Diamond Court San Diego, CA 92131
Tel) 858 – 566 – 0221 Fax) 858 – 566 – 0287
email) SProvol@CEInsight.com Website) www.CEInsight.com

Renewable Energy Certificates (RECs)

Renewable Energy Certificates

Renewable energy certificates (RECs), also known as green certificates, green tags, or tradable renewable certificates, represent the environmental attributes of the power produced from renewable energy projects and are sold separate from commodity electricity. Customers can buy green certificates whether or not they have access to green power through their local utility or a competitive electricity marketer. And they can purchase green certificates without having to switch electricity suppliers.

- Table of Retail Products
- Table of Commercial &/or Wholesale Marketers
- List of REC Marketers

Renewable Energy Certificates

Retail Products

The table shown here summarizes renewable energy certificate (REC) products available to retail customers nationally or regionally. Please contact our Webmaster if you have questions or more recent information regarding these products.

Company and product listings do not represent endorsement by either the National Renewable Energy Laboratory or the U.S. Department of Energy.

National Retail REC Products (last updated October 2007)					
Certificate Marketer	**Product Name**	**Renewable Resources**	**Location of Renewable Resources**	**Residential Price Premiums***	**Certification**
3Degrees	Renewable Energy Certificates	100% new wind	Nationwide	2.0¢/kWh	Green-e
3 Phases Renewables	Green Certificates	100% biomass, geothermal, hydro, solar, wind	Nationwide	1.2¢/kWh	Green-e
BlueStar Energy (ComEd territory only)	Go Green & Save Green	new wind	Nationwide	0.0¢/kWh	Green-e
Bonneville Environmental Foundation	Denali Green Tags (Alaska only)	100% new wind	10% Alaska, 90% Nationwide	2.0¢/kWh	Green-e
Bonneville Environmental Foundation	*Solar* Green Tags	100% new solar	Nationwide	5.6¢/kWh	Green-e

Bonneville Environmental Foundation	*Wind & Solar* Green Tags Blend	50% new wind, 50% new solar	Nationwide	2.4¢/kWh	Green-e
Bonneville Environmental Foundation	*Wind* Green Tags	100% wind	Nationwide	2.0¢/kWh	Green-e
Bonneville Environmental Foundation	Zephyr Energy (Kansas Only)	50% new low-impact hydropower	Mid-West, West	2.0¢/kWh	Green-e
Carbonfund.org	*My*GreenFuture	99% new wind, 1% new solar	Nationwide	0.5¢/kWh	Green-e
Carbon Solutions Group	CSG CleanBuild	biomass, biogas, wind, solar, hydro	Nationwide	0.9¢/kWh	Green-e
Choose Renewables	CleanWatts	100% new wind	Nationwide	1.7¢/kWh	Green-e
Clean and Green	Clean and Green Membership	100% new wind	Nationwide	1.6¢/kWh-3.0¢/kWh	—
Community Energy	NewWind Energy	100% new wind	Nationwide	2.5¢/kWh	Green-e
Conservation Services Group	ClimateSAVE	95% new wind, 5% new solar	Kansas (wind), New York (solar)	1.6¢/kWh-1.75¢/kWh	Green-e
*Native*Energy	*Cool*Watts	100% new wind	Nationwide	0.8¢/kWh	Green-e
*Native*Energy	Remooable Energy	100% new biogas	Pennsylvania	0.8¢/kWh-1.0¢/kWh	CCX***
Enpalo	US CleanGen	100% new wind	Nationwide	1.0¢/kWh	Green-e
Good Energy	Good Green RECs	various	Nationwide	0.4¢/kWh-1.5¢/kWh	Green-e
Green Mountain Energy	BeGreen RECs	wind, solar, biomass	Nationwide	1.4¢/kWh	—
Juice Energy	Positive Juice - Wind	100% wind	Nationwide	1.1¢/kWh	Green-e
Maine Renewable Energy/Maine Interfaith Power & Light	Maine WindWatts	100% new wind	Maine	2.0¢/kWh	Green-e
Mass Energy Consumers Alliance	New England Wind Fund	100% new wind	New England	~5.0¢/kWh (donation)	—
MMA Renewable Ventures	PVUSA Solar Green Certificates	100% solar	California	3.3¢/kWh	Green-e
Premier Energy	Premier 100%	100% wind	Nationwide	0.95¢/kWh-	Green-e

Marketing	Wind REC			2.0¢/kWh	
Renewable Choice Energy	American Wind	100% new wind	Nationwide	2.0¢/kWh	Green-e
Santee Cooper	SC Green Power	landfill gas, solar	South Carolina	3.0¢/kWh	Green-e
Sky Blue Electric	Sky Blue 40	100% wind	Nationwide	4.2¢/kWh	Green-e
SKY energy, Inc.	Wind-e Renewable Energy	100% new wind	Nationwide	2.4¢/kWh	Green-e
Sterling Planet	Sterling Wind	100% new wind	Nationwide	1.85¢/kWh	Green-e
Village Green Energy	Village Green Power	solar, wind, biogas	California, Nationwide	2.0¢/kWh-2.5¢/kWh	Green-e
Waverly Light & Power	Iowa Energy Tags	100% wind	Iowa	2.0¢/kWh	—
WindCurrent	Chesapeake Windcurrent	100% new wind	Mid-Atlantic States	2.5¢/kWh	Green-e
WindStreet Energy	Renewable Energy Credit Program	wind	Nationwide	~1.2¢/kWh	—

Footnote:
* Product prices are updated as of July 2006. Premium may also apply to small commercial customers. Large users may be able to negotiate price premiums.
** Product is sourced from Green-e and ERT-certified RECs. ERT also certifies the entire product portfolio.
*** The Climate Neutral Network certifies the methodology used to calculate the CO2 emissions offset.
NA = Not applicable.

Source:
National Renewable Energy Laboratory.

Renewable Energy Certificates

Commercial &/or Wholesale Marketers

The table shown here lists commercial &/or wholesale marketers of renewable energy certificates (RECs).

Company and product listings do not represent endorsement by either the National Renewable Energy Laboratory or the U.S. Department of Energy.

National Commercial &/or Wholesale REC Marketers			
3Degrees	3 Phases Renewables	Amerex Brokers	Aquila
Basin Electric	BlueStar Energy	Bonneville	Bonneville

Power Cooperative	Services	Environmental Foundation	Power Administration (BPA)
BP Energy Company	Brookfield Renewable Power	Calpine Corporation	Carbonfund.org
Carbon Solutions Group	Centennial Energy Resources	Clean Currents	Clear Energy Brokerage & Consulting
Clear Sky Power	ComEd	Community Energy Inc.	Conservation Services Group
Constellation NewEnergy	Element Markets	Empire District Electric Company	Endless Energy Corporation
Enpalo	Exelon Power Team	FirstEnergy Solutions Corporation	FPL Energy
Good Energy, LP	Green Mountain Energy Company	Hess Energy	Juice Energy
Liberty Power	Maine Interfaith Power & Light	Mainstay Energy	Massachusetts Energy Consumers Alliance (Mass Energy)
MidAmerican Energy	MotivEarth	*Native*Energy	Neuwing Energy Ventures
Nexant Clean Energy Solutions	Old Mill Power Company	Pacific Renewables	Peoples Energy Services
PowerLight	PPL Corporation	PPM Energy	Premier Energy Marketing
Premier Power Solutions	QVINTA, Inc.	Reliant Energy	Renewable Choice Energy
Select Energy	Sempra Energy Solutions	Shell Trading	SKY energy, Inc.
Sol Systems	Spartan Renewable Energy	Sterling Planet, Inc.	Strategic Energy
SUEZ Energy Resources NA	SunEdison	Sun Farm Ventures, Inc.	TFS Energy
Tradition Energy	Tullett Prebon	TXU Energy	Unicoi Energy Services
Viking Wind Partners, LLC	Village Green Energy	Vision Quest	Waste Management
Waverly Light	Western Area	WindCurrent	WindQuest

and Power	Power Administration		Energy, Inc.
WindStreet Energy			

Renewable Energy Certificates

REC Marketers

Below you will find information and news about wholesale and retail renewable energy certificate marketers and brokers.

Company and product listings do not represent endorsement by either the National Renewable Energy Laboratory or the U.S. Department of Energy.

Active Retail Marketers

3Degrees
3 Phases Renewables
Bonneville Environmental Foundation
Carbon Solutions Group
Choose Renewables
Community Energy Inc.
Conservation Services Group
Enpalo
Good Energy, LP
Green Mountain Energy Company
Juice Energy
Maine Interfaith Power & Light
Massachusetts Energy Consumers Alliance (Mass Energy)
*Native*Energy
Pacific Gas and Electric Company
Premier Energy Marketing
Renewable Choice Energy
SKY energy, Inc.
Sterling Planet, Inc.
Village Green Energy
Waverly Light and Power
WindCurrent
WindStreet Energy

Certificate Brokers

3 Phases Renewables
Amerex Brokers
Cantor Fitzgerald
Environmental Brokerage

Active Commercial & / or Wholesale Marketers

3Degrees
3 Phases Renewables
Amerex Brokers
Aquila
Basin Electric Power Cooperative
BlueStar Energy Services
Bonneville Environmental Foundation
Bonneville Power Administration (BPA)
BP Energy Company
Brookfield Renewable Power
Calpine Corporation
Carbonfund.org
Carbon Solutions Group
Centennial Energy Resources
Clean Currents
Clear Energy Brokerage & Consulting
Clear Sky Power
ComEd
Community Energy Inc.
Conservation Services Group
Constellation NewEnergy
Element Markets
Empire District Electric Company
Endless Energy Corporation
Enpalo
Exelon Power Team
FirstEnergy Solutions Corporation

Chicago Climate Exchange
Clear Energy Brokerage & Consulting
Element Markets
Emission Credit Brokers
Evolution Markets
GFI Group
Good Energy, LP
GT Energy
Natsource
TFS Energy
Tullett Prebon

Consumer Protection / REC Tracking Systems

APX, Inc.
Clean Power Markets, Inc.
Environmental Resources Trust
Federal Trade Commission
Gold Standard Foundation
Green-e TRC Certification
Michigan Independent Power Producers Association
Western Renewable Energy Generation Information System

Inactive

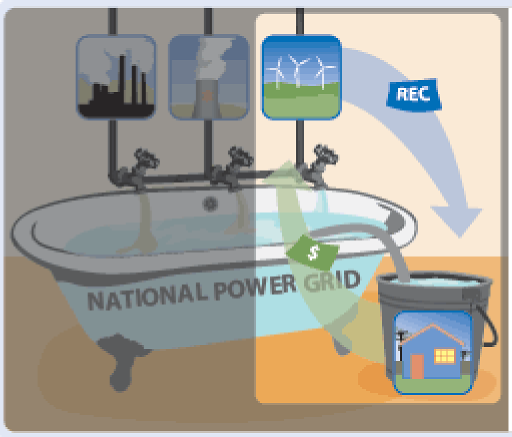
Big Green Energy
Burlington Electric Department
Clean and Green
Connecticut Energy Cooperative
EAD Environmental (Natsource)
Los Angeles Department of Water and Power
National Energy and Gas Transmission
Navitas Energy
FPL Energy
Good Energy, LP
Green Mountain Energy Company
Hess Energy
Juice Energy
Liberty Power
Maine Interfaith Power & Light
Mainstay Energy
Massachusetts Energy Consumers Alliance (Mass Energy)
MidAmerican Energy
MotivEarth
*Native*Energy
Neuwing Energy Ventures
Nexant Clean Energy Solutions
Old Mill Power Company
Pacific Renewables
Peoples Energy Services
PowerLight
PPL Corporation
PPM Energy
Premier Energy Marketing
Premier Power Solutions
QVINTA, Inc.
Reliant Energy
Renewable Choice Energy
Select Energy
Sempra Energy Solutions
Shell Trading
SKY energy, Inc.
Sol Systems
Spartan Renewable Energy
Sterling Planet, Inc.
Strategic Energy
SUEZ Energy Resources NA
SunEdison
Sun Farm Ventures, Inc.
TFS Energy
Tradition Energy
Tullett Prebon
TXU Energy
Unicoi Energy Services
Viking Wind Partners, LLC
Village Green Energy
Vision Quest
Waste Management
Waverly Light and Power
Western Area Power Administration
WindCurrent
WindQuest Energy, Inc.
WindStreet Energy

How Renewable Energy Credits Work

The United States power grid is like a big bathtub filled with electrons. Power generators of all types dump their electricity into this bathtub.

Since seventy percent of these electrons come from burning fossil fuels, this "water" is pretty dirty.

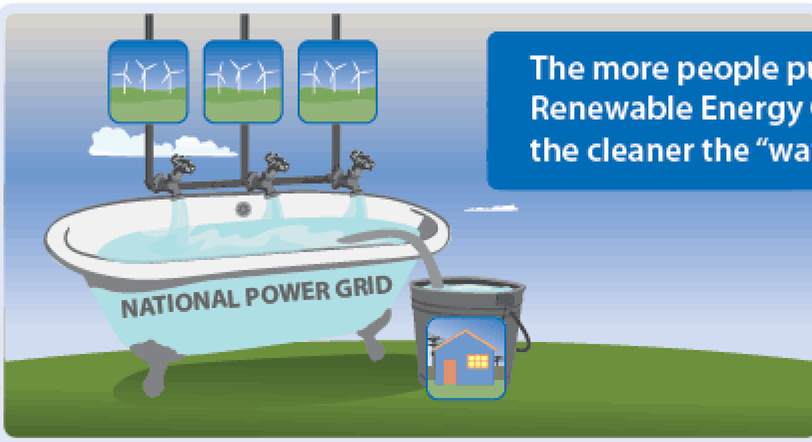
We all draw electricity from this bathtub, so we can't help but consume a lot of "dirty water".



Renewable energy producers generate Renewable Energy Credits every time they generate electricity.

Renewable Choice Energy sells these credits on behalf of the renewable energy producers.

Purchasing Renewable Energy Credits allows consumers to guarantee the electricity they consume is replaced by clean power.



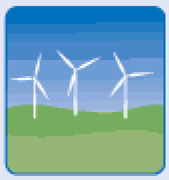
The more people purchase Renewable Energy Credits, the cleaner the "water" gets!

There are two ways to buy renewable energy in the United States:

A

Install renewable energy onsite (e.g. solar panels)

B



Fund renewable generation on the electric power system (e.g. Renewable Energy Credits)

Many large companies, government institutions, non-profit organizations, educational institutions and individuals pursue Option B because they can:

- Purchase renewable energy for multiple facilities in one transaction
- Encourage renewable energy development wherever it is most practical
- Support multiple renewable energy projects/technologies
- Support efficient, large-scale projects
- Receive a fixed price for multi-year commitments
- Rely on independent tracking, auditing, and verification
- Guarantee measurable emission reductions

A few of the leading environmental non-profit organizations that support Renewable Energy Credit purchasing:

Union of Concerned Scientists, World Resources Institute, The Nature Conservancy, NRDC, Environmental Defense, Sierra Club, The Pew Charitable Trusts

A few of the organizations purchasing Renewable Energy Credits today:

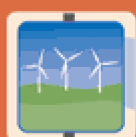
NFL, Starbucks Coffee, Harvard, Bank of America, Department of Energy, Department of the Air Force, Whole Foods, Vail Resorts, FedEx Kinko's, Pepsi

Did you know…

Renewable Energy Credits are the accepted way to track renewable energy generation in the United States.

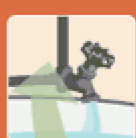
All regional power systems (including WREGIS, ERCOT, NEPOOL) rely on Renewable Energy Credits.

State-mandated renewable energy programs rely on Renewable Energy Credits.



Twenty-four states plus the District of Columbia now use RECs to promote renewable energy development.

Federal legislation will likely include Renewable Energy Credits.



In August 2007, the U.S. House of Representatives passed legislation (Roll Call No. 827) requiring that 15 percent of electricity come from renewable energy by the year 2020.

A Carbon Reduction Tool

Purchasing RECs is the widely accepted way to address electricity consumption in your environmental foot- print. Leading organizations, including the Environmental Protection Agency and the World Resources Institute, advise companies and people looking to offset pollution caused by their electricity consumption to buy Renewable Energy Credits.

WORLD RESOURCES INSTITUTE

Verified, Certified, Audited

Green-e, a widely respected non-profit pro- gram, verifies and certifies corporate and residential Renewable Energy Credit purchases. A large number of stakeholders worked to create Green-e which champions the highest environmental certifica- tion standard available. Green-e also audits voluntary transactions, guar- anteeing every credit comes from an environmentally sound project that does not benefit from government regulations.

Renewable Energy Property Tax Exemption

DSIRE
Database of State Incentives for Renewables & Efficiency

U.S. Department of Energy Energy Efficiency and Renewable Energy
North Carolina Solar Center
IREC

6/3/09

Federal
Incentives/Policies for Renewables & Efficiency

Renewable Electricity Production Tax Credit (PTC)

Last DSIRE Review: 02/19/2009

Incentive Type: Corporate Tax Credit

Eligible Renewable/Other Technologies: Landfill Gas, Wind, Biomass, Hydroelectric, Geothermal Electric, Municipal Solid Waste, Hydrokinetic Power (i.e., Flowing Water), Anaerobic Digestion, Small Hydroelectric, Tidal Energy, Wave Energy, Ocean Thermal

Applicable Sectors: Commercial, Industrial

Amount: 2.1¢/kWh for wind, geothermal, closed-loop biomass; 1.0¢/kWh for other eligible technologies. Generally applies to first 10 years of operation.

Eligible System Size: Marine and Hydrokinetic: Minimum capacity of 150 kW
Agricultural Livestock Waste: Minimum capacity of 150 kW

Web Site: http://www.irs.gov/pub/irs-pdf/f8835.pdf

Authority 1: 26 USC § 45

Date Enacted: 1992

Summary:
Note: The American Recovery and Reinvestment Act of 2009 (H.R. 1) allows taxpayers eligible for the federal renewable electricity production tax credit (PTC) to take the federal business energy investment tax credit (ITC) or to receive a grant from the U.S. Treasury Department instead of taking the PTC for new installations. The new law also allows taxpayers eligible for the business ITC to receive a grant from the U.S. Treasury Department instead of taking the business ITC for new installations.

The federal renewable electricity production tax credit (PTC) is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources and sold by the taxpayer to an unrelated person during the taxable year. Originally enacted in 1992, the PTC has been renewed and expanded numerous times, most recently by H.R. 1424 (Div. B, Sec. 101 & 102) in October 2008 and again by H.R. 1 (Div. B, Section 1101 &1102) in February 2009.

The October 2008 legislation extended the in-service deadlines for all qualifying renewable technologies; expanded the list of qualifying resources to include marine and hydrokinetic resources, such as wave, tidal, current and ocean thermal; and made changes to the definitions of several qualifying resources and facilities. The effective dates of these changes vary. Marine and hydrokinetic energy production is eligible as of the date the legislation was enacted (October 3, 2008), as is the incremental energy production associated with expansions of biomass facilities. A change in the definition of "trash facility" no longer requires that such facilities burn trash, and is also effective immediately. One further provision redefining the term "non-hydroelectric dam," took effect December 31, 2008.

The February 2009 legislation revised the credit by: (1) extending the in-service deadline for most eligible technologies by three years (two years for marine and hydrokinetic resources); and (2) allowing facilities that qualify for the PTC to opt instead to take the federal business energy investment credit (ITC) or an equivalent cash grant from the U.S. Department of Treasury. The ITC or grant for PTC-eligible technologies is generally equal to 30% of eligible costs.*

The tax credit amount is 1.5¢/kWh in 1993 dollars (indexed for inflation) for some technologies, and half of that amount for others. The rules governing the PTC vary by resource and facility type. The table below outlines two of the most important characteristics of the tax credit -- in-service deadline and credit amount -- as they apply to different facilities. The table includes changes made by H.R. 1, in February 2009, and the inflation-adjusted credit amounts are current for the 2008 tax year. (See the history section below for information on prior rules.)

Resource Type	In-Service Deadline	Credit Amount
Wind	December 31, 2012	2.1¢/kWh
Closed-Loop Biomass	December 31, 2013	2.1¢/kWh

Open-Loop Biomass	December 31, 2013	1.0¢/kWh
Geothermal Energy	December 31, 2013	2.1¢/kWh
Landfill Gas	December 31, 2013	1.0¢/kWh
Municipal Solid Waste	December 31, 2013	1.0¢/kWh
Qualified Hydroelectric	December 31, 2013	1.0¢/kWh
Marine and Hydrokinetic (150 kW or larger)**	December 31, 2013	1.0¢/kWh

The duration of the credit is generally 10 years after the date the facility is placed in service, but there are two exceptions:

- Open-loop biomass, geothermal, small irrigation hydro, landfill gas and municipal solid waste combustion facilities placed into service after October 22, 2004, and before enactment of the *Energy Policy Act of 2005*, on August 8, 2005, are only eligible for the credit for a five-year period.
- Open-loop biomass facilities placed in service before October 22, 2004, are eligible for a five-year period beginning January 1, 2005.

In addition, the tax credit is reduced for projects that receive other federal tax credits, grants, tax-exempt financing, or subsidized energy financing. The credit is claimed by completing Form 8835, "Renewable Electricity Production Credit," and Form 3800, "General Business Credit." For more information, contact IRS Telephone Assistance for Businesses at 1-800-829-4933.

History
As originally enacted by the *Energy Policy Act of 1992*, the PTC expired at the end of 2001, and was subsequently extended in March 2002 as part of the *Job Creation and Worker Assistance Act of 2002* (H.R. 3090). The PTC then expired at the end of 2003 and was not renewed until October 2004, as part of H.R. 1308, the *Working Families Tax Relief Act of 2004*, which extended the credit through December 31, 2005. The *Energy Policy Act of 2005* (H.R. 6) modified the credit and extended it through December 31, 2007. In December 2006, the PTC was extended for yet another year -- through December 31, 2008 -- by the *Tax Relief and Health Care Act of 2006* (H.R. 6111).

The American Jobs Creation Act of 2004 (H.R. 4520), expanded the PTC to include additional eligible resources -- geothermal energy, open-loop biomass, solar energy, small irrigation power, landfill gas and municipal solid waste combustion -- in addition to the formerly eligible wind energy, closed-loop biomass, and poultry-waste energy resources. The *Energy Policy Act of 2005* (EPAct 2005) further expanded the credit to certain hydropower facilities. As a result of EPAct 2005, solar facilities placed into service after December 31, 2005, are no longer eligible for this incentive. Solar facilities placed in-service during the roughly one-year window in which solar was eligible are permitted to take the full credit (i.e., 2.1¢/kWh) for five years.

** Prior to H.R. 1, geothermal facilities were already eligible for a 10% tax credit under the energy ITC. It is not clear at this time if geothermal electric facilities will be eligible for a 10% tax credit, as defined by the ITC rules, or the full 30% tax credit now available for PTC eligible technologies in general.*

*** H.R. 1424 added marine and hydrokinetic energy as eligible resources and removed "small irrigation power" as an eligible resource effective October 3, 2008. However, the definition of marine and hydrokinetic energy encompasses the resources that would have formerly been defined as small irrigation power facilities. Thus H.R. 1424 effectively extended the in-service deadline for small irrigation power facilities by 3 years, from the end of 2008 until the end of 2011 (since extended again through 2013).*

Contact:

Public Information - IRS
U.S. Internal Revenue Service
1111 Constitution Avenue, N.W.
Washington, DC 20224
Phone: (800) 829-1040
Web Site: http://www.irs.gov

APPENDIX F
Sources

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SOFTWARE:

(1) RETScreen® International – Clean Energy Project Analysis Software; Version 3.2

(2) Google™ Earth©2006

WIND TURBINE PRODUCT BROCHURES:

(3) Vestas V-82 1.65 megawatt
Vestas Wind Systems A/S
Alsvej 21
8900 Randers
Denmark
Tel. +45 97 30 00 00
Fax +45 97 30 00 01
vestas@vestas.com
www.vestas.com

(4) AAER A-1500 kW & A-1650 wind turbine
AAER Wind Energy™
AAER USA
4801 Woodway Drive
Suite 300 East
Houston, Texas 77056
Tel.: (866) -448 -5155
Fax: (866)-265-1045
info@aaer.ca
www.aaer.ca

(5) Gamesa G80 Wind Turbine
Gamesa Corporación Tecnológica **S.A.**
Ramón y Cajal 7-9
01007 Vitoria, Álava
Call Center: 902734949 (España)
Call Center: (+34) 944037352 (Calls from outside Spain)

MAPS:

(6) TrueWind Solutions. Wind Power Map of New England – Predicted Power Density at a Height of 50 meters Above Surface. http://www.mtcp.org/

(7) AWS Truewind, LLC. AWS Truewind. www.awstruewind.com

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(8) Massachusetts Technology Collaborative.
75 North Drive
Westborough, MA 01581
Phone: (508) 870-0312
Fax: (508) 898-2275
© 1995 - 2008 Massachusetts Technology Collaborative
mtc@masstech.org

(9) AMERICAN WIND ENERGY ASSOCIATION®
1501 M Street, NW, Suite 1000
Washington, DC 20005
Phone: 202.383.2500
Fax: 202.383.2505
windmail@awea.org
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(10) U.S Department of Energy
Energy Efficiency and Renewable Energy
1000 Independence Ave., SW
Washington, DC 20585
1-800-dial-DOE | f/202-586-4403
www.energy.gov