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RETScreen® International

Clean Energy Project Analysis Software

Wind Energy Project Model

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**Clean Energy
Decision Support Centre**

www.retscreen.net


- Training & Support
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Partners



Units: Metric

Site Conditions		Estimate	Notes/Range
Project name		Scenario #1	See Online Manual
Project location		Calgary, AB	
Wind data source		Wind speed	
Nearest location for weather data		Calgary Int'l. A, AB	See Weather Database
Annual average wind speed	m/s	4.4	
Height of wind measurement	m	10.0	3.0 to 100.0 m
Wind shear exponent	-	0.15	0.10 to 0.40
Wind speed at 10 m	m/s	4.4	
Average atmospheric pressure	kPa	88.9	60.0 to 103.0 kPa
Annual average temperature	°C	4	-20 to 30 °C

System Characteristics		Estimate	Notes/Range
Grid type	-	Central-grid	
Wind turbine rated power	kW	1,000	 Complete Equipment Data sheet
Number of turbines	-	20	
Wind plant capacity	kW	20,000	
Hub height	m	45.0	6.0 to 100.0 m
Wind speed at hub height	m/s	5.5	
Array losses	%	3%	0% to 20%
Airfoil soiling and/or icing losses	%	2%	1% to 10%
Other downtime losses	%	2%	2% to 7%
Miscellaneous losses	%	3%	2% to 6%

Annual Energy Production		Estimate Per Turbine	Estimate Total	Notes/Range
Wind plant capacity	kW	1,000	20,000	
	MW	1.000	20.000	
Unadjusted energy production	MWh	1,545	30,902	
Pressure adjustment coefficient	-	0.88	0.88	0.59 to 1.02
Temperature adjustment coefficient	-	1.04	1.04	0.98 to 1.15
Gross energy production	MWh	1,414	28,282	
Losses coefficient	-	0.90	0.90	0.75 to 1.00
Specific yield	kWh/m²	556	556	150 to 1,500 kWh/m²
Wind plant capacity factor	%	15%	15%	20% to 40%
Renewable energy delivered	MWh	1,278	25,556	
	GJ	4,600	92,003	

[Complete Cost Analysis sheet](#)

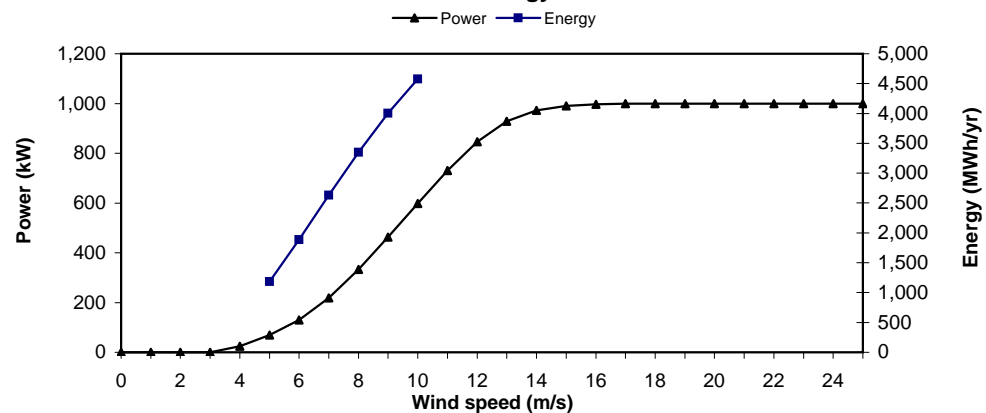
RETScreen® Equipment Data - Wind Energy Project

Wind Turbine Characteristics		Estimate	Notes/Range
Wind turbine rated power	kW	1,000	See Product Database 6.0 to 100.0 m 7 to 80 m 35 to 5,027 m²
Hub height	m	45.0	
Rotor diameter	m	54	
Swept area	m²	2,300	
Wind turbine manufacturer		Bonus Energy	Site specific
Wind turbine model		AN BONUS 1 MW	
Energy curve data source	-	User-defined	

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	-
4	24.1	-
5	69.3	1,182.0
6	130.0	1,889.0
7	219.1	2,632.0
8	333.5	3,351.0
9	463.1	4,004.0
10	598.1	4,575.0
11	730.0	-
12	846.5	-
13	928.8	-
14	972.6	-
15	990.8	-
16	997.2	-
17	999.2	-
18	999.8	-
19	999.9	-
20	1,000.0	-
21	1,000.0	-
22	1,000.0	-
23	1,000.0	-
24	1,000.0	-
25	1,000.0	-

Power and Energy Curves



[Return to Energy Model sheet](#)

Type of project: **Custom**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	6.0	\$ 800	\$ 4,800	-	-	-
Wind resource assessment	met tower	6	\$ 22,000	\$ 132,000	-	-	-
Environmental assessment	p-d	8.0	\$ 800	\$ 6,400	-	-	-
Preliminary design	p-d	18.0	\$ 800	\$ 14,400	-	-	-
Detailed cost estimate	p-d	18.0	\$ 800	\$ 14,400	-	-	-
GHG baseline study and MP	project			\$ -	-	-	-
Report preparation	p-d	8.0	\$ 800	\$ 6,400	-	-	-
Project management	p-d	6.0	\$ 800	\$ 4,800	-	-	-
Travel and accommodation	p-trip	4	\$ 3,000	\$ 12,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 195,200	0.6%		
Development							
PPA negotiation	p-d	20.0	\$ 1,200	\$ 24,000	-	-	-
Permits and approvals	p-d	250.0	\$ 800	\$ 200,000	-	-	-
Land rights	project	1	\$ 30,000	\$ 30,000	-	-	-
Land survey	p-d	50.0	\$ 600	\$ 30,000	-	-	-
GHG validation and registration	project			\$ -	-	-	-
Project financing	p-d	100.0	\$ 1,500	\$ 150,000	-	-	-
Legal and accounting	p-d	100.0	\$ 1,200	\$ 120,000	-	-	-
Project management	p-yr	1.25	\$ 130,000	\$ 162,500	-	-	-
Travel and accommodation	p-trip	18	\$ 3,000	\$ 54,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 770,500	2.2%		
Engineering							
Wind turbine(s) micro-siting	p-d	175.0	\$ 800	\$ 140,000	-	-	-
Mechanical design	p-d	100.0	\$ 800	\$ 80,000	-	-	-
Electrical design	p-d	150.0	\$ 800	\$ 120,000	-	-	-
Civil design	p-d	90.0	\$ 800	\$ 72,000	-	-	-
Tenders and contracting	p-d	110.0	\$ 800	\$ 88,000	-	-	-
Construction supervision	p-yr	0.85	\$ 130,000	\$ 110,500	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 610,500	1.8%		
Energy Equipment							
Wind turbine(s)	kW	20,000	\$ 1,200	\$ 24,000,000	-	-	-
Spare parts	%	1.0%	\$ 24,000,000	\$ 240,000	-	-	-
Transportation	turbine	20	\$ 33,000	\$ 660,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 24,900,000	71.6%		
Balance of Plant							
Wind turbine(s) foundation(s)	turbine	20	\$ 78,000	\$ 1,560,000	-	-	-
Wind turbine(s) erection	turbine	20	\$ 52,000	\$ 1,040,000	-	-	-
Road construction	km	3.00	\$ 50,000	\$ 150,000	-	-	-
Transmission line	km	8.50	\$ 70,000	\$ 595,000	-	-	-
Substation	project	1	\$ 2,055,000	\$ 2,055,000	-	-	-
Control and O&M building(s)	building	1	\$ 125,000	\$ 125,000	-	-	-
Transportation	project	1	\$ 68,000	\$ 68,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 5,593,000	16.1%		
Miscellaneous							
Training	p-d	40.0	\$ 800	\$ 32,000	-	-	-
Commissioning	p-d	50.0	\$ 800	\$ 40,000	-	-	-
Contingencies	%	5%	\$ 32,141,200	\$ 1,607,060	-	-	-
Interest during construction	6.0%	12 month(s)	\$ 33,748,260	\$ 1,012,448	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 2,691,508	7.7%		
Initial Costs - Total				\$ 34,760,708	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Land lease	project	1	\$ 57,000	\$ 57,000	-	-	-
Property taxes	project	1	\$ 23,000	\$ 23,000	-	-	-
Insurance premium	project	1	\$ 46,000	\$ 46,000	-	-	-
Transmission line maintenance	%	3.0%	\$ 2,650,000	\$ 79,500	-	-	-
Parts and labour	kWh	25,556,461	\$ 0.008	\$ 204,452	-	-	-
GHG monitoring and verification	project			\$ -	-	-	-
Community benefits	-	1	\$ 15,000	\$ 15,000	-	-	-
Travel and accommodation	p-trip	12	\$ 3,000	\$ 36,000	-	-	-
General and administrative	%	6%	\$ 460,952	\$ 27,657	-	-	-
				\$ -	-	-	-
Contingencies	%	10%	\$ 488,609	\$ 48,861	-	-	-
Annual Costs - Total				\$ 537,470	100.0%		

Periodic Costs (Credits)	Period	Unit Cost	Amount	Interval Range	Unit Cost Range
Drive train	Cost	10 yr	\$ 1,000,000	\$ 1,000,000	-
Blades	Cost	15 yr	\$ 1,000,000	\$ 1,000,000	-
			\$ -	-	-
End of project life	Credit	-	\$ -	-	-

[Go to GHG Analysis sheet](#)

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

Use GHG analysis sheet?
 Potential CDM project?

Type of analysis:

Background Information

Project Information		Global Warming Potential of GHG	
Project name	Scenario #1	20.0 MW	21 tonnes CO ₂ = 1 tonne CH ₄ (IPCC 1996)
Project location	Calgary, AB	Central-grid	310 tonnes CO ₂ = 1 tonne N ₂ O (IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO ₂ emission factor (kg/GJ)	CH ₄ emission factor (kg/GJ)	N ₂ O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (tCO ₂ /MWh)
Coal	100.0%	94.6	0.0020	0.0030	35.0%	8.0%	1.069
Electricity mix	100%	293.8	0.0062	0.0093		8.0%	1.069

Does baseline change during project life?

Proposed Case Electricity System (Wind Energy Project)

Fuel type	Fuel mix (%)	CO ₂ emission factor (kg/GJ)	CH ₄ emission factor (kg/GJ)	N ₂ O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (tCO ₂ /MWh)
Electricity system							
Wind	100.0%	0.0	0.0000	0.0000	100.0%	8.0%	0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (tCO ₂ /MWh)	Proposed case GHG emission factor (tCO ₂ /MWh)	End-use annual energy delivered (MWh)	Gross annual GHG emission reduction (tCO ₂)	GHG credits transaction fee (%)	Net annual GHG emission reduction (tCO ₂)
Electricity system	1.069	0.000	23,512	25,123	0.0%	25,123

[Complete Financial Summary sheet](#)

RETScreen® Financial Summary - Wind Energy Project

Annual Energy Balance					
Project name		Scenario #1			
Project location		Calgary, AB			
Renewable energy delivered	MWh	25,556	Net GHG reduction	t _{CO2} /yr	25,123
Excess RE available	MWh	-			
Firm RE capacity	kW	-			
Grid type		Central-grid	Net GHG emission reduction - 25 yrs	t _{CO2}	628,067

Financial Parameters					
Avoided cost of energy	\$/kWh	0.0450	Debt ratio	%	70.0%
RE production credit	\$/kWh	-	Debt interest rate	%	8.5%
			Debt term	yr	10
GHG emission reduction credit	\$/t _{CO2}	-	Income tax analysis?	yes/no	No
Energy cost escalation rate	%	3.0%			
Inflation	%	2.5%			
Discount rate	%	9.0%			
Project life	yr	25			

Project Costs and Savings					
Initial Costs			Annual Costs and Debt		
Feasibility study	0.6%	\$ 195,200	O&M	\$	537,470
Development	2.2%	\$ 770,500			
Engineering	1.8%	\$ 610,500	Debt payments - 10 yrs	\$	3,708,460
Energy equipment	71.6%	\$ 24,900,000	Annual Costs and Debt - Total	\$	4,245,929
Balance of plant	16.1%	\$ 5,593,000			
Miscellaneous	7.7%	\$ 2,691,508	Annual Savings or Income		
Initial Costs - Total	100.0%	\$ 34,760,708	Energy savings/income	\$	1,150,041
Incentives/Grants		\$ -	Capacity savings/income	\$	-
			Annual Savings - Total	\$	1,150,041
Periodic Costs (Credits)					
Drive train	\$	1,000,000	Schedule yr # 10,20		
Blades	\$	1,000,000	Schedule yr # 15		
	\$	-			
End of project life - Credit	\$	-			

Financial Feasibility					
Pre-tax IRR and ROI	%	-7.1%	Calculate energy production cost?	yes/no	No
After-tax IRR and ROI	%	-7.1%	Calculate GHG reduction cost?	yes/no	No
Simple Payback	yr	56.7			
Year-to-positive cash flow	yr	more than 25	Project equity	\$	10,428,212
Net Present Value - NPV	\$	(27,163,120)	Project debt	\$	24,332,495
Annual Life Cycle Savings	\$	(2,765,375)	Debt payments	\$/yr	3,708,460
Benefit-Cost (B-C) ratio	-	(1.60)	Debt service coverage	-	(0.11)

Yearly Cash Flows			
Year #	Pre-tax \$	After-tax \$	Cumulative \$
0	(10,428,212)	(10,428,212)	(10,428,212)
1	(3,074,824)	(3,074,824)	(13,503,037)
2	(3,053,061)	(3,053,061)	(16,556,097)
3	(3,030,575)	(3,030,575)	(19,586,672)
4	(3,007,345)	(3,007,345)	(22,594,017)
5	(2,983,345)	(2,983,345)	(25,577,362)
6	(2,958,551)	(2,958,551)	(28,535,913)
7	(2,932,937)	(2,932,937)	(31,468,850)
8	(2,906,477)	(2,906,477)	(34,375,328)
9	(2,879,143)	(2,879,143)	(37,254,471)
10	(4,130,992)	(4,130,992)	(41,385,463)
11	886,719	886,719	(40,498,745)
12	916,846	916,846	(39,581,899)
13	947,966	947,966	(38,633,933)
14	980,109	980,109	(37,653,824)
15	(434,988)	(434,988)	(38,088,812)
16	1,047,601	1,047,601	(37,041,211)
17	1,083,018	1,083,018	(35,958,192)
18	1,119,598	1,119,598	(34,838,594)
19	1,157,377	1,157,377	(33,681,217)
20	(442,222)	(442,222)	(34,123,438)
21	1,236,690	1,236,690	(32,886,748)
22	1,278,305	1,278,305	(31,608,443)
23	1,321,280	1,321,280	(30,287,163)
24	1,365,661	1,365,661	(28,921,503)
25	1,411,491	1,411,491	(27,510,011)

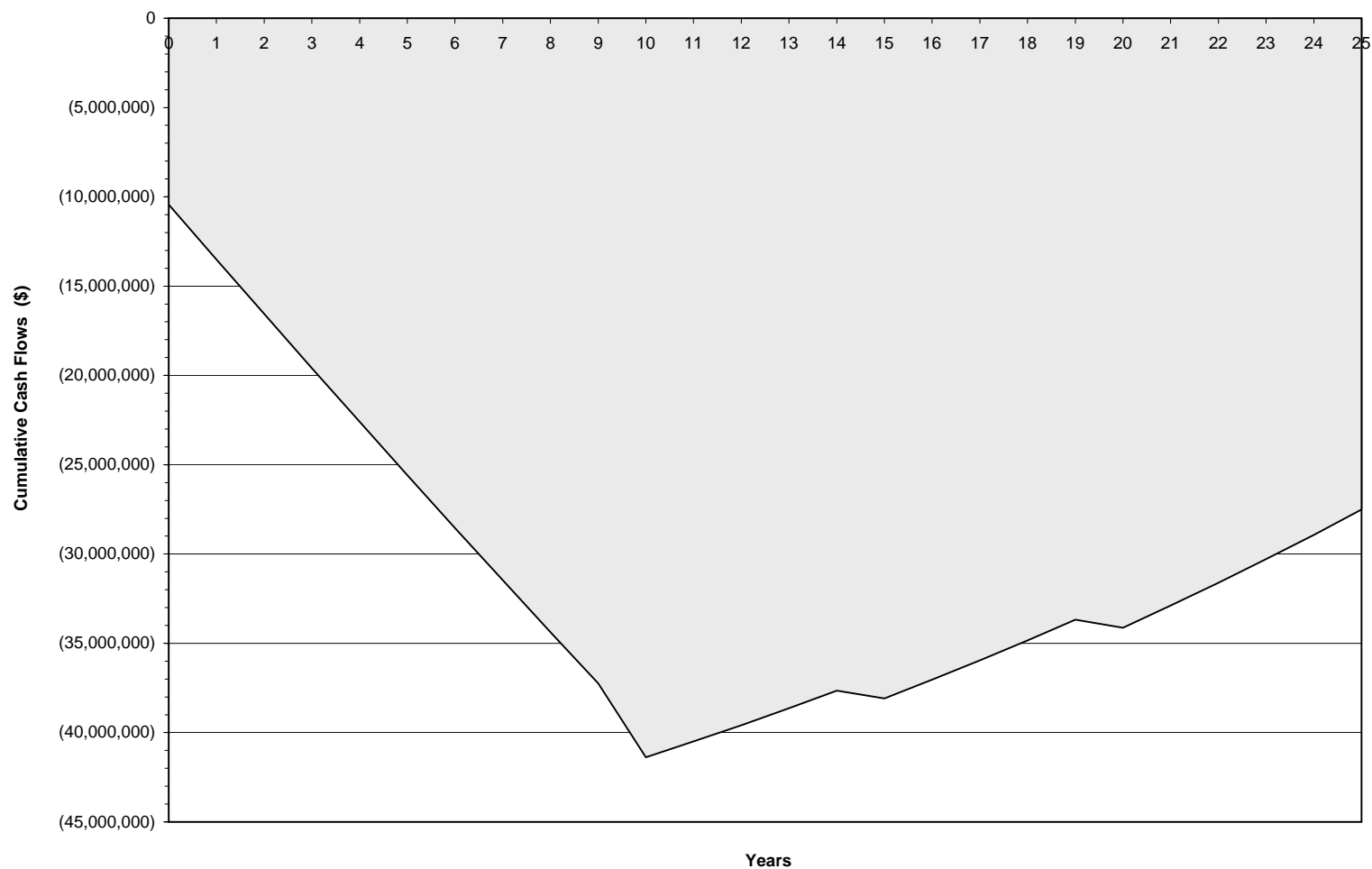
Cumulative Cash Flows Graph

Wind Energy Project Cumulative Cash Flows Scenario #1, Calgary, AB

Renewable energy delivered (MWh/yr): 25,556

Total Initial Costs: \$ 34,760,708

Net GHG emissions reduced (tCO₂/yr): 25,123



Year-to-positive cash flow: more than 25 yr

Net Present Value: \$ -27,163,120



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Partners




Version 3.0

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NRCan/CETC - Varennes

Units: **Metric**

Site Conditions		Estimate	Notes/Range
Project name		Scenario #2	See Online Manual
Project location		Pincher Creek, AB	
Wind data source		Wind speed	
Nearest location for weather data		Lethbridge A, AB	See Weather Database
Annual average wind speed	m/s	7.0	
Height of wind measurement	m	10.0	3.0 to 100.0 m
Wind shear exponent	-	0.15	0.10 to 0.40
Wind speed at 10 m	m/s	7.0	
Average atmospheric pressure	kPa	90.7	60.0 to 103.0 kPa
Annual average temperature	°C	6	-20 to 30 °C

System Characteristics		Estimate	Notes/Range
Grid type	-	Central-grid	
Wind turbine rated power	kW	1,000	 Complete Equipment Data sheet
Number of turbines	-	20	
Wind plant capacity	kW	20,000	
Hub height	m	45.0	6.0 to 100.0 m
Wind speed at hub height	m/s	8.8	
Array losses	%	3%	0% to 20%
Airfoil soiling and/or icing losses	%	2%	1% to 10%
Other downtime losses	%	2%	2% to 7%
Miscellaneous losses	%	3%	2% to 6%

Annual Energy Production		Estimate Per Turbine	Estimate Total	Notes/Range
Wind plant capacity	kW	1,000	20,000	
	MW	1.000	20.000	
Unadjusted energy production	MWh	3,855	77,097	
Pressure adjustment coefficient	-	0.90	0.90	0.59 to 1.02
Temperature adjustment coefficient	-	1.03	1.03	0.98 to 1.15
Gross energy production	MWh	3,573	71,469	
Losses coefficient	-	0.90	0.90	0.75 to 1.00
Specific yield	kWh/m²	1,404	1,404	150 to 1,500 kWh/m²
Wind plant capacity factor	%	37%	37%	20% to 40%
Renewable energy delivered	MWh	3,229	64,583	
	GJ	11,625	232,497	

[Complete Cost Analysis sheet](#)

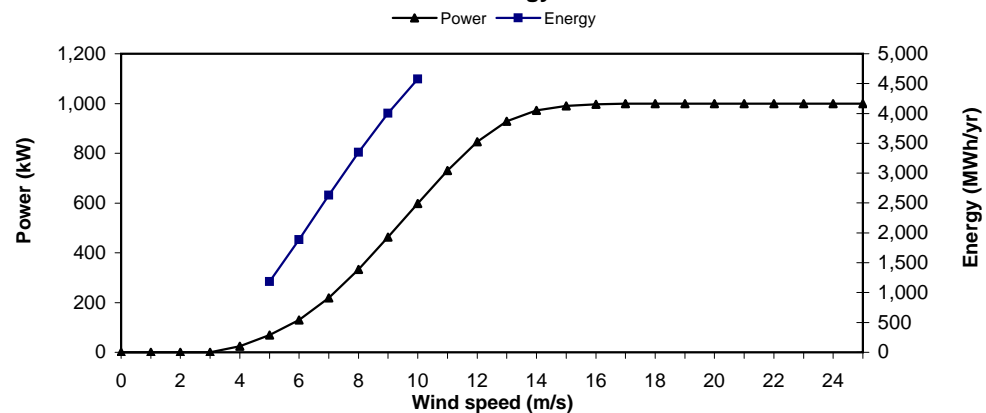
RETScreen® Equipment Data - Wind Energy Project

Wind Turbine Characteristics		Estimate	Notes/Range
Wind turbine rated power	kW	1,000	See Product Database 6.0 to 100.0 m 7 to 80 m 35 to 5,027 m²
Hub height	m	45.0	
Rotor diameter	m	54	
Swept area	m²	2,300	
Wind turbine manufacturer		Bonus Energy	Site specific
Wind turbine model		AN BONUS 1 MW	
Energy curve data source	-	User-defined	

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	-
4	24.1	-
5	69.3	1,182.0
6	130.0	1,889.0
7	219.1	2,632.0
8	333.5	3,351.0
9	463.1	4,004.0
10	598.1	4,575.0
11	730.0	-
12	846.5	-
13	928.8	-
14	972.6	-
15	990.8	-
16	997.2	-
17	999.2	-
18	999.8	-
19	999.9	-
20	1,000.0	-
21	1,000.0	-
22	1,000.0	-
23	1,000.0	-
24	1,000.0	-
25	1,000.0	-

Power and Energy Curves



[Return to Energy Model sheet](#)

Type of project: **Custom**

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	6.0	\$ 800	\$ 4,800	-	-	-
Wind resource assessment	met tower	6	\$ 22,000	\$ 132,000	-	-	-
Environmental assessment	p-d	8.0	\$ 800	\$ 6,400	-	-	-
Preliminary design	p-d	18.0	\$ 800	\$ 14,400	-	-	-
Detailed cost estimate	p-d	18.0	\$ 800	\$ 14,400	-	-	-
GHG baseline study and MP	project			\$ -	-	-	-
Report preparation	p-d	8.0	\$ 800	\$ 6,400	-	-	-
Project management	p-d	6.0	\$ 800	\$ 4,800	-	-	-
Travel and accommodation	p-trip	4	\$ 3,000	\$ 12,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 195,200	0.6%		
Development							
PPA negotiation	p-d	20.0	\$ 1,200	\$ 24,000	-	-	-
Permits and approvals	p-d	250.0	\$ 800	\$ 200,000	-	-	-
Land rights	project	1	\$ 30,000	\$ 30,000	-	-	-
Land survey	p-d	50.0	\$ 600	\$ 30,000	-	-	-
GHG validation and registration	project			\$ -	-	-	-
Project financing	p-d	100.0	\$ 1,500	\$ 150,000	-	-	-
Legal and accounting	p-d	100.0	\$ 1,200	\$ 120,000	-	-	-
Project management	p-yr	1.25	\$ 130,000	\$ 162,500	-	-	-
Travel and accommodation	p-trip	18	\$ 3,000	\$ 54,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 770,500	2.5%		
Engineering							
Wind turbine(s) micro-siting	p-d	175.0	\$ 800	\$ 140,000	-	-	-
Mechanical design	p-d	100.0	\$ 800	\$ 80,000	-	-	-
Electrical design	p-d	150.0	\$ 800	\$ 120,000	-	-	-
Civil design	p-d	90.0	\$ 800	\$ 72,000	-	-	-
Tenders and contracting	p-d	110.0	\$ 800	\$ 88,000	-	-	-
Construction supervision	p-yr	0.85	\$ 130,000	\$ 110,500	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 610,500	2.0%		
Energy Equipment							
Wind turbine(s)	kW	20,000	\$ 1,000	\$ 20,000,000	-	-	-
Spare parts	%	1.0%	\$ 20,000,000	\$ 200,000	-	-	-
Transportation	turbine	20	\$ 33,000	\$ 660,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 20,860,000	68.6%		
Balance of Plant							
Wind turbine(s) foundation(s)	turbine	20	\$ 78,000	\$ 1,560,000	-	-	-
Wind turbine(s) erection	turbine	20	\$ 52,000	\$ 1,040,000	-	-	-
Road construction	km	3.00	\$ 50,000	\$ 150,000	-	-	-
Transmission line	km	8.50	\$ 70,000	\$ 595,000	-	-	-
Substation	project	1	\$ 2,055,000	\$ 2,055,000	-	-	-
Control and O&M building(s)	building	1	\$ 125,000	\$ 125,000	-	-	-
Transportation	project	1	\$ 68,000	\$ 68,000	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 5,593,000	18.4%		
Miscellaneous							
Training	p-d	40.0	\$ 800	\$ 32,000	-	-	-
Commissioning	p-d	50.0	\$ 800	\$ 40,000	-	-	-
Contingencies	%	5%	\$ 28,101,200	\$ 1,405,060	-	-	-
Interest during construction	6.0%	12 month(s)	\$ 29,506,260	\$ 885,188	-	-	-
				\$ -	-	-	-
Sub-total:				\$ 2,362,248	7.8%		
Initial Costs - Total				\$ 30,391,448	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Land lease	project	1	\$ 57,000	\$ 57,000	-	-	-
Property taxes	project	1	\$ 23,000	\$ 23,000	-	-	-
Insurance premium	project	1	\$ 46,000	\$ 46,000	-	-	-
Transmission line maintenance	%	3.0%	\$ 2,650,000	\$ 79,500	-	-	-
Parts and labour	kWh	64,582,523	\$ 0.008	\$ 516,660	-	-	-
GHG monitoring and verification	project			\$ -	-	-	-
Community benefits	-	1	\$ 15,000	\$ 15,000	-	-	-
Travel and accommodation	p-trip	12	\$ 3,000	\$ 36,000	-	-	-
General and administrative	%	6%	\$ 773,160	\$ 46,390	-	-	-
				\$ -	-	-	-
Contingencies	%	10%	\$ 819,550	\$ 81,955	-	-	-
Annual Costs - Total				\$ 901,505	100.0%		

Periodic Costs (Credits)	Period	Unit Cost	Amount	Interval Range	Unit Cost Range
Drive train	Cost	10 yr	\$ 1,000,000	\$ 1,000,000	-
Blades	Cost	15 yr	\$ 1,000,000	\$ 1,000,000	-
			\$ -	-	-
End of project life	Credit	-	\$ -	-	-

[Go to GHG Analysis sheet](#)

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

Use GHG analysis sheet?
 Potential CDM project?

Type of analysis:

Background Information

Project Information			Global Warming Potential of GHG		
Project name	Scenario #2	Project capacity	20.0 MW	21 tonnes CO ₂ = 1 tonne CH ₄	(IPCC 1996)
Project location	Pincher Creek, AB	Grid type	Central-grid	310 tonnes CO ₂ = 1 tonne N ₂ O	(IPCC 1996)

Base Case Electricity System (Baseline)

Fuel type	Fuel mix (%)	CO ₂ emission factor (kg/GJ)	CH ₄ emission factor (kg/GJ)	N ₂ O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (tCO ₂ /MWh)
Coal	100.0%	94.6	0.0020	0.0030	35.0%	8.0%	1.069
Electricity mix	100%	293.8	0.0062	0.0093		8.0%	1.069

Does baseline change during project life?

Proposed Case Electricity System (Wind Energy Project)

Fuel type	Fuel mix (%)	CO ₂ emission factor (kg/GJ)	CH ₄ emission factor (kg/GJ)	N ₂ O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (tCO ₂ /MWh)
Electricity system							
Wind	100.0%	0.0	0.0000	0.0000	100.0%	8.0%	0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (tCO ₂ /MWh)	Proposed case GHG emission factor (tCO ₂ /MWh)	End-use annual energy delivered (MWh)	Gross annual GHG emission reduction (tCO ₂)	GHG credits transaction fee (%)	Net annual GHG emission reduction (tCO ₂)
Electricity system	1.069	0.000	59,416	63,486	0.0%	63,486

[Complete Financial Summary sheet](#)

RETScreen® Financial Summary - Wind Energy Project
Annual Energy Balance

Project name	Scenario #2				
Project location	Pincher Creek, AB				
Renewable energy delivered	MWh	64,583	Net GHG reduction	t _{CO2} /yr	63,486
Excess RE available	MWh	-			
Firm RE capacity	kW	-			
Grid type	Central-grid				
			Net GHG emission reduction - 25 yrs	t _{CO2}	1,587,158

Financial Parameters

Avoided cost of energy	\$/kWh	0.0450	Debt ratio	%	70.0%
RE production credit	\$/kWh	0.025	Debt interest rate	%	8.5%
RE production credit duration	yr	25	Debt term	yr	15
RE credit escalation rate	%	2.5%			
GHG emission reduction credit	\$/t _{CO2}	5.0	Income tax analysis?	yes/no	No
GHG reduction credit duration	yr	25			
GHG credit escalation rate	%	2.5%			
Energy cost escalation rate	%	3.0%			
Inflation	%	2.5%			
Discount rate	%	9.0%			
Project life	yr	25			

Project Costs and Savings

Initial Costs			Annual Costs and Debt		
Feasibility study	0.6%	\$ 195,200	O&M	\$	901,505
Development	2.5%	\$ 770,500			
Engineering	2.0%	\$ 610,500	Debt payments - 15 yrs	\$	2,561,827
Energy equipment	68.6%	\$ 20,860,000	Annual Costs and Debt - Total	\$	3,463,331
Balance of plant	18.4%	\$ 5,593,000			
Miscellaneous	7.8%	\$ 2,362,248	Annual Savings or Income		
Initial Costs - Total	100.0%	\$ 30,391,448	Energy savings/income	\$	2,906,214
			Capacity savings/income	\$	-
Incentives/Grants	\$	-	RE production credit income - 25 yrs	\$	1,614,563
			GHG reduction income - 25 yrs	\$	317,432
			Annual Savings - Total	\$	4,838,208
Periodic Costs (Credits)					
Drive train	\$	1,000,000	Schedule yr # 10,20		
Blades	\$	1,000,000	Schedule yr # 15		
	\$	-			
End of project life - Credit	\$	-			

Financial Feasibility

			Calculate energy production cost?	yes/no	No
Pre-tax IRR and ROI	%	22.8%			
After-tax IRR and ROI	%	22.8%	Calculate GHG reduction cost?	yes/no	No
Simple Payback	yr	7.7			
Year-to-positive cash flow	yr	5.2	Project equity	\$	9,117,434
Net Present Value - NPV	\$	19,534,240	Project debt	\$	21,274,013
Annual Life Cycle Savings	\$	1,988,708	Debt payments	\$/yr	2,561,827
Benefit-Cost (B-C) ratio	-	3.14	Debt service coverage	-	1.58

Yearly Cash Flows

Year #	Pre-tax \$	After-tax \$	Cumulative \$
0	(9,117,434)	(9,117,434)	(9,117,434)
1	1,487,826	1,487,826	(7,629,609)
2	1,604,034	1,604,034	(6,025,575)
3	1,723,596	1,723,596	(4,301,979)
4	1,846,610	1,846,610	(2,455,368)
5	1,973,176	1,973,176	(482,192)
6	2,103,397	2,103,397	1,621,205
7	2,237,378	2,237,378	3,858,583
8	2,375,230	2,375,230	6,233,813
9	2,517,064	2,517,064	8,750,876
10	1,382,911	1,382,911	10,133,787
11	2,813,145	2,813,145	12,946,932
12	2,967,633	2,967,633	15,914,565
13	3,126,588	3,126,588	19,041,153
14	3,290,137	3,290,137	22,331,291
15	2,010,118	2,010,118	24,341,408
16	6,193,388	6,193,388	30,534,796
17	6,371,540	6,371,540	36,906,336
18	6,554,847	6,554,847	43,461,183
19	6,743,456	6,743,456	50,204,639
20	5,298,906	5,298,906	55,503,545
21	7,137,205	7,137,205	62,640,750
22	7,342,668	7,342,668	69,983,418
23	7,554,077	7,554,077	77,537,495
24	7,771,608	7,771,608	85,309,103
25	7,995,436	7,995,436	93,304,539

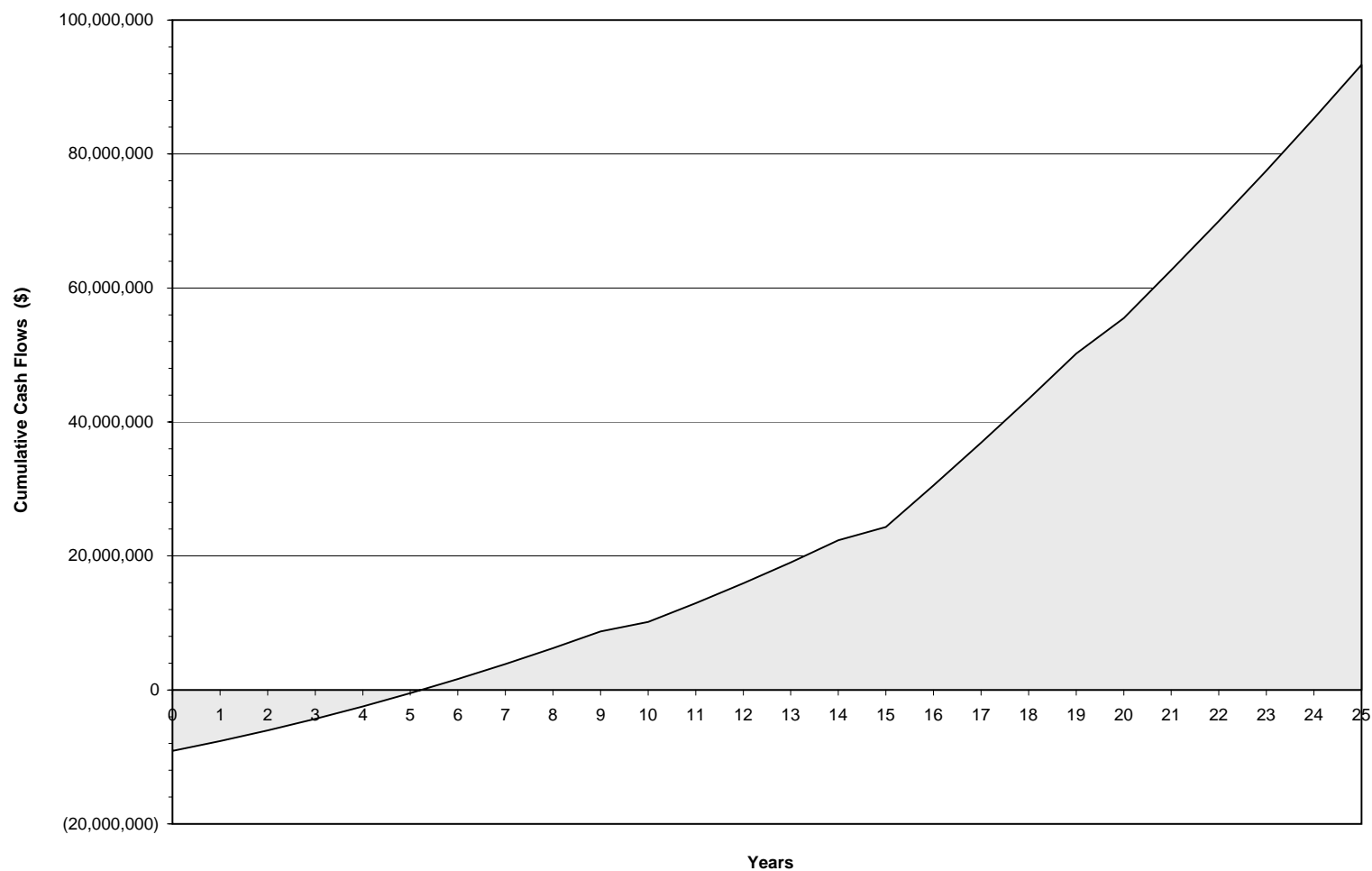
Cumulative Cash Flows Graph

Wind Energy Project Cumulative Cash Flows Scenario #2, Pincher Creek, AB

Renewable energy delivered (MWh/yr): 64,583

Total Initial Costs: \$ 30,391,448

Net GHG emissions reduced (tCO₂/yr): 63,486



IRR and ROI: 22.8%

Year-to-positive cash flow: 5.2 yr

Net Present Value: \$ 19,534,240