MICROFILM DIVIDER

OMB/RECORDS MANAGEMENT DIVISION
SFN 2053 (2/85) 5M

ROLL NUMBER

DESCRIPTION

2238

2005 SENATE FINANCE AND TAXATION

SB 2238

2005 SENATE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. **SB 2238**

Senate Finance and Taxation Committee

❑ Conference Committee

Hearing Date January 24, 2005

Tape Number	Side A	Side B	Meter #
#1	X		0.7 - 26.9
Committee Clerk Signature	Sharon Renfrow		

Minutes: All committee members present.

SEN. URLACHER: called the meting to order and opened the hearing on SB 2238.

REP. BRANDENBURG: appeared as a cosponsor of the bill and on behalf of the prime sponsor, Sen. Erberle, stating this bill deals with wind turbines to be built with schools to go together and build a wind turbine. It depends on the situation and the size of the school. This bill was around last session and people stated it was a good idea, but will it really work. We couldn't' answer because there was a lot of questions, a study was done by EAPC concerning wind turbines and some schools went to work on that, and the schools were Ashley, Ellendale, Kulm, Napoleon, Wishek and Zeeland. The study was done and there could be a savings of $114,000.00. The bill before you goes into the big issue of the voided cost and the wholesale cost and the retail portion in between and this bill also asks for a tax credit for the generator or the power company that is currently providing the power to the schools.

SEN. BERCIER: this is for sale, are the schools considering using this to offset their electrical needs on a daily basis?

SEN. BRANDENBURG: Actually they become a generator, this also brings new technology back and our young people will bring this technology forward which will save the school money, which is proven by this report. It also educates the young people to look at new technology and energy that would keep people in our state.

SEN. URLACHER: those in MN, are those large schools that are utilizing this?

SEN. BRANDENBURG: both, some small and some larger ones in Iowa and MN. The larger the school the bigger the turbine, the more economic it is.

SEN. URLACHER: Are they building in transmission between schools?

SEN. BRANDENBURG: It's part of the grid, you have to have the substation that will handle it.

SEN. BERCIER: with the 7 schools, you have 1 turbine to offset all of their costs?

SEN. BRANDENBURG: Yes, these schools going together because they are small schools. A person can look on the Internet and see how much wind that power is putting out, etc.

SEN. BERCIER: would this apply to single schools and are they exclusive to IOU's and not the REC's?

SEN. BRANDENBURG: Yes, those studies are actually being done right now and dealing with IOU's, this allows them to come to the table allow the schools to sit down with the power companies, work together and provide a tax credit so they could offset their loss or avoided costs.

TOM LOVIK: The Econ. Dev. Coordinator for the City of Wishek appeared in support with written testimony stating they strongly believe in the economic & environmental benefits wind

energy can provide to ND. Our wind group applied for and received a grant from the Div. Of Community Services to have a feasibility study conducted using information on electricity use from 7 school districts in our area. The results indicate that they can pay for a turbine in about 8 years and collectively save about $114,000.00 a year. Once the turbine is paid for, the annual savings for each school can keep another teacher employed, revive a dead art program or maybe buy new band uniforms, and pay for a new bus.

DAPHNE BECKER: a high school student in Ashley School appeared in support with written testimony stating this would give us something to survive a little longer in a smaller community, this plan would give not only jobs and lower expenses, but it would give these small towns some life and some survival ideas.

BRIAN DUCHSCHERER: Superintendent of Wishek Public School appeared in support stating their school was one of the schools that are in the study and we feel that its great educational benefits for our students and as superintendent we look financially at our district and its promising to be a financial benefit to our school district.

STEVE SCHULTZ: Representing Otter Tail Power Company appeared in opposition of the bill with written testimony stating. they oppose the bill because there are Federal laws that will not allow us to do what the bill asks for and not to save load for Otter Tail Power Company. Basically FERC will not allow us to buy above a voided cost.

FLETCHER POLING: of Basin Electric appeared in opposition of the bill with written testimony, stating their concern is that placing single wind turbines in scattered locations across the state is not the most efficient way to provide a learning experience.

No further testimony, hearing was closed.

2005 SENATE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. **SB 2238**

Senate Finance and Taxation Committee

❑ Conference Committee

Hearing Date **February 1, 2005**

Tape Number	Side A	Side B	Meter #
# 2		X	61.2 - 31.5
#3	X		0.0 - 1.7
Committee Clerk Signature			

Minutes: AFTERNOON COMMITTEE WORK

SEN. WARDNER: Steve Schulz had a problem with this. I thought he was bringing us amendments on this. I'll get ahold of Mr. Schulz.

SEN. EVERY: I thought that those FERC Regulations applied to the IOU's and not the REC's and, its starting to come back to me, but there was some FERC Regulations that this Schulz was concerned about.

SEN. BERCIER: the bottom sentence of the 2nd paragraph is what Steve Schulz's is concerned with.

SEN. URLACHER: we'll have Sen. Wardner check it out.

2005 SENATE STANDING COMMITTEE MINUTES

BILL/RESOLUTION NO. **SB 2238**

Senate Finance and Taxation Committee

☐ Conference Committee

Hearing Date **February 9, 2005**

Tape Number	Side A	Side B	Meter #
#1		X	2.1 - 14.0
Committee Clerk Signature	Sharon Lenfest		

Minutes:

SEN. URLACHER: this relates to wind energy; tax credits and that seemed to have some negative testimony. (FERC) not very workable.

SEN. BERCIER: there was a concern about them being mandated by an avoided cost rate. Page 1, line 22 on.

SEN. URLACHER: keeps coming to mind, seems like the problem comes in the transmission line cost. That creates a differential.

SEN. EVERY: with regard to wind, and we've heard that argument for the 3 sessions that I've been here now and at some point we have to decide its time to move forward and work through our transmission problems and catch up with the rest of the country. I'm going to support the bill, I don't see that there's much of a future for it, but I'll support it.

SEN. WARDNER: This really doesn't affect transmission its just a hiccup is the buy back, they want more than was FERC will allow them. They have to follow FERC's rules. I signed on this

bill because of schools, the way they could take care of some of their energy costs if they could do this, I thought it would be great and I do believe in renewable energy. The problem in it if the bill states more than FERC will allow they will have to adjust to FERC's regulations. I will support it for the schools.

SEN. URLACHER: I'm for renewable energy but should the local government get involved in the business?

SEN. BERCIER: when you go to wind meetings, Richardton is brought up all the time and Belcourt second because of the long history of using it on the policy side.

SEN. URLACHER: I know that one was purchased as a used unit; I think they got a break by the seller as well.

SEN. BERCIER: I've attended a lot of these wind energy meetings on the national level and when you look at policy, this is one step for it. We lacked sorely in the state is policy for renewable energy so that there is any kind of incentive for wind developers to come in. This will save some schools some money in their operating budget which some of those schools need $114,000 I think by the time they are done. They have a large investment in that turbin. If they put up one turbin and then try to sell that and distribute it, there's going to be some bookkeeping issues but I think this is a step in the right direction in helping the wind industry, renewable industry in the state. The transmission issue is local.

SEN. URLACHER: transmission is the issue because when they don't have wind energy, they have to bring in that.

SEN. WARDNER: remind you back in 2001 session we did pass 3 pieces of legislation and they went through this committee on wind energy, one was a sales tax exemption, one was an

income tax credit and one was a property tax abatement and at that time we said we were put on a level playing field with MN that we would be able to compete. However, Sen. Every is right, it's the transmission that has been the big hold up for us. Its not only important to the renewables its also important to the fossil fuels and right now there's never been a time when they need each other. We have done some things.

SEN. COOK: has there been any public news about 2 large wind farms coming to ND? I heard it again last night. I believe Ottertail will be building one of them.

SEN. BERCIER: that 150 mega watt farm that's going up by Rugby is happening because Ottertail and Excel Energy jointly built a transmission line from Harvey up to Grenwall Canada a couple of years ago.

SEN. WARDNER: made a **MOTOIN FOR DO PASS**, seconded by Sen. Every

ROLL CALL VOTE: 3-3-0 **MOTION FAILED**

SEN. COOK: made a **MOTION FOR DO NOT PASS**, seconded by Sen. Tollefson.

ROLL CALL VOTE: 3-3-0 **MOTION FAILED**

SEN. WARDNER: made a **MOTION TO SEND OUT SB 2238 WITHOUT RECOMMENDATION**, seconded by Sen. Bercier

VOICE VOTE: 6-0-0 Sen. Cook will carry the bill.

FISCAL NOTE

Requested by Legislative Council
01/18/2005

Bill/Resolution No.: SB 2238

1A. **State fiscal effect:** *Identify the state fiscal effect and the fiscal effect on agency appropriations compared to funding levels and appropriations anticipated under current law.*

	2003-2005 Biennium		2005-2007 Biennium		2007-2009 Biennium	
	General Fund	Other Funds	General Fund	Other Funds	General Fund	Other Funds
Revenues						
Expenditures						
Appropriations						

1B. **County, city, and school district fiscal effect:** *Identify the fiscal effect on the appropriate political subdivision.*

2003-2005 Biennium			2005-2007 Biennium			2007-2009 Biennium		
Counties	Cities	School Districts	Counties	Cities	School Districts	Counties	Cities	School Districts

2. **Narrative:** *Identify the aspects of the measure which cause fiscal impact and include any comments relevant to your analysis.*

SB 2238 provides a tax credit against gross receipts or corporate income taxes for electricity purchased by a cooperative or corporation from a school district and generated by a wind turbine owned by the school district. The credit is equal to the difference between the amount paid to the school district for electricity and the amount that the cooperative or corporation would have paid in the open market for the same amount of electricity.

3. **State fiscal effect detail:** *For information shown under state fiscal effect in 1A, please:*
   A. **Revenues:** *Explain the revenue amounts. Provide detail, when appropriate, for each revenue type and fund affected and any amounts included in the executive budget.*

It is not possible to estimate the negative fiscal impact of this bill because we do not know how many kilowatt hours may qualify, what the purchase price will be, nor what the open market price would be. Any gross receipts tax credit resulting from SB 2238 will reduce the revenue distributed to all the taxing districts in which the cooperative has power lines. Any corporate income tax credit resulting from SB 2238 will reduce state general fund revenues.

   B. **Expenditures:** *Explain the expenditure amounts. Provide detail, when appropriate, for each agency, line item, and fund affected and the number of FTE positions affected.*

   C. **Appropriations:** *Explain the appropriation amounts. Provide detail, when appropriate, of the effect on the biennial appropriation for each agency and fund affected and any amounts included in the executive budget. Indicate the relationship between the amounts shown for expenditures and appropriations.*

Name:	Kathryn L. Strombeck	**Agency:**	Office of Tax Commissioner
Phone Number:	328-3402	**Date Prepared:**	01/21/2005

Date: 2-9-05
Roll Call Vote #: 1

2005 SENATE STANDING COMMITTEE ROLL CALL VOTES
BILL/RESOLUTION NO. *SB* 2238

Senate **Finance and Taxation** Committee

☐ Check here for Conference Committee

Legislative Council Amendment Number _____

Action Taken Do Pass

Motion Made By Wardner Seconded By Every

Senators	Yes	No	Senators	Yes	No
Sen. Urlacher		✓	Sen. Bercier	✓	
Sen. Wardner	✓		Sen. Every	✓	
Sen. Cook		✓			
Sen. Tollefson		✓			

Total (Yes) 3 No 3

Absent _____

Floor Assignment _____

If the vote is on an amendment, briefly indicate intent:

Date: 2-9-05
Roll Call Vote #: 2

2005 SENATE STANDING COMMITTEE ROLL CALL VOTES
BILL/RESOLUTION NO. *SB* 2238

Senate **Finance and Taxation** Committee

☐ Check here for Conference Committee

Legislative Council Amendment Number _____

Action Taken Do Not Pass

Motion Made By Cook Seconded By Tollefson

Senators	Yes	No	Senators	Yes	No
Sen. Urlacher	✓		Sen. Bercier		✓
Sen. Wardner		✓	Sen. Every		✓
Sen. Cook	✓				
Sen. Tollefson	✓				

Total (Yes) 3 No 3

Absent 0

Floor Assignment _____

If the vote is on an amendment, briefly indicate intent:

Date: 2-9-05
Roll Call Vote #: 3

2005 SENATE STANDING COMMITTEE ROLL CALL VOTES
BILL/RESOLUTION NO. *SB* 2238

Senate **Finance and Taxation** Committee

☐ Check here for Conference Committee

Legislative Council Amendment Number

Action Taken Without Recommendation

Motion Made By Wardner Seconded By Bercier

Senators	Yes	No	Senators	Yes	No
Sen. Urlacher	✓		Sen. Bercier	✓	
Sen. Wardner	✓		Sen. Every	✓	
Sen. Cook	✓				
Sen. Tollefson	✓				

Voice Vote

Total (Yes) 6 No 0

Absent 0

Floor Assignment Cook

If the vote is on an amendment, briefly indicate intent:

REPORT OF STANDING COMMITTEE

SB 2238: Finance and Taxation Committee (Sen. Urlacher, Chairman) recommends **BE PLACED ON THE CALENDAR WITHOUT RECOMMENDATION** (6 YEAS, 0 NAYS, 0 ABSENT AND NOT VOTING). SB 2238 was placed on the Eleventh order on the calendar.

2005 TESTIMONY

SB 2238

EAPC ARCHITECTS ENGINEERS

Final Report

ND Public Schools Wind Turbine Study

SB 2238

July 22, 2004

Submitted to:

Tom Lovik
McIntosh County
Wind Energy Committee, LLC
Box 466
1015 4th Ave. S
Wishek, ND 58495-0466

Submitted by:

Jay Haley, P.E. & Kevin Romuld, M.E.
EAPC Architects Engineers
3100 DeMers Ave.
Grand Forks, ND 58201

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Appendices

1. Executive Summary

A number of people in North Dakota have expressed an interest in having public schools own and operate wind turbines to supply some of their own electricity in an effort to save money, and to provide a platform for education on renewable energy technology.

The purpose of this study was to determine the financial feasible of a group of ND public schools collectively owning and operating a wind turbine to supply electricity to their collective electric loads.

Contractual agreements and permitting issues were not within the scope of this study. It was assumed that contractual agreements could be reached between the participating schools and the utilities that serve them. It was also assumed that it is possible to get the necessary permits and that a suitable site could be found for the wind turbine and the interconnection to the electric utility grid.

Seven schools participated in the study including Ashley, Ellendale, Kulm, Napoleon, Strasburg, Wishek, and Zeeland. Their total electric utility expenses for the year 2002 were used for this study and amounted to 1,984,921 kWh at a total cost of $135,725.

The wind turbine that best-matched the total electric load was the Vestas V47 wind turbine, which has a generating capacity of 660 kW, and would produce approximately 2,331,585 KWh per year in the area of study.

The results of this study indicate that the total annual savings to the schools would be approximately $114,470 per year and that the simple payback would be approximately 8 years.

2. Background

The McIntosh County Wind Energy Committee, LLC is interested in promoting the idea of a group of public schools in the south-central part of North Dakota owning and operating a utility-scale wind turbine to provide electricity for themselves. The group of public schools is shown in Figure 1.

The study followed the following outline:

1. Search for wind data and perform analysis.
2. Model the wind resource based on the available data.
3. Review the schools' electrical energy consumption and costs.
4. Estimate the annual energy production of a wind turbine generator that would match up to the schools energy requirements.

5. Perform an economical feasibility analysis for the project.

Because the region that encompasses all of the participating schools is so large, the focus of the study was limited to the Wishek area of McIntosh County. This area has an excellent wind resource and electrical transmission lines in the vicinity. This does not however rule out other possible wind turbine sites for future investigation as the project progresses.

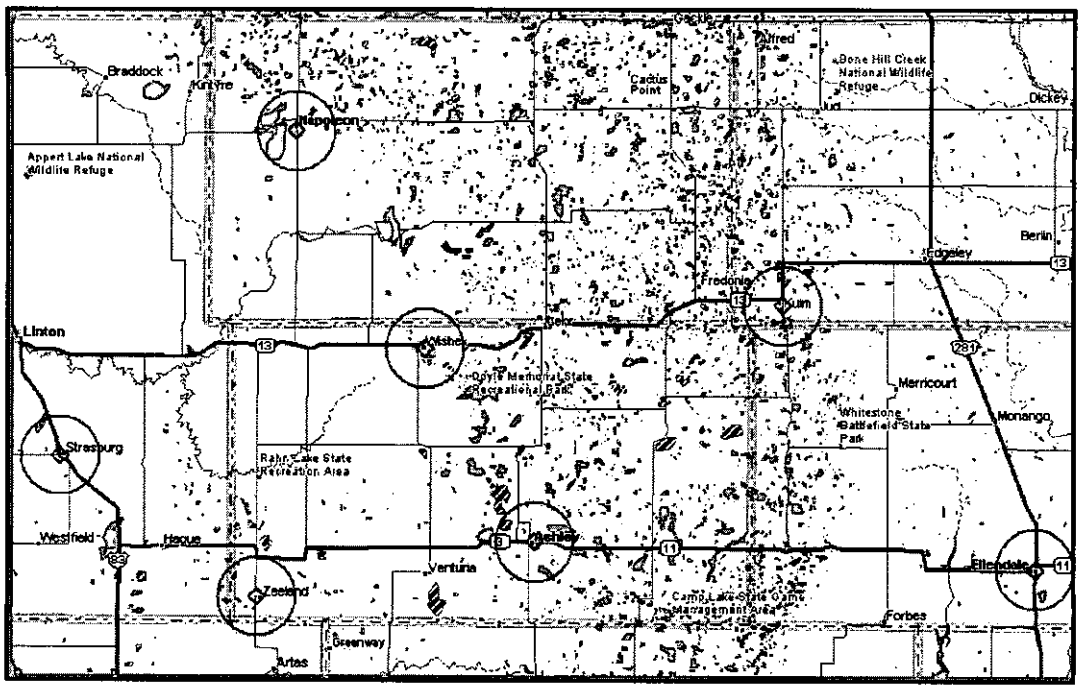


Figure 1 – Locations of participating schools.

3. Available Wind Data

Wind data from three wind-monitoring stations was available and the locations are shown in Figure 2. The Wishek 2257 and the NDAWN Wishek site is short-term wind data and the NDAWN Edgeley site is longer-term data.

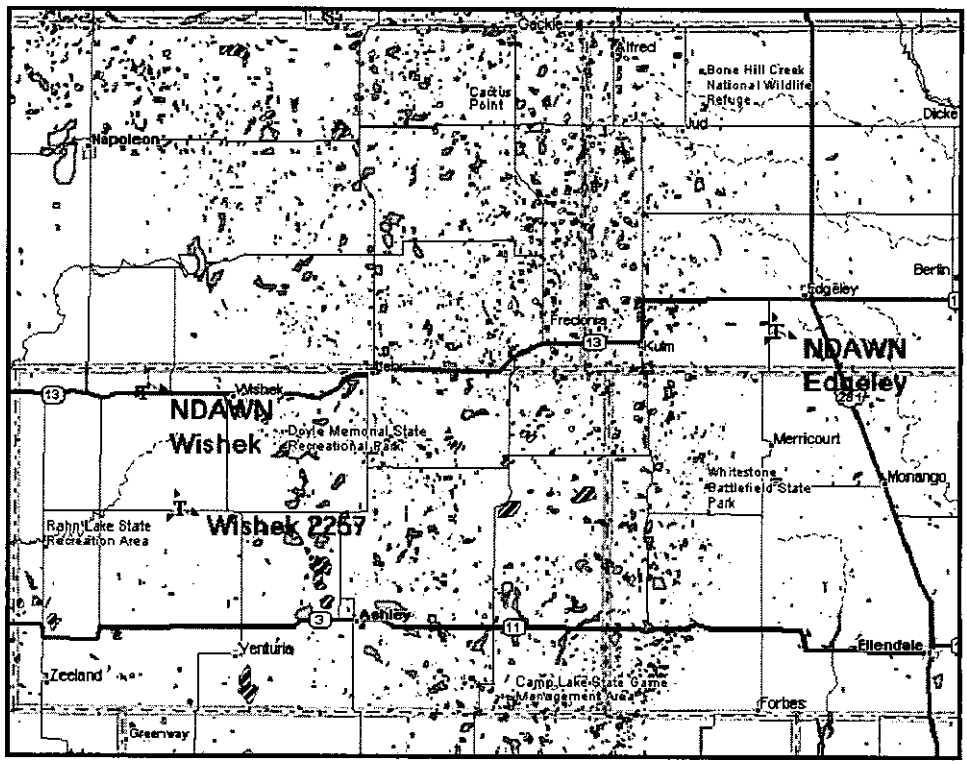


Figure 2 – Locations of wind monitoring stations.

3.1. Short-Term Wind Data

The Wishek 2257 wind-monitoring station is located 13.6 kilometers (km) SSW of Wishek. The site has a base elevation of 689 meters (m) and measurement heights of 10, 30 and 40 m. Data from June 2001 to April 2003 was used for analysis. The site is still active.

The NDAWN Wishek wind-monitoring station is located 9 km W of Wishek. The site has a base elevation of 670 m and a measurement height of 3 m. Data from July 2001 to June 2003 was used for analysis. The site is still active.

3.2. Long-Term Wind Data

The NDAWN Edgeley wind-monitoring station is located 5 km SW of Edgeley and 70 km NE of the Wishek WMS. The site has a base elevation of 508 m and a measurement height of 3 m. Data from 1993 to April 2003 was used for analysis. The site is still active.

3.3. Correlation Between Short and Long-Term Wind Data

The Wishek and NDAWN hourly average wind speeds for a one-month parallel time period are shown in Figure 3. Trend lines of the two data sets show a good correlation.

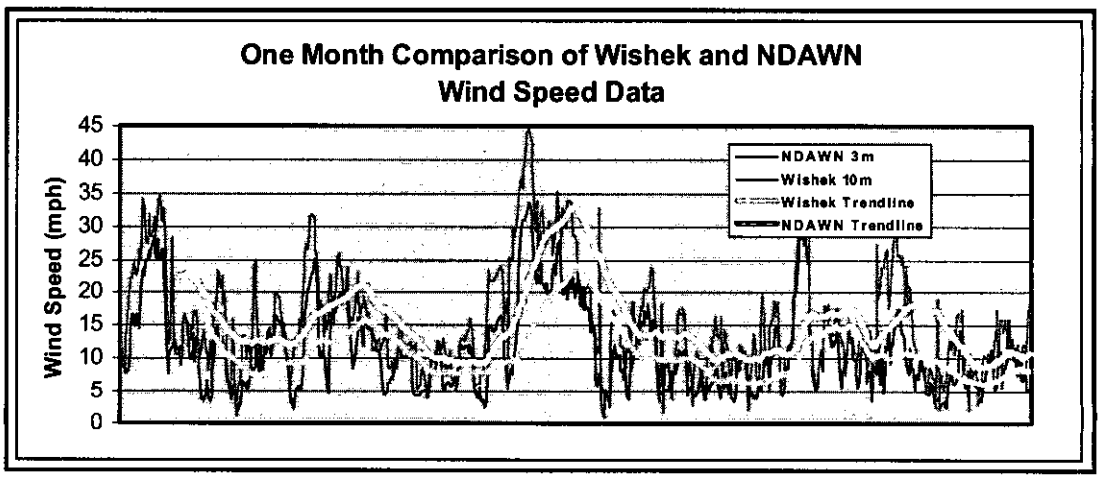


Figure 3 – Correlation between short and long-term wind data.

It is typical to use the correlation information to scale the short-term data to make it more representative of the long-term. Although we find a strong correlation between the two sites in this case, we elected not to perform the scale-up of the wind data because of the uncertainties regarding wind data collected at the low level of 3 m, and, by not scaling up the data, our estimates remain slightly more conservative.

4. Analysis and Calculation Setup

Sophisticated computer programs were used to model the wind resource and estimate the annual energy production of a wind turbine generator. The wind data was input into the model and scrutinized to eliminate any anomalous data. A mathematical equation is used to fit a Weibull curve to the wind date for each sector of wind direction to describe a time independent observed wind climate. The observed wind climate is then cleaned based on local roughness, orography (variation in height elevation), and obstacles to produce a regional wind statistic for the area. The regional wind statistic is used in conjunction with the local

roughness, orography, and obstacles to model the wind resource and estimate the annual energy produced by a specified wind turbine generator at any specified site in the surrounding area.

4.1. Wishek Wind Data Analysis

The 40 m wind data from the Wishek 2257 wind-monitoring station was analyzed. A comprehensive report for three years of data can be found in Appendix A. The data recovery was 97%. The 40 m mean wind speed is 8.2 meters/second (m/s). The graphical presentation of the Wishek 40 m wind data is shown in Figure 4 and Figure 5.

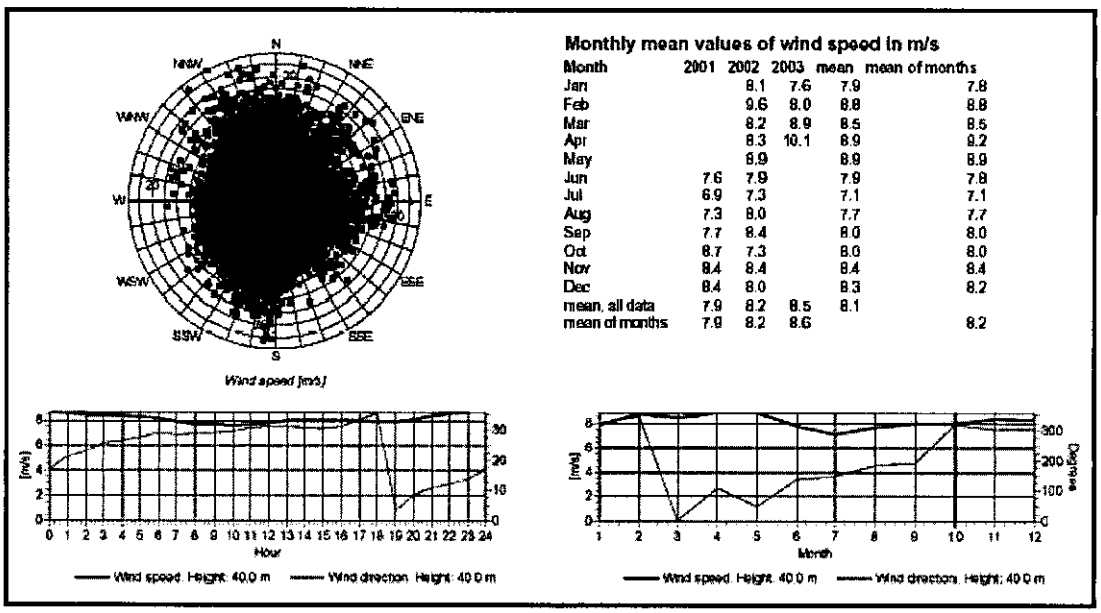


Figure 4 – Wishek 40 m mean wind speed by month and hour.

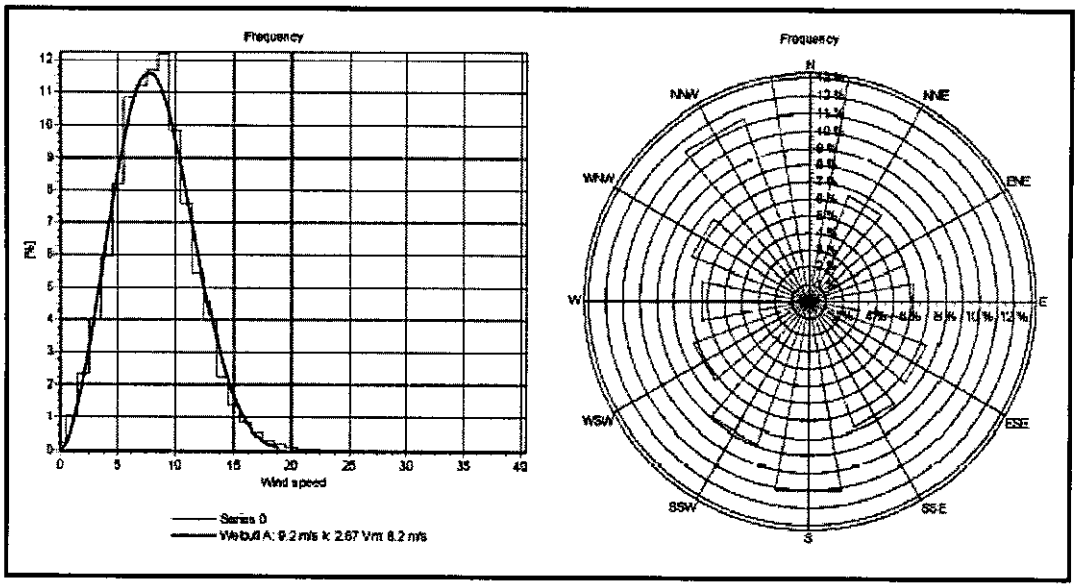


Figure 5 – Wishek 40 m Weibull curve and frequency.

4.2. Terrain Description (Orography, Roughness, Obstacles)

The orography, roughness and obstacle in the vicinity of the Wishek wind-monitoring station can have an effect of the wind data. No obstacle were identified that would have a significant effect on the wind data. The orography within a 5-km radius of the site is described using digital elevation models (DEM) shown in Figure 6.

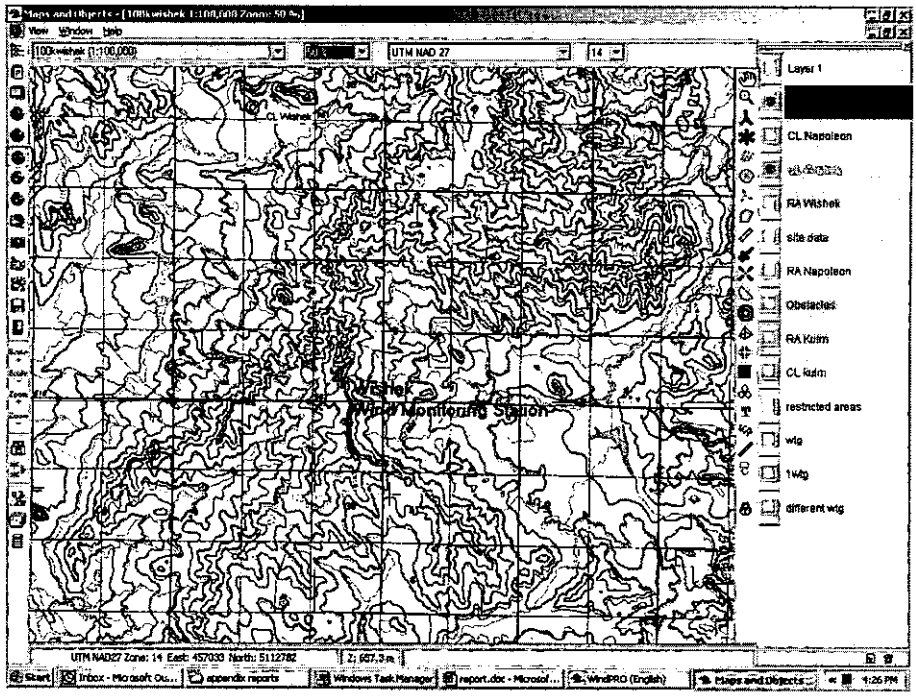


Figure 6 – Digital elevation models describing changes in surface elevation.

The roughness is described by digitizing surface roughness areas within 20 km of the site. Areas like cities and towns, forests and water are digitized and assigned a roughness class value, which describes the surface roughness. A background roughness class of 1.2 was used for areas that were not digitized. The roughness class values used for the digitized areas are shown in Figure 7. A map showing digitized surface roughness areas is shown in Figure 8.

Type	Value
Forrest RC=3	3.0
City/Town RC=3	3.0
Agricultural, open RC=1	1.0
Agricultural, less closed RC=2	2.0
Agricultural, closed RC=2.5	2.5
Agricultural, less open RC=1.5	1.5
Water inlet RC=0.2	0.2

Figure 7 – Roughness class values.

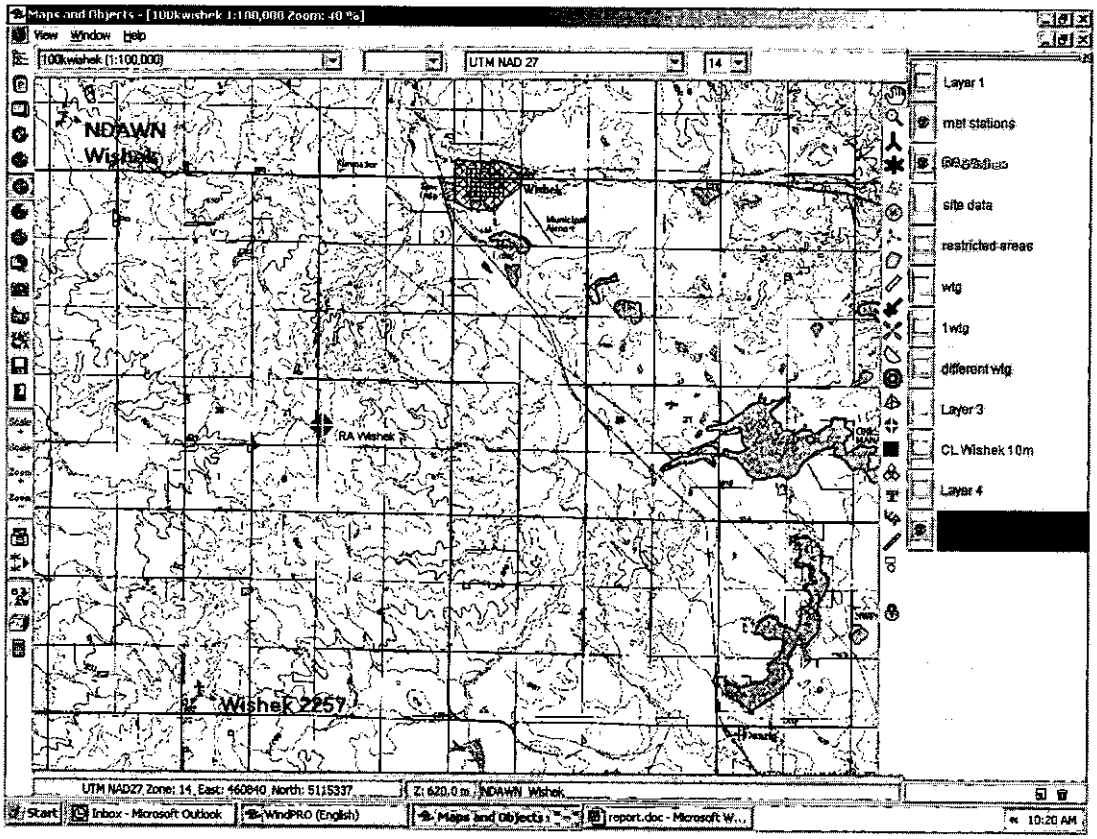


Figure 8 – Digitized surface roughness areas.

4.3. Wind Statistic

A wind statistic is a mathematical model describing the wind resource at a particular site, which ignores the effects of the local surface roughness elements around the site. It essentially describes the "pure" wind resource at the site. By using this "pure" wind resource model and adding back in the surface roughness information from another site, we can estimate the wind resource for the new site.

Wind statistics were generated using the NDAWN Wishek 3 m data and the Wishek 2257 10, 30 and 40 m data, the results are shown in Figure 9. Wind statistics are compared using the calculated wind turbine energy levels. An average site in Denmark is arbitrarily chosen to have a wind turbine energy level of 100 and is used for comparing wind statistics. The wind turbine energy levels of the three different measurement heights of the Wishek 2257 wind data are very similar. The 3 m NDAWN Wishek data predicts a higher wind turbine energy level but is only 3% higher than the 40 m 2257 Wishek data. The wind statistic generated by the 40 m Wishek 2257 wind data will be used to represent

the regional wind climate in the area and energy production estimates will be based on this wind statistic.

Name	WTG energy
3.0 m NDAWN Wishek	151.6
40.0 m 2257 Wishek	147.2
30.0 m 2257 Wishek	146.7
10.0 m 2257 Wishek	145.6

Figure 9 – Wind statistics.

4.4. Wind Resource Map

A wind resource map was generated using the 40 m 2257 wind statistic and roughness and orography files to describe the local terrain. The wind resource map at 50 m height is shown in Figure 10.

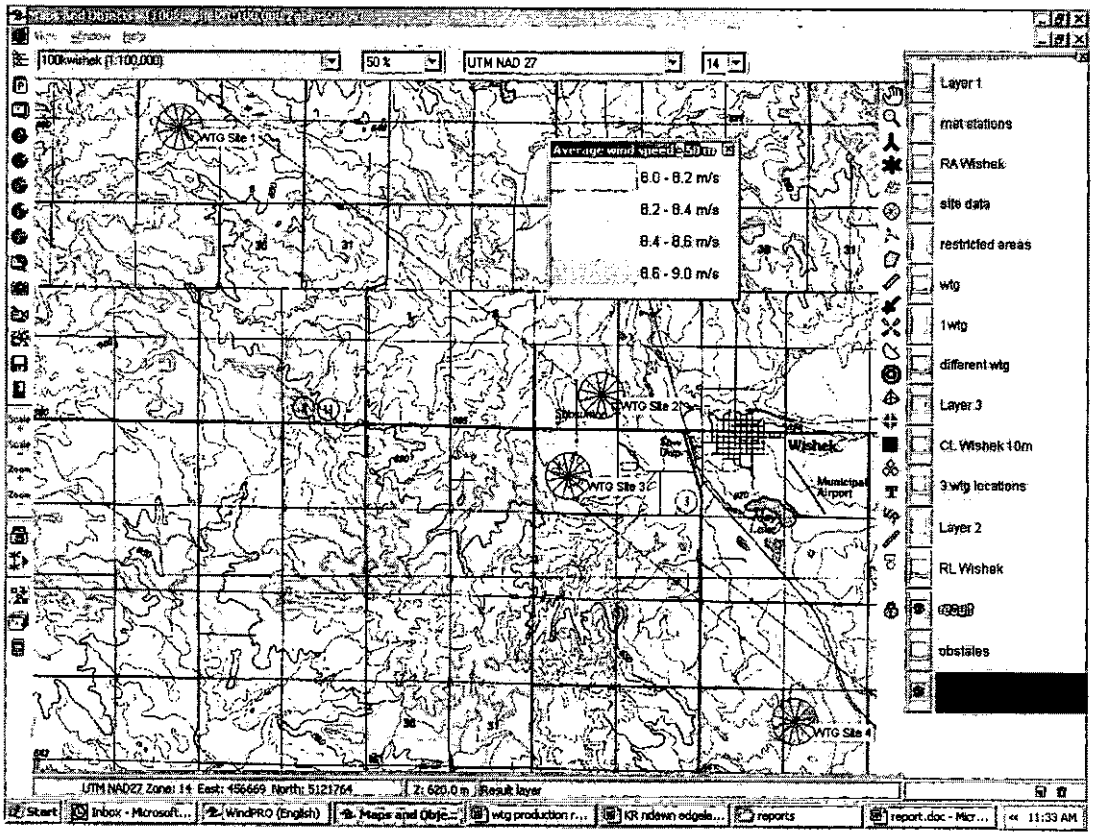


Figure 10 – Wind resource map at 50 m height.

5. Wind Turbine Annual Energy Production

Four wind turbine sites were tested in close proximity to the power transmission lines and substation. The locations are shown in Figure 11. An air density of 1.166 kg/m^3 was used for the calculations. The NEG Micon NM48 and the Vestas V47 wind turbines were used for the calculations with a hub height of 50 m. The results of the estimated annual energy production (AEP) in megawatt-hours (MWh) are shown in Table 1. The four wind turbine sites vary by approximately 5% in gross AEP. The net AEP is the gross AEP minus 10% for energy losses and uncertainties. The comprehensive wind energy production analyses can be found in Appendix B.

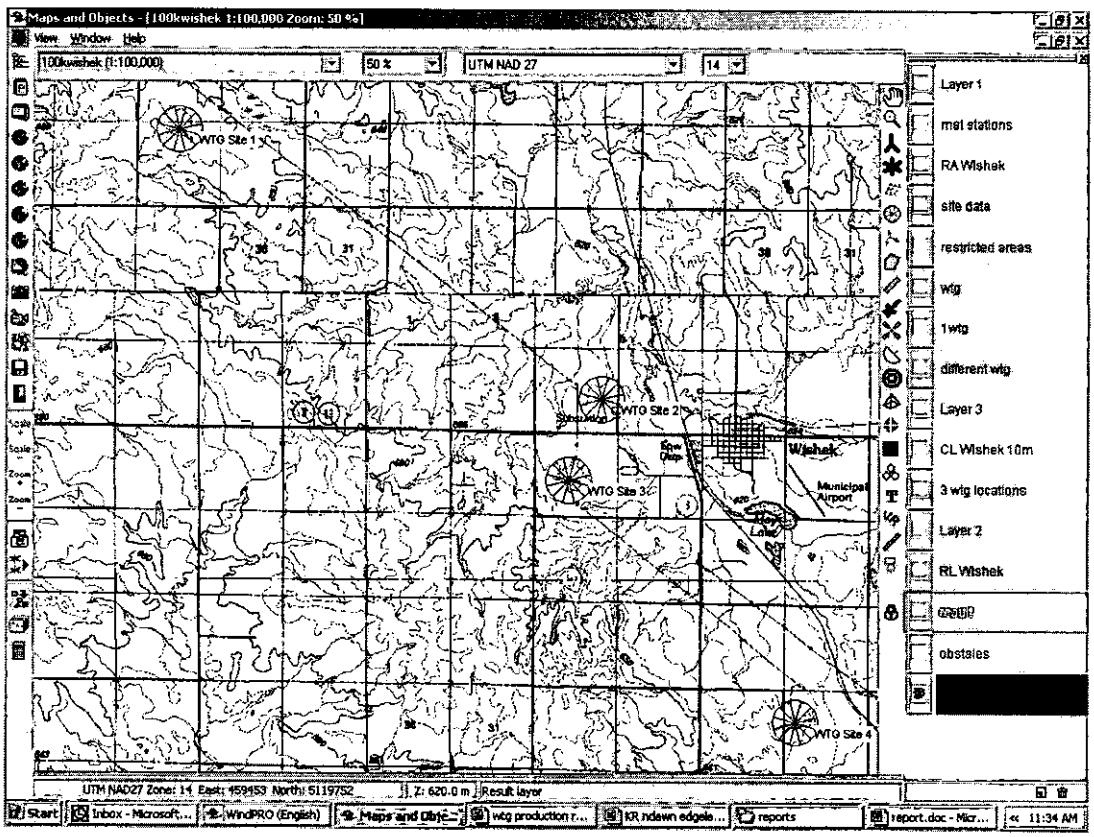


Figure 11 – Locations of wind turbine sites tested.

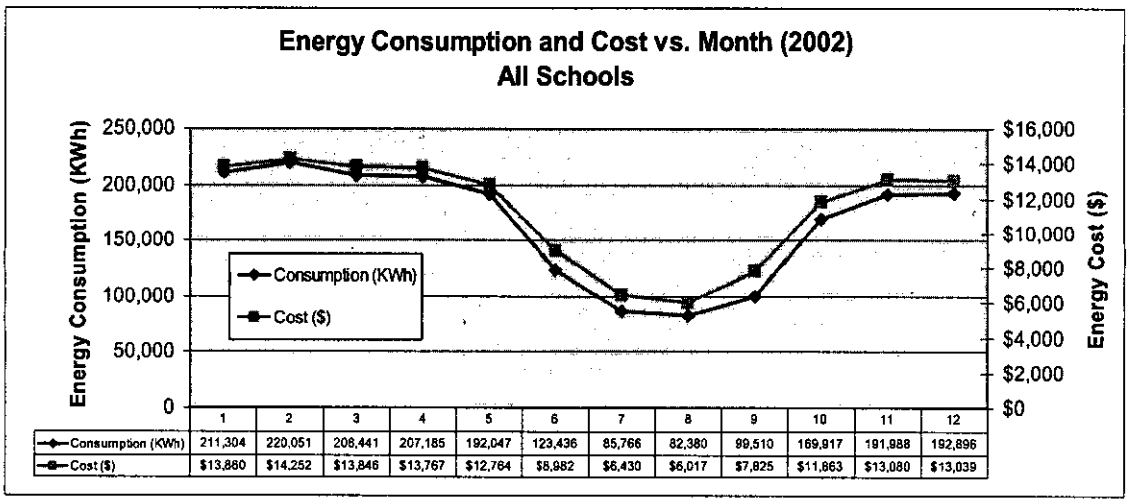
	Annual Energy Production (KWh)		Capacity Factor		[3] Annual Energy Production Reduced 10% (KWh)	
WTG Site	[1] NM48/750	[2] V47/660	[1] NM48/750	[2] V47/660	[1] NM48/750	[2] V47/660
1	2,737,000	2,637,000	41.6%	45.6%	2,463,300	2,373,300
2	2,656,500	2,563,200	40.4%	44.3%	2,390,850	2,306,880
3	2,643,400	2,550,500	40.2%	44.1%	2,379,060	2,295,450
4	2,709,400	2,611,900	41.2%	45.1%	2,438,460	2,350,710
Average	2,686,575	2,590,650	40.9%	44.8%	2,417,918	2,331,585

[1] - NEG Micon NM48, 750kw, 48m rotor diameter, 50m hub height
[2] - Vestas V47, 660kw, 47m rotor diameter, 50m hub height
[3] - 10% energy reduction for energy losses and uncertainties

Table 1 – Estimated annual energy production

6. Energy Production vs. Schools' Consumption

The total energy consumption and cost vs. month for the seven schools participating in the study is shown in Figure 12. The 2002 annual energy consumption is 1,984,921 kWh at a cost of $135,725



	1	2	3	4	5	6	7	8	9	10	11	12
Consumption (KWh)	211,304	220,051	208,441	207,185	192,047	123,436	85,766	82,380	99,510	169,917	191,988	192,896
Cost ($)	$13,880	$14,252	$13,846	$13,767	$12,764	$8,982	$6,430	$6,017	$7,825	$11,863	$13,080	$13,039

Figure 12 – Graph of schools energy consumption and cost vs. month.

From Table 1, the average annual energy production of the four sites reduced 10% for the V47/660 wind turbine is 2,331,585 KWh. This was used as the basis for the estimated average annual energy production and is approximately 17% higher than the 2002 energy consumption of the schools. A wind index generated from the NDAWN Edgeley long-data was used to estimate the maximum, minimum and average monthly production of the wind turbine. The estimated maximum, minimum and average wind turbine production and the 2002 energy consumption vs. month are shown in Figure 13. On a monthly basis, the average wind turbine production shows a good correlation to the 2002 energy consumption of the schools.

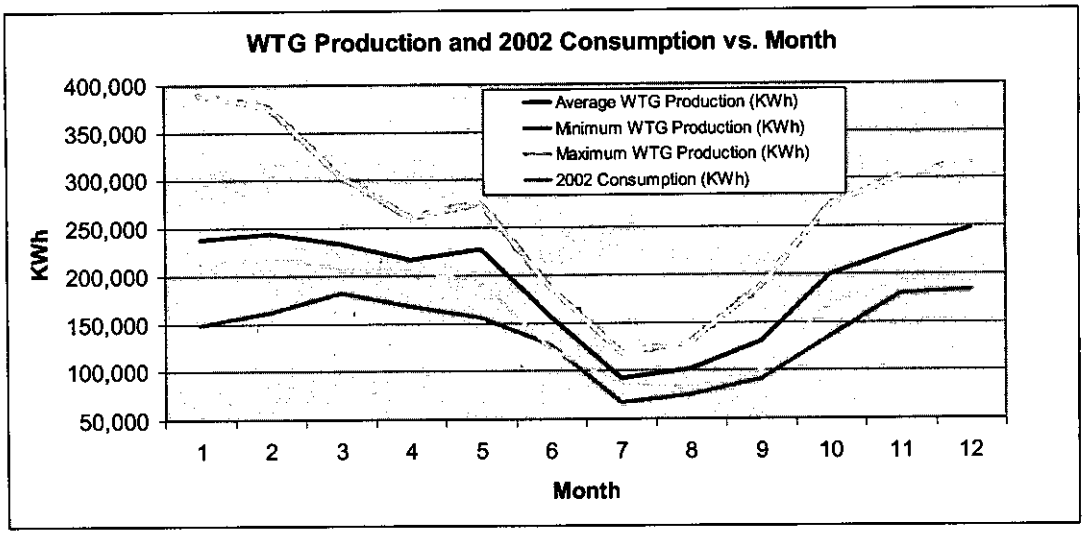


Figure 13 – Wind turbine production and 2002 school consumption vs. month.

7. Economic Feasibility Analysis

The purpose of this study was to determine the economic feasibility of the public schools aggregating their individual energy consumption and utility bills as if they were all served through a single meter, and then supplying some portion of their collective energy needs with a wind turbine owned by the schools.

This study does not address the contractual issues that would need to be addressed by the schools and the utilities that serve them, in order to allow this type of arrangement. This study simply assumes that such an arrangement is possible, and treats the schools' individual electrical loads as if they were a single load, served by one utility through a single meter.

A detailed utility analysis was performed to compare the schools' collective monthly electric utility costs with and without the addition of a wind turbine. The monthly savings for the wind energy case were summed up to determine the annual savings.

The annual savings were then input into a cash flow model that incorporates the initial cost, annual savings, and annual expenses to determine the net annual cash flow.

7.1. Utility Analysis

Overview

In order to determine the financial feasibility of this project, it is necessary to compare a "business-as-usual" case where nothing is changed, to the case where the wind turbine supplies some portion of the school's collective energy requirements. The schools' usage of electricity, as well as the amount of electricity generated by the wind turbine, will vary from month to month. In order to make an accurate comparison, the two cases must be compared on a monthly basis. Based on monthly utility bills, an average collective usage is projected for each month of the year. Based on the average production less 10% for the four sites with a V47 wind turbine, the wind energy production is estimated for each month of the year.

If the monthly wind turbine output is less than the monthly usage, an assumption is made that the schools consume all of the wind energy. The value of this wind energy is then equal to the retail rate of the electricity that would otherwise have been provided by the local utility.

If the monthly wind turbine output is more than the monthly usage, an assumption is made that the excess electricity is fed back onto the local distribution grid, and the schools are credited for the excess generation at the utilities avoided cost which is typically around $0.015 per kWh in North Dakota.

Business-as-Usual Case

In the "business-as-usual" case, a simplifying assumption is made to combine service charges, demand charges, and energy charges into a single "blended rate". This is done by taking the total utility charges for the year for all seven schools and dividing by the total energy usage to arrive at an average annual price per kWh. The blended rate for this project is $0.0684 per kWh.

Wind Energy Case

In the case where some of the electricity is supplied by the wind turbine, wind energy consumed by the schools is valued at the blended utility retail rate ($0.0684 per kWh). Excess wind energy that is fed back onto the local distribution grid is valued at the utilities avoided cost, which is assumed to be $0.015 per kWh. The schools' energy usage and wind generation are summed up on a monthly basis.

In this case, the wind turbine produces excess electricity each month. In reality, there will be times when the wind is not blowing, or the wind turbines are producing less than the schools' instantaneous load. For this reason, we have

assumed that the schools will purchase 25% of their electricity from the utility, and supply 75% from the wind turbine for each month of the year.

Wind turbine

For this study, the total collective energy consumption of the seven schools is less than the output of the smallest commercially available, utility-scale wind turbine, which is the Vestas V47. This is a very reliable, well-known machine, which best matches the collective load.

Estimated Annual Savings

The estimated annual savings is derived by comparing the estimated monthly utility bill from the "business-as-usual" case, to the wind energy case. The monthly savings are summed up to determine the annual savings. The results of the detailed utility analysis indicate an estimated savings of $114,470 per year. The detailed utility analysis is included in Appendix C.

7.2. Cash Flow Analysis

Once the annual saving were estimated, a cash flow analysis was performed, which incorporates the annual savings along with associated annual expenses to arrive at a net annual cash flow. The cash flow analysis is performed for the Vestas V47-660 wind turbine with a 50 m tower.

The following key assumptions were used for the economic feasibility analysis:

- Wind turbine life: 20 years
- Inflation: 0%
- Rate Escalation: 0%
- Wind turbine: Vestas V47-660, 47 m rotor diameter, 50 m hub height
- Average annual energy production: 2,331,585 KWh per year
- Average annual collective energy usage: 1,984,921 kWh per year
- Average annual collective energy cost: $0.0684/kWh
- Wind turbine installed cost: $880,950
- Land lease payments: $2,283 per year (2% of gross savings)
- Financing: $300,000 down, 6% APR interest for 10 years

Actual project costs will vary based on current exchange rates, interest rates, the price of steel, and permitting costs.

The annual savings is taken from the detailed utility analysis.

The annual expenses taken into account are property and liability insurance, extended warranty costs, landowner lease payments, debt service, and operating and maintenance costs.

The detailed cash flow analysis can be found in Appendix D.

8. Permitting

Determining actual compliance with local zoning and ordinances was not within the scope of this study. In the event that this project should move forward, it will be necessary to investigate municipal, township, county, state and federal regulatory requirements during the permitting phase of the project.

9. Summary and Conclusions

The purpose of this study was to determine if it would be financially feasible for a group of public schools to own and operate a wind turbine to supply some of their own electricity to offset the aggregate amount of their individual electricity bills.

For the wind energy generation, an average of four different sites in the area was used as the basis for the financial model. A specific location was not specified as a part of this study. There are many sites within the region of interest that will meet or exceed the production estimates used for this study.

For total electricity usage, the collective amount used by all participating schools in the year 2002 was used for the study. The total annual electricity usage is an important variable in this study. As the total usage diminishes, the project will become less financially attractive. As the usage increases, the project becomes more financially attractive.

For the electricity cost, an average of all participating schools costs was used for the study. It is likely that any group rate negotiated for a project such as this would be in the range of the average assumed for this study.

Based on these assumptions, this type of project is financially feasible and would save ND taxpayers money.

Issues regarding contracts, cooperation and coordination among the utilities that serve the schools was not addressed as a part of this study, nor were the permitting issues that would need to be addressed if the schools should decide to move forward with this project.

Appendix A

Comprehensive Wind Data Analysis

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wtg study

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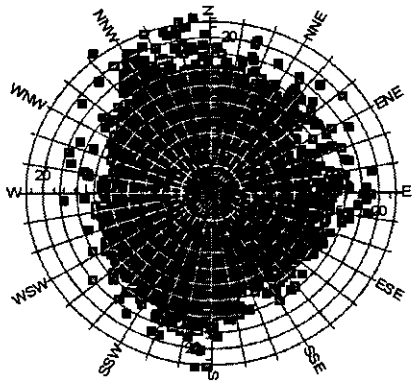
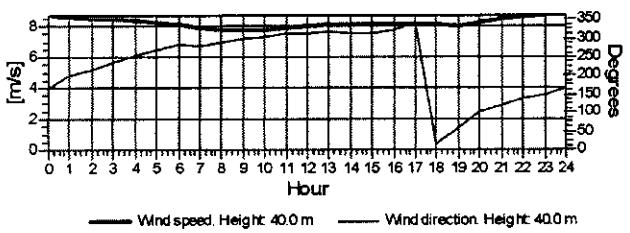
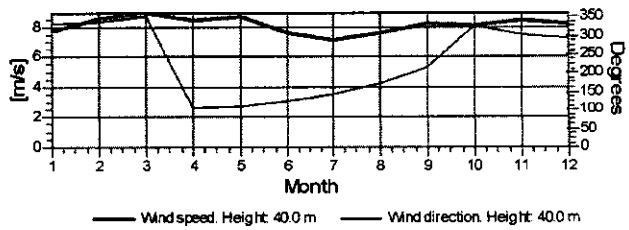


Wind speed [m/s]

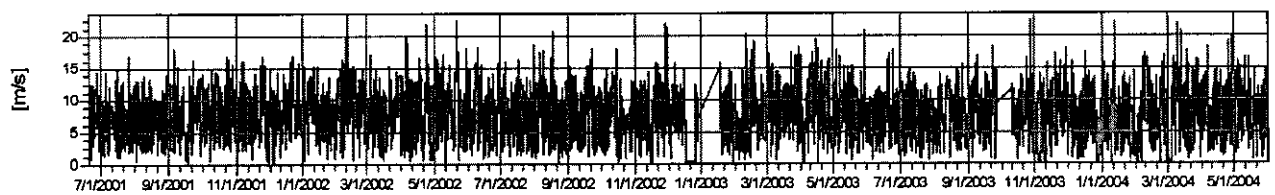
Monthly mean values of wind speed in m/s

Month	2001	2002	2003	2004	mean	mean of months
Jan		8.1	7.6	7.5	7.7	7.7
Feb		9.6	8.0	8.1	8.5	8.5
Mar		8.2	8.9	9.8	8.9	8.9
Apr		8.3	9.0	8.2	8.5	8.5
May		8.9	8.6	8.5	8.7	8.7
Jun	7.6	7.9	7.4		7.6	7.6
Jul	6.9	7.3	7.1		7.1	7.1
Aug	7.3	8.0	7.6		7.6	7.6
Sep	7.7	8.4	8.6		8.2	8.2
Oct	8.7	7.3	8.2		8.0	8.1
Nov	8.4	8.4	8.5		8.4	8.4
Dec	8.4	8.0	8.0		8.2	8.2
mean, all data	7.9	8.2	8.1	8.4	8.1	
mean of months	7.9	8.2	8.1	8.4		8.1

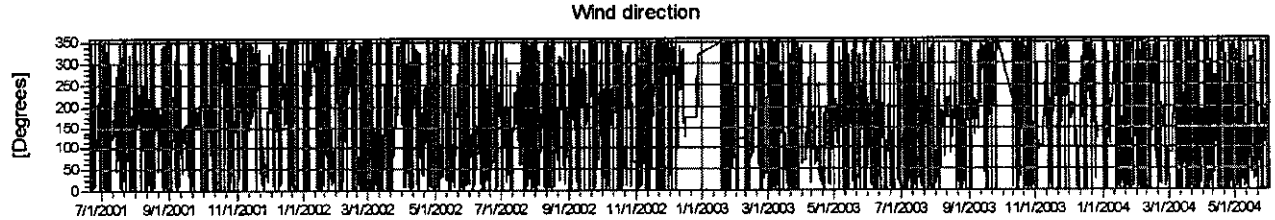




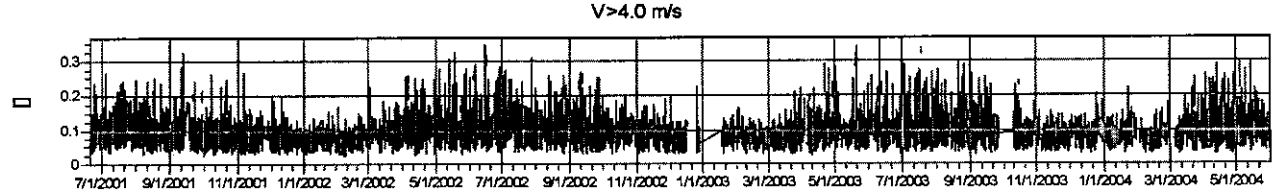
Wind speed



Wind direction



Turbulence intensity
V>4.0 m/s



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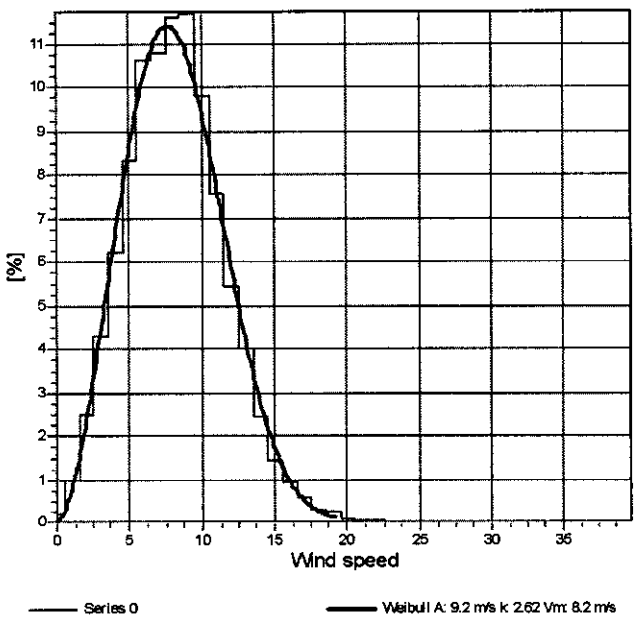

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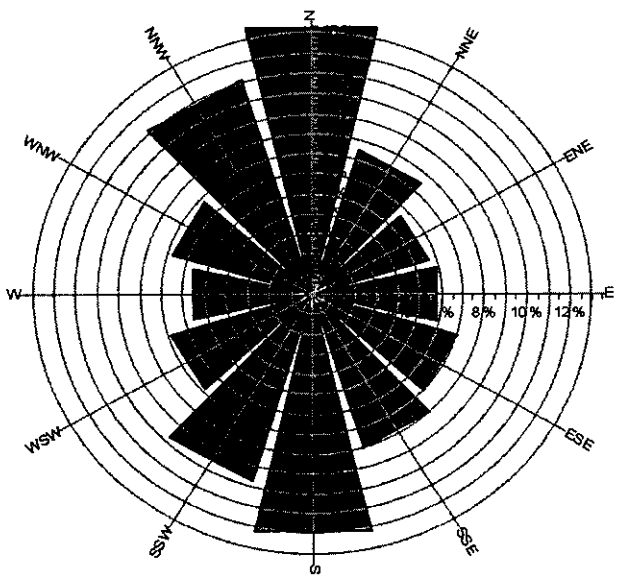

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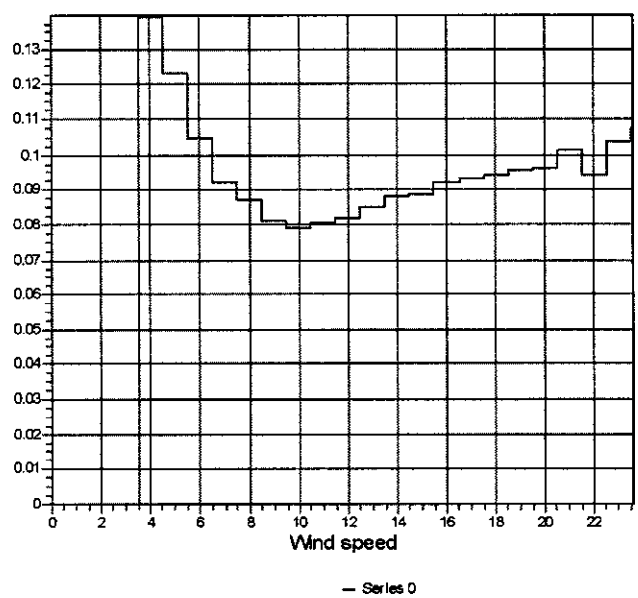

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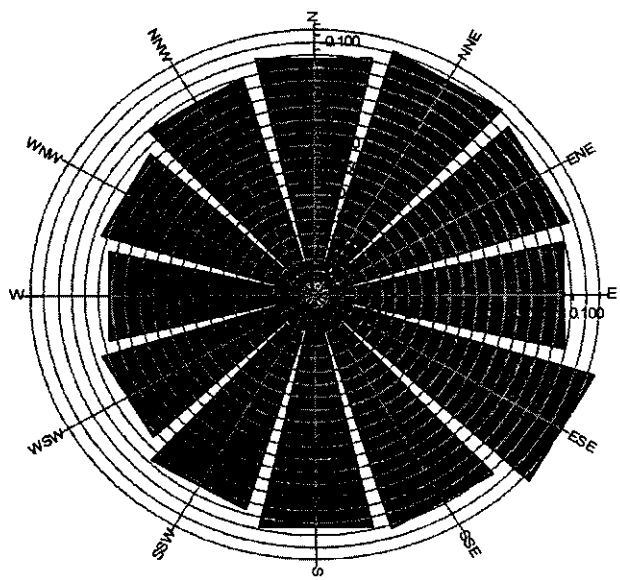

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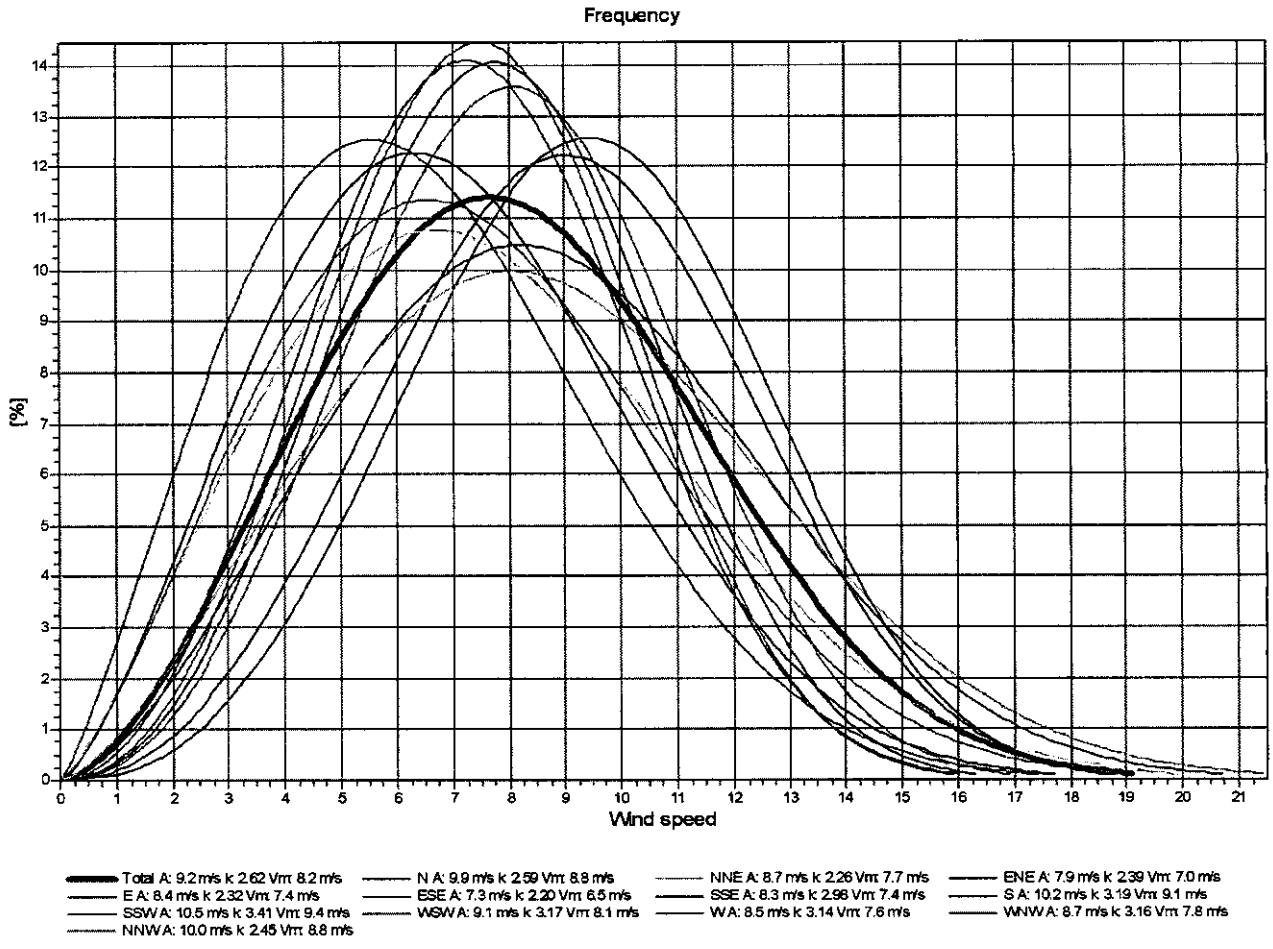
Name of meteo object: 2257 Wishek update data for meteo report

Weibull Data

k-parameter correction: 0.0080/m

Sector	A- parameter [m/s]	Mean wind speed [m/s]	k- parameter	Frequency	Frequency [%]	Wind shear
0-N	9.92	8.81	2.592	13.57	13.6	0.13
1-NNE	8.67	7.68	2.258	7.51	7.5	0.14
2-ENE	7.93	7.03	2.385	5.67	5.7	0.16
3-E	8.38	7.42	2.316	5.92	5.9	0.39
4-ESE	7.31	6.48	2.202	7.01	7.0	0.12
5-SSE	8.29	7.40	2.983	8.02	8.0	0.25
6-S	10.16	9.10	3.193	12.17	12.2	0.22
7-SSW	10.47	9.40	3.413	9.70	9.7	0.30
8-WSW	9.09	8.14	3.174	6.84	6.8	0.27
9-W	8.45	7.56	3.138	5.69	5.7	0.23
10-WNW	8.75	7.83	3.162	6.79	6.8	0.19
11-NNW	9.97	8.84	2.453	11.11	11.1	0.22
mean	9.20	8.18	2.624	100.00	100.0	0.21



Appendix B

Comprehensive Wind Energy Production Analyses

EAPC, 3100 DeMers Avenue, Grand Forks, North Dakota, 58201 ; Telephone: 701 - 775 - 5507 ; Fax: 701 - 772 - 3605

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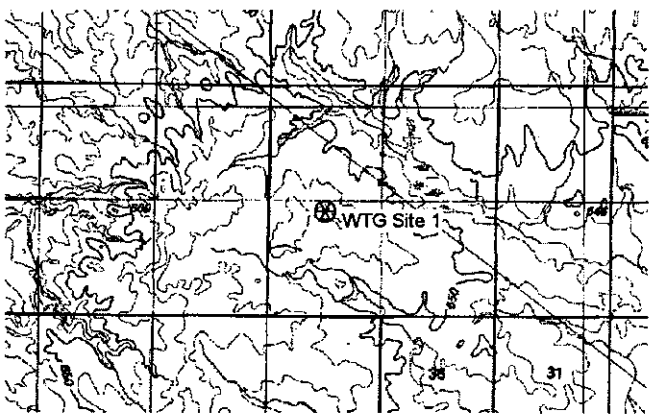
WAsP interface - Main Result

Calculation: Site 1

Name	WTG Site 1
Site Coordinates	
UTM NAD27 Zone: 14 East: 446,365 North: 5,128,522	
Air density	1.166 kg/m3
Height above sea level	670 m
Mean temperature	6.0 °C

Calculation is based on "WTG Site 1", using WAsP (RVEA0011 1, 0, 0, 11) to convert the wind statistics and the terrain classifcation to a site specific wind speed distribution.
Using the selected power curve, the expected annual energy production is calculated.

Wind statistics	US 40.0 m 2257 Wishek.lib



Scale 1:100,000

Site Data

Calculation Results

Key results for height 50.0 m above ground level

Wind energy: 4,854 kWh/m2; Mean wind speed: 8.6 m/s; Equivalent roughness: 0.9

Calculated Annual Energy

WTG type						Power curve		Annual Energy			
Valid	Manufact.	Type	Power	Diam.	Height	Creator	Name	Result	Result-10%	Mean wind speed	Capacity factor
			[kW]	[m]	[m]			[MWh]	[MWh]	[m/s]	[%]
Yes	NEG MICON	NM48/750	750/200	48.2	50.0	EMD	Windtest/Man. 09-1999	2,737.0	2,463	8.6	41.6
Yes	VESTAS	V47-US	660	47.0	50.0	USER	US version	2,637.0	2,373	8.6	45.6

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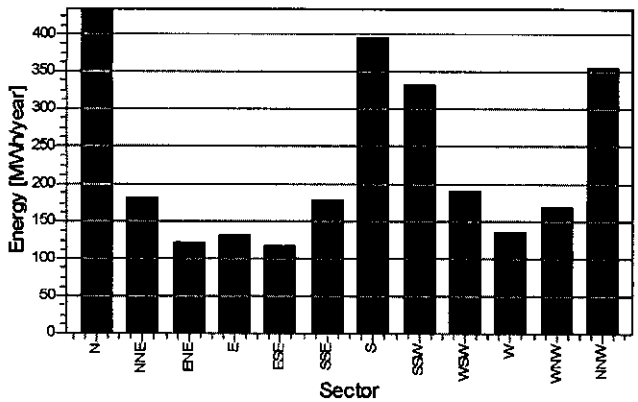
WAsP interface - Production Analysis

Calculation: Site 1 **WTG:** NEG MICON NM48-750 750-200 48.2 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

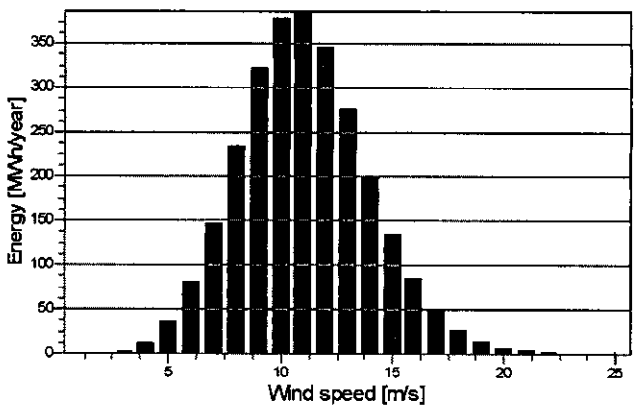
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	405.5	169.5	113.0	123.9	109.6	164.9	370.2	310.5	177.4	128.3	157.9	334.3	2,565.0
+Increase due to hills	[MWh]	27.7	11.6	7.9	6.5	7.9	14.5	25.5	19.4	11.8	8.5	11.0	19.9	172.0
Resulting energy	**[MWh]**	**433.1**	**181.0**	**120.9**	**130.4**	**117.5**	**179.4**	**395.7**	**329.9**	**189.2**	**136.8**	**168.9**	**354.1**	**2,737.0**
Specific energy	[kWh/m2]													1,500
Specific energy	[kWh/kW]													3,649
Increase due to hills	[%]	6.8	6.8	7.0	5.2	7.2	8.8	6.9	6.3	6.6	6.6	6.9	5.9	6.7
Directional Distribution	[%]	15.8	6.6	4.4	4.8	4.3	6.6	14.5	12.1	6.9	5.0	6.2	12.9	100.0
Utilization	[%]	27.5	29.0	34.2	31.4	35.5	37.4	29.2	30.0	35.1	38.5	37.1	27.8	30.9
Operational	[Hours/year]	1,159	581	492	489	595	679	981	764	585	503	600	963	8,391
Full Load Equivalent	[Hours/year]	577	241	161	174	157	239	528	440	252	182	225	472	3,649
A- parameter	[m/s]	10.5	9.5	8.3	8.7	7.5	8.7	10.8	11.1	9.5	8.8	8.9	10.4	9.7
Mean wind speed	[m/s]	9.3	8.4	7.4	7.7	6.6	7.8	9.7	10.0	8.5	7.9	8.0	9.2	8.6
k- parameter		2.66	2.37	2.45	2.30	2.26	3.18	3.12	3.56	3.30	3.56	3.28	2.65	2.69
Frequency	[%]	13.8	6.9	5.9	5.8	7.1	8.1	11.7	9.1	7.0	6.0	7.2	11.5	100.0
Power density	[W/m2]													554

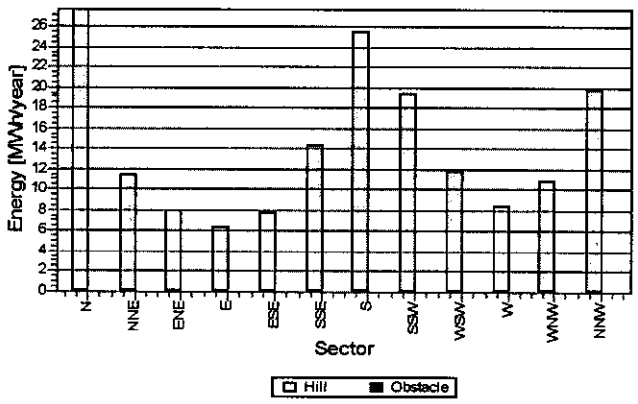
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



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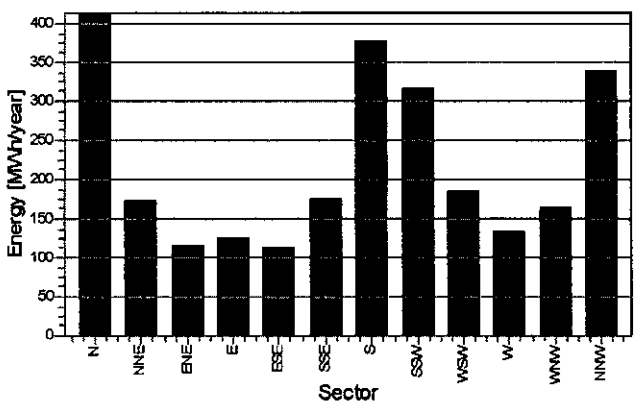
WAsP interface - Production Analysis

Calculation: Site 1 **WTG:** VESTAS V47-US 660 47.0 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

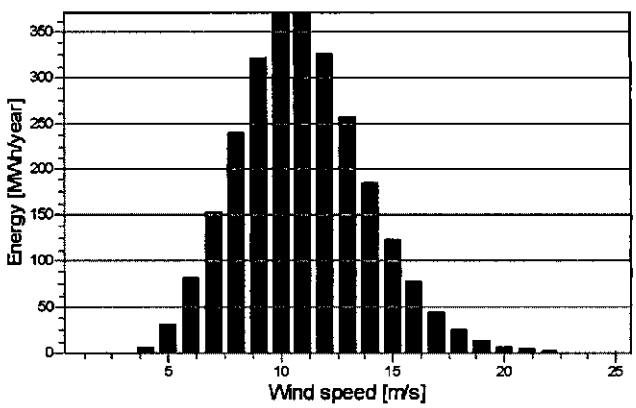
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	389.1	163.1	109.6	119.5	106.3	161.6	355.8	298.3	172.7	126.2	154.6	320.8	2,477.7
+Increase due to hills	[MWh]	25.5	10.8	7.5	6.1	7.6	13.7	23.2	17.5	10.9	8.0	10.3	18.3	159.3
Resulting energy	**[MWh]**	**414.6**	**173.9**	**117.1**	**125.6**	**113.9**	**175.4**	**379.0**	**315.8**	**183.6**	**134.2**	**164.9**	**339.1**	**2,637.0**
Specific energy	[kWh/m2]													1,520
Specific energy	[kWh/kW]													3,995
Increase due to hills	[%]	6.5	6.6	6.8	5.1	7.1	8.5	6.5	5.9	6.3	6.3	6.7	5.7	6.4
Directional Distribution	[%]	15.7	6.6	4.4	4.8	4.3	6.7	14.4	12.0	7.0	5.1	6.3	12.9	100.0
Utilization	[%]	27.7	29.3	34.8	31.9	36.2	38.5	29.4	30.2	35.8	39.7	38.1	28.0	31.3
Operational	[Hours/year]	1,159	581	492	489	595	679	981	764	585	503	600	963	8,391
Full Load Equivalent	[Hours/year]	628	263	177	190	173	266	574	478	278	203	250	514	3,995
A- parameter	[m/s]	10.5	9.5	8.3	8.7	7.5	8.7	10.8	11.1	9.5	8.8	8.9	10.4	9.7
Mean wind speed	[m/s]	9.3	8.4	7.4	7.7	6.6	7.8	9.7	10.0	8.5	7.9	8.0	9.2	8.6
k- parameter		2.66	2.37	2.45	2.30	2.26	3.18	3.12	3.56	3.30	3.56	3.28	2.65	2.69
Frequency	[%]	13.8	6.9	5.9	5.8	7.1	8.1	11.7	9.1	7.0	6.0	7.2	11.5	100.0
Power density	[W/m2]													554

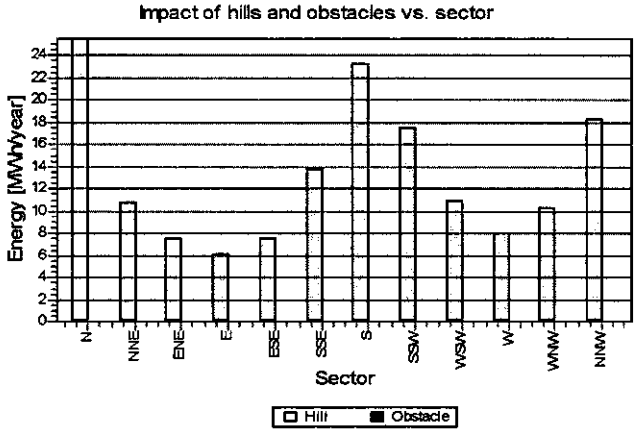
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



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WAsP interface - Power Curve Analysis

Calculation: Site 1 **WTG:** NEG MICON NM48-750 750-200 48.2 !O! Windtest/Man. 09-1999, Hub height: 50.0 m

Name: Windtest/Man. 09-1999
Source: Windtest/Manufacturer

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type
09/17/1999	EMD	11/20/2000	10/7/2002	25.0	Stall	User defined

According to Main Specification: TIC 386'001 NM 48/750 dated 15-12-2000

Power curve

Original data from Windcat, Air density: 1.225 kg/m3

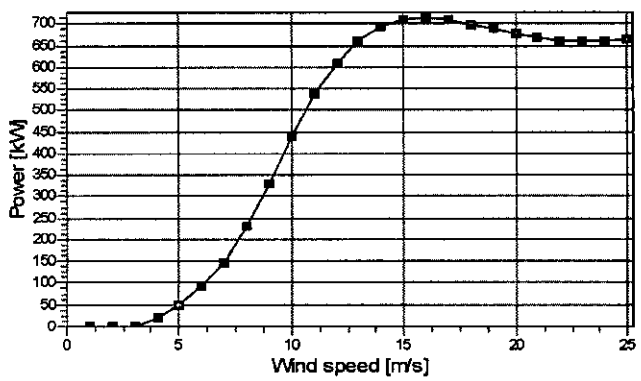
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
3.0	0.0	0.00	4.0	0.98
4.0	19.5	0.27	5.0	0.86
5.0	53.1	0.38	6.0	0.76
6.0	97.4	0.40	7.0	0.90
7.0	155.3	0.41	8.0	0.83
8.0	244.6	0.43	9.0	0.76
9.0	349.2	0.43	10.0	0.69
10.0	462.2	0.41	11.0	0.61
11.0	564.5	0.38	12.0	0.54
12.0	640.5	0.33	13.0	0.47
13.0	696.3	0.28	14.0	0.42
14.0	729.8	0.24	15.0	0.37
15.0	745.5	0.20	16.0	0.33
16.0	750.0	0.16	17.0	0.30
17.0	744.6	0.14	18.0	0.27
18.0	734.8	0.11	19.0	0.25
19.0	723.0	0.09	20.0	0.23
20.0	711.9	0.08	21.0	0.22
21.0	701.4	0.07	22.0	0.20
22.0	694.3	0.06	23.0	0.19
23.0	692.8	0.05	24.0	0.18
24.0	695.2	0.04	25.0	0.17
25.0	700.6	0.04		

Power, Efficiency and energy vs. wind speed

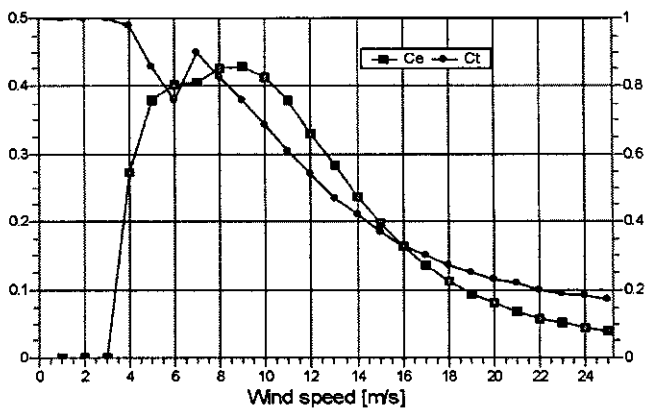
Data used in calculation, Air density: 1.166 kg/m3

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1.0	0.0	0.00	0.50- 1.50	0.0	0.0	0.0
2.0	0.0	0.00	1.50- 2.50	0.0	0.0	0.0
3.0	0.0	0.00	2.50- 3.50	1.8	1.8	0.1
4.0	18.6	0.27	3.50- 4.50	11.8	13.6	0.5
5.0	50.5	0.38	4.50- 5.50	36.8	50.4	1.8
6.0	92.7	0.40	5.50- 6.50	80.5	130.9	4.8
7.0	147.8	0.41	6.50- 7.50	146.9	277.8	10.2
8.0	232.8	0.43	7.50- 8.50	233.8	511.6	18.7
9.0	332.4	0.43	8.50- 9.50	320.7	832.3	30.4
10.0	439.9	0.41	9.50-10.50	378.3	1,210.6	44.2
11.0	537.3	0.38	10.50-11.50	385.8	1,596.4	58.3
12.0	609.7	0.33	11.50-12.50	344.8	1,941.2	70.9
13.0	662.8	0.28	12.50-13.50	275.7	2,216.8	81.0
14.0	694.7	0.24	13.50-14.50	200.7	2,417.5	88.3
15.0	709.6	0.20	14.50-15.50	134.5	2,552.0	93.2
16.0	713.9	0.16	15.50-16.50	83.8	2,635.7	96.3
17.0	708.7	0.14	16.50-17.50	48.7	2,684.5	98.1
18.0	699.4	0.11	17.50-18.50	26.6	2,711.1	99.1
19.0	688.2	0.09	18.50-19.50	13.7	2,724.8	99.6
20.0	677.6	0.08	19.50-20.50	6.7	2,731.5	99.8
21.0	667.6	0.07	20.50-21.50	3.1	2,734.7	99.9
22.0	660.9	0.06	21.50-22.50	1.4	2,736.1	100.0
23.0	659.4	0.05	22.50-23.50	0.6	2,736.7	100.0
24.0	661.7	0.04	23.50-24.50	0.2	2,736.9	100.0
25.0	666.9	0.04	24.50-25.50	0.1	2,737.0	100.0

Power curve
Data used in calculation



Ce and Ct curve



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WAsP interface - Power Curve Analysis

Calculation: Site 1 **WTG:** VESTAS V47-US 660 47.0 !O! US version, Hub height: 50.0 m

Name: US version
Source: Vestas

Source/Date	Created by	Created	Edited	Stop wind speed [m/s]	Power control	CT curve type
07/04/2002	USER	5/31/2002	5/31/2002	25.0	Pitch	User defined

Power curve

Original data from Windcat, Air density: 1.225 kg/m3

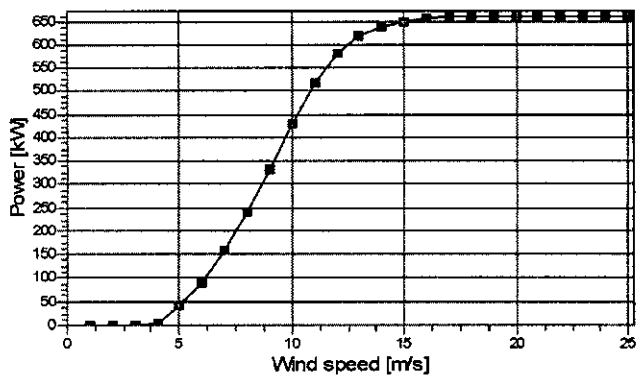
Wind speed [m/s]	Power [kW]	Ce	Wind speed [m/s]	Ct curve
4.0	2.9	0.04	3.0	0.00
5.0	43.8	0.33	4.0	0.92
6.0	96.7	0.42	5.0	0.89
7.0	166.0	0.46	6.0	0.88
8.0	252.0	0.46	7.0	0.88
9.0	350.0	0.45	8.0	0.83
10.0	450.0	0.42	9.0	0.81
11.0	538.0	0.38	10.0	0.75
12.0	600.0	0.33	11.0	0.66
13.0	635.0	0.28	12.0	0.57
14.0	651.0	0.23	13.0	0.40
15.0	657.0	0.19	14.0	0.31
16.0	659.0	0.16	15.0	0.24
17.0	660.0	0.13	16.0	0.20
18.0	660.0	0.11	17.0	0.17
			18.0	0.14
			19.0	0.12
			20.0	0.10
			21.0	0.09
			22.0	0.08
			23.0	0.07
			24.0	0.07
			25.0	0.06

Power, Efficiency and energy vs. wind speed

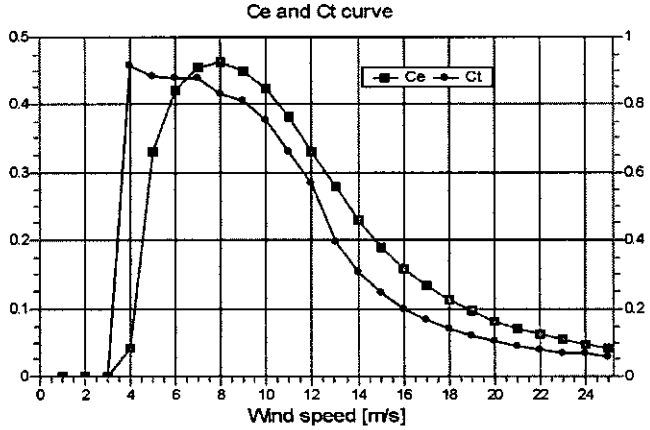
Data used in calculation, Air density: 1.166 kg/m3

Wind speed [m/s]	Power [kW]	Ce	Interval [m/s]	Energy [MWh]	Acc.Energy [MWh]	Relative [%]
1.0	0.0	0.00	0.50- 1.50	0.0	0.0	0.0
2.0	0.0	0.00	1.50- 2.50	0.0	0.0	0.0
3.0	0.0	0.00	2.50- 3.50	0.0	0.0	0.0
4.0	2.8	0.04	3.50- 4.50	6.4	6.4	0.2
5.0	41.7	0.33	4.50- 5.50	31.4	37.8	1.4
6.0	92.0	0.42	5.50- 6.50	80.8	118.7	4.5
7.0	158.0	0.46	6.50- 7.50	153.3	272.0	10.3
8.0	239.9	0.46	7.50- 8.50	239.9	511.9	19.4
9.0	333.1	0.45	8.50- 9.50	320.1	832.0	31.6
10.0	428.8	0.42	9.50-10.50	369.1	1,201.1	45.5
11.0	516.2	0.38	10.50-11.50	370.9	1,572.0	59.6
12.0	579.8	0.33	11.50-12.50	327.1	1,899.1	72.0
13.0	617.9	0.28	12.50-13.50	257.5	2,156.7	81.8
14.0	637.8	0.23	13.50-14.50	184.9	2,341.5	88.8
15.0	648.1	0.19	14.50-15.50	123.1	2,464.7	93.5
16.0	654.6	0.16	15.50-16.50	76.9	2,541.6	96.4
17.0	660.0	0.13	16.50-17.50	45.3	2,586.8	98.1
18.0	660.0	0.11	17.50-18.50	25.1	2,611.9	99.0
19.0	660.0	0.10	18.50-19.50	13.1	2,625.0	99.5
20.0	660.0	0.08	19.50-20.50	6.5	2,631.6	99.8
21.0	660.0	0.07	20.50-21.50	3.1	2,634.7	99.9
22.0	660.0	0.06	21.50-22.50	1.4	2,636.1	100.0
23.0	660.0	0.05	22.50-23.50	0.6	2,636.7	100.0
24.0	660.0	0.05	23.50-24.50	0.2	2,636.9	100.0
25.0	660.0	0.04	24.50-25.50	0.1	2,637.0	100.0

Power curve
Data used in calculation



Ce and Ct curve



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WAsP interface - Wind Data Analysis

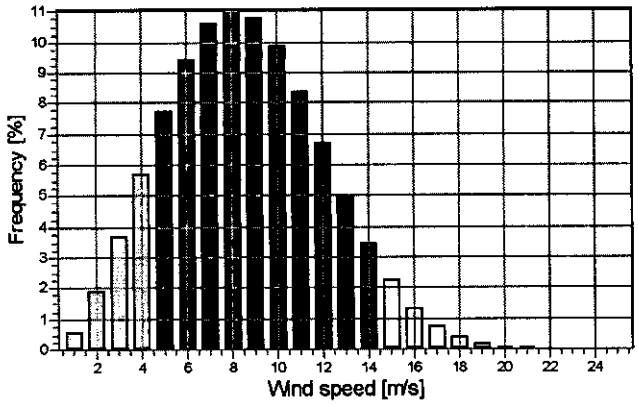
Calculation: Site 1 **Wind data:** A - WTG Site 1; Hub height: 50.0

Site Coordinates
UTM NAD27 Zone: 14 East: 446,365 North: 5,128,522
Wind statistics US 40.0 m 2257 Wishek.lib

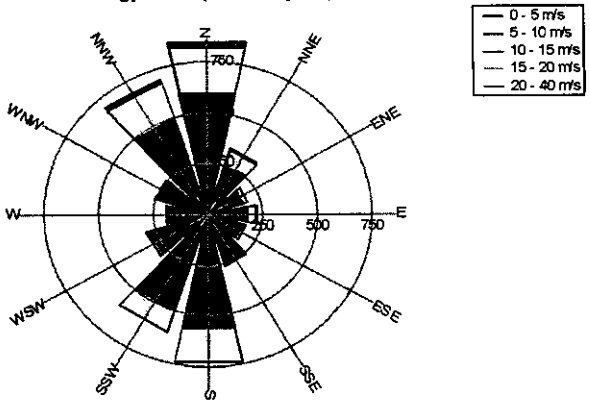
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	10.49	9.32	2.662	13.8
1 NNE	9.46	8.38	2.373	6.9
2 ENE	8.34	7.39	2.451	5.9
3 E	8.67	7.69	2.299	5.8
4 ESE	7.50	6.65	2.264	7.1
5 SSE	8.66	7.76	3.182	8.1
6 S	10.81	9.67	3.123	11.7
7 SSW	11.12	10.02	3.557	9.1
8 WSW	9.51	8.53	3.303	7.0
9 W	8.77	7.90	3.561	6.0
10 WNW	8.91	7.99	3.275	7.2
11 NNW	10.39	9.23	2.646	11.5
All	9.66	8.59	2.689	100.0

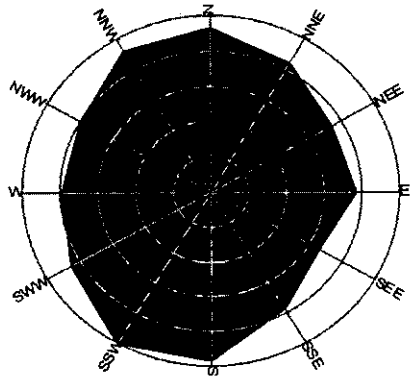
Weibull Distribution



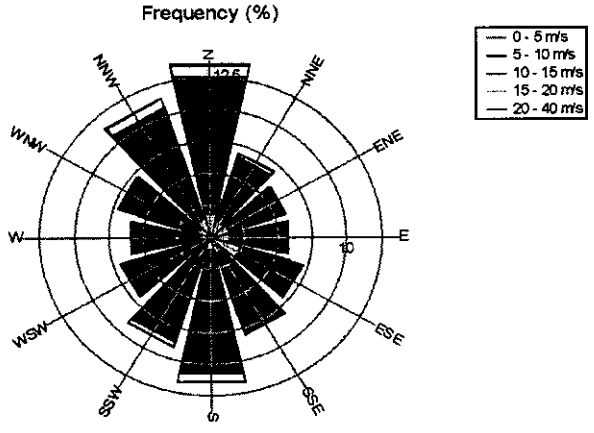
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



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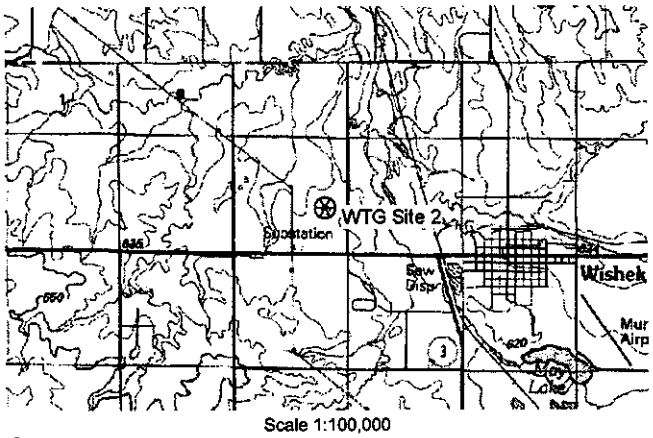
WAsP interface - Main Result

Calculation: Site 2

Name WTG Site 2
Site Coordinates
UTM NAD27 Zone: 14 East: 454,495 North: 5,123,406
Air density 1.166 kg/m3
Height above sea level 670 m
Mean temperature 6.0 °C

Calculation is based on "WTG Site 2", using WAsP (RVEA0011 1, 0, 0, 11) to convert the wind statistics and the terrain classifcation to a site specific wind speed distribution.
Using the selected power curve, the expected annual energy production is calculated.

Wind statistics US 40.0 m 2257 Wishek.lib



Scale 1:100,000

⊛ Site Data

Calculation Results

Key results for height 50.0 m above ground level
Wind energy: 4,580 kWh/m2; Mean wind speed: 8.4 m/s; Equivalent roughness: 1.0

Calculated Annual Energy

WTG type						Power curve		Annual Energy			
Valid	Manufact.	Type	Power	Diam.	Height	Creator	Name	Result	Result-10%	Mean wind speed	Capacity factor
			[kW]	[m]	[m]			[MWh]	[MWh]	[m/s]	[%]
Yes	NEG MICON	NM48/750	750/200	48.2	50.0	EMD	Windtest/Man. 09-1999	2,656.5	2,391	8.4	40.4
Yes	VESTAS	V47-US	660	47.0	50.0	USER	US version	2,563.2	2,307	8.4	44.3

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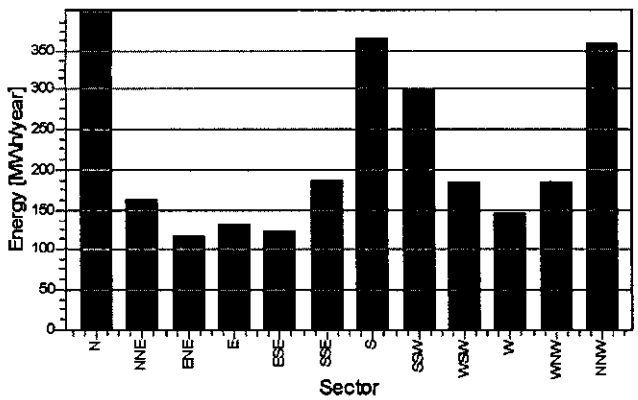
WAsP interface - Production Analysis

Calculation: Site 2 **WTG:** NEG MICON NM48-750 750-200 48.2 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

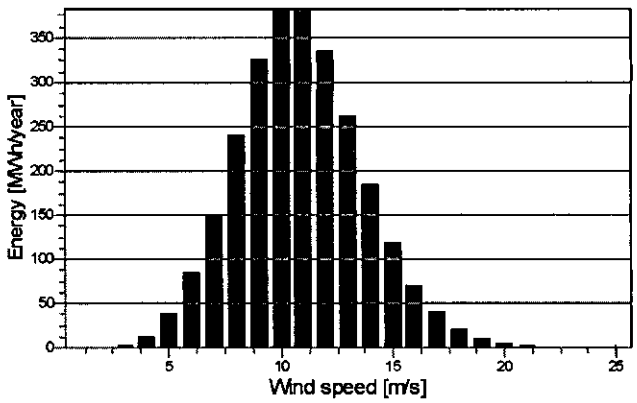
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	393.9	161.8	111.5	124.2	112.4	169.4	358.4	298.3	176.8	133.3	166.5	340.6	2,547.0
-Decrease due to obstacles	[MWh]	0.0	0.0	0.0	1.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9
+Increase due to hills	[MWh]	6.0	0.5	4.3	8.6	13.1	17.2	6.3	0.9	7.1	12.5	18.8	17.0	112.4
Resulting energy	**[MWh]**	**399.9**	**162.4**	**115.8**	**131.7**	**123.8**	**186.5**	**364.7**	**299.1**	**183.9**	**145.8**	**185.3**	**357.6**	**2,656.5**
Specific energy	[kWh/m2]													1,456
Specific energy	[kWh/kW]													3,542
Decrease due to obstacles	[%]	0.0	0.0	0.0	0.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Increase due to hills	[%]	1.5	0.3	3.9	6.9	11.7	10.1	1.7	0.3	4.0	9.4	11.3	5.0	4.4
Directional Distribution	[%]	15.1	6.1	4.4	5.0	4.7	7.0	13.7	11.3	6.9	5.5	7.0	13.5	100.0
Utilization	[%]	28.6	30.5	34.7	31.8	35.5	37.1	30.5	31.6	35.5	38.1	36.3	28.0	31.8
Operational	[Hours/year]	1,118	557	489	505	621	694	949	734	584	522	632	980	8,383
Full Load Equivalent	[Hours/year]	533	216	154	176	165	249	486	399	245	194	247	477	3,542
A- parameter	[m/s]	10.2	9.1	8.2	8.6	7.5	8.7	10.5	10.7	9.4	8.9	9.1	10.3	9.5
Mean wind speed	[m/s]	9.1	8.1	7.3	7.6	6.7	7.8	9.4	9.7	8.4	8.0	8.1	9.2	8.4
k- parameter		2.66	2.37	2.44	2.29	2.28	3.15	3.13	3.56	3.30	3.54	3.23	2.65	2.71
Frequency	[%]	13.3	6.6	5.8	6.0	7.4	8.3	11.3	8.8	7.0	6.2	7.5	11.7	100.0
Power density	[W/m2]													523

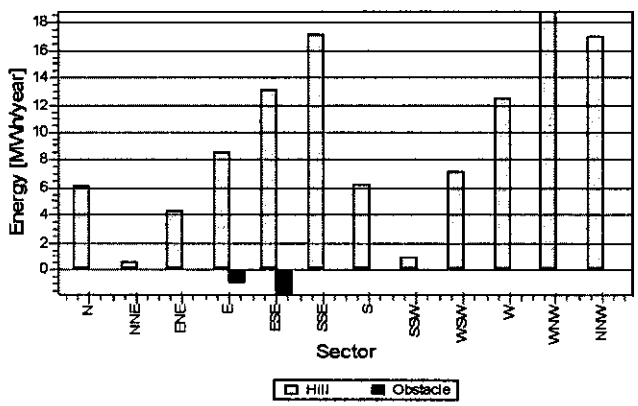
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



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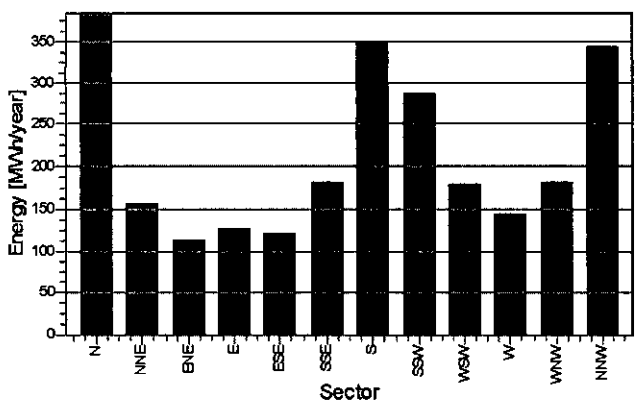
WAsP interface - Production Analysis

Calculation: Site 2 **WTG:** VESTAS V47-US 660 47.0 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

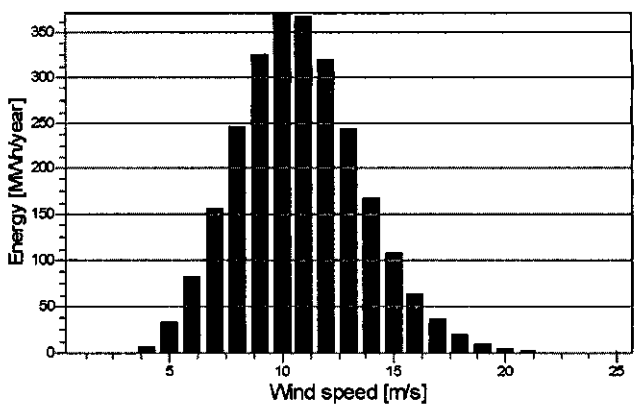
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	377.9	155.7	108.1	119.9	109.1	165.9	344.5	286.6	172.1	131.1	162.8	326.9	2,460.7
-Decrease due to obstacles	[MWh]	0.0	0.0	0.0	1.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7
+Increase due to hills	[MWh]	5.6	0.5	4.1	8.1	12.6	16.2	5.7	0.8	6.6	11.8	17.6	15.7	105.2
Resulting energy	**[MWh]**	**383.4**	**156.2**	**112.2**	**127.0**	**120.0**	**182.1**	**350.2**	**287.4**	**178.7**	**142.9**	**180.5**	**342.6**	**2,563.2**
Specific energy	[kWh/m2]													1,477
Specific energy	[kWh/kW]													3,884
Decrease due to obstacles	[%]	0.0	0.0	0.0	0.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Increase due to hills	[%]	1.5	0.3	3.8	6.7	11.5	9.8	1.7	0.3	3.8	9.0	10.8	4.8	4.3
Directional Distribution	[%]	15.0	6.1	4.4	5.0	4.7	7.1	13.7	11.2	7.0	5.6	7.0	13.4	100.0
Utilization	[%]	28.9	30.9	35.3	32.3	36.2	38.1	30.8	31.9	36.3	39.3	37.2	28.2	32.3
Operational	[Hours/year]	1,118	557	489	505	621	694	949	734	584	522	632	980	8,383
Full Load Equivalent	[Hours/year]	581	237	170	192	182	276	531	435	271	216	273	519	3,884
A- parameter	[m/s]	10.2	9.1	8.2	8.6	7.5	8.7	10.5	10.7	9.4	8.9	9.1	10.3	9.5
Mean wind speed	[m/s]	9.1	8.1	7.3	7.6	6.7	7.8	9.4	9.7	8.4	8.0	8.1	9.2	8.4
k- parameter		2.66	2.37	2.44	2.29	2.28	3.15	3.13	3.56	3.30	3.54	3.23	2.65	2.71
Frequency	[%]	13.3	6.6	5.8	6.0	7.4	8.3	11.3	8.8	7.0	6.2	7.5	11.7	100.0
Power density	[W/m2]													523

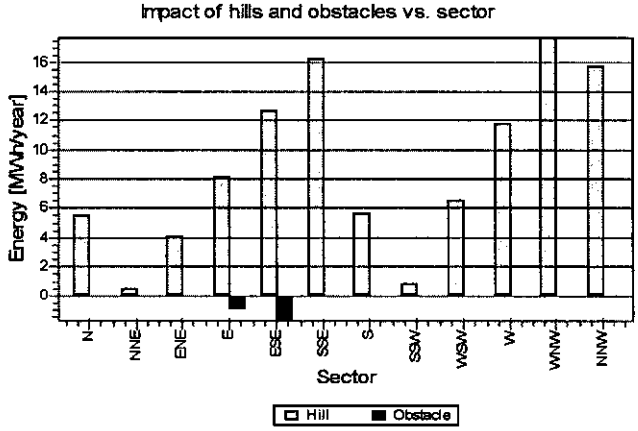
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



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WAsP interface - Wind Data Analysis

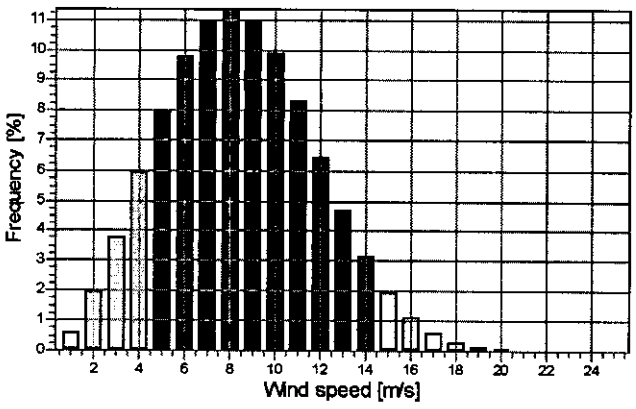
Calculation: Site 2 **Wind data:** A - WTG Site 2; Hub height: 50.0

Site Coordinates
UTM NAD27 Zone: 14 East: 454,495 North: 5,123,406
Wind statistics US 40.0 m 2257 Wishek.lib

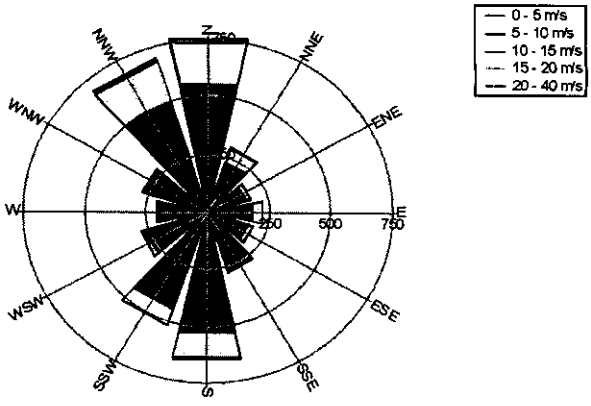
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	10.19	9.06	2.658	13.3
1 NNE	9.10	8.06	2.373	6.6
2 ENE	8.19	7.26	2.443	5.8
3 E	8.57	7.59	2.295	6.0
4 ESE	7.54	6.68	2.275	7.4
5 SSE	8.72	7.81	3.154	8.3
6 S	10.48	9.38	3.131	11.3
7 SSW	10.72	9.65	3.564	8.8
8 WSW	9.39	8.42	3.299	7.0
9 W	8.87	7.99	3.545	6.2
10 WNW	9.07	8.13	3.229	7.5
11 NNW	10.33	9.18	2.646	11.7
All	9.49	8.44	2.713	100.0

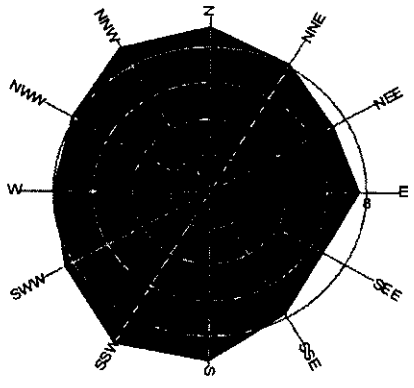
Weibull Distribution



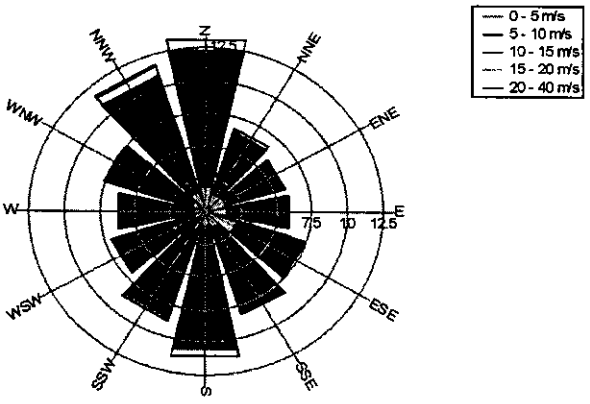
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



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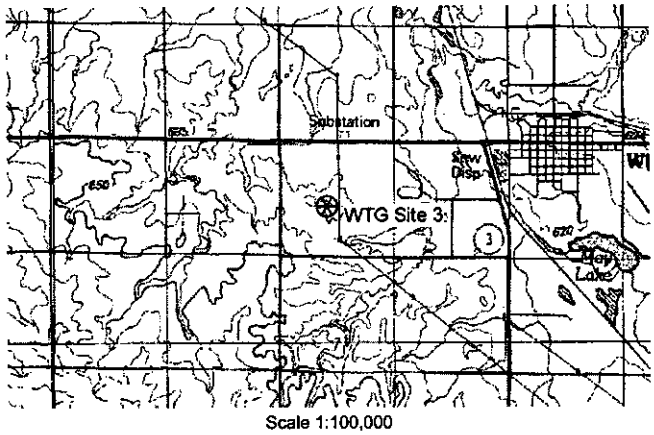
WAsP interface - Main Result

Calculation: Site 3

Name WTG Site 3
Site Coordinates
UTM NAD27 Zone: 14 East: 453,864 North: 5,121,866
Air density 1.166 kg/m3
Height above sea level 670 m
Mean temperature 6.0 °C

Calculation is based on "WTG Site 3", using WAsP (RVEA0011 1, 0, 0, 11) to convert the wind statistics and the terrain classifcation to a site specific wind speed distribution.
Using the selected power curve, the expected annual energy production is calculated.

Wind statistics US 40.0 m 2257 Wishek.lib



Scale 1:100,000

⊗ Site Data

Calculation Results

Key results for height 50.0 m above ground level
Wind energy: 4,576 kWh/m2; Mean wind speed: 8.4 m/s; Equivalent roughness: 1.0

Calculated Annual Energy

WTG type						Power curve		Annual Energy			
Valid	Manufact.	Type	Power	Diam.	Height	Creator	Name	Result	Result-10%	Mean wind speed	Capacity factor
			[kW]	[m]	[m]			[MWh]	[MWh]	[m/s]	[%]
Yes	NEG MICON	NM48/750	750/200	48.2	50.0	EMD	Windtest/Man. 09-1999	2,643.4	2,379	8.4	40.2
Yes	VESTAS	V47-US	660	47.0	50.0	USER	US version	2,550.5	2,295	8.4	44.1

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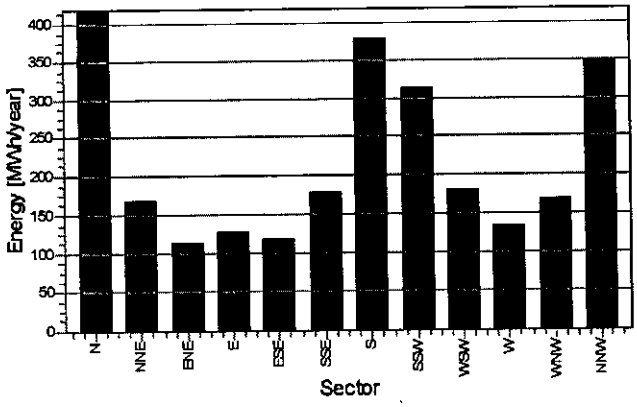
WAsP interface - Production Analysis

Calculation: Site 3 **WTG:** NEG MICON NM48-750 750-200 48.2 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

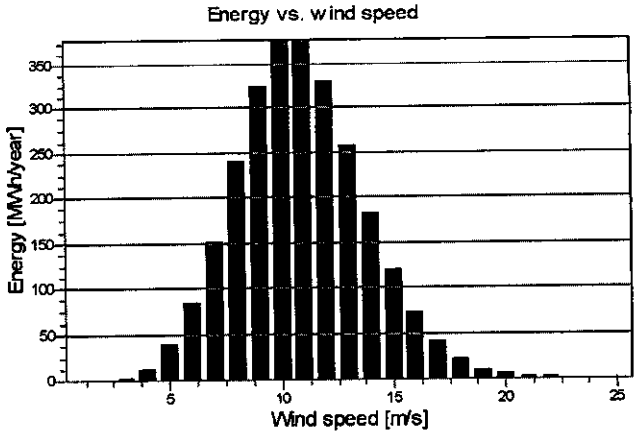
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	406.9	164.9	110.4	123.4	111.8	167.0	367.8	306.5	176.5	129.3	159.9	337.7	2,562.2
-Decrease due to obstacles	[MWh]	0.0	0.0	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
+Increase due to hills	[MWh]	12.2	3.6	2.3	3.2	5.6	9.9	12.0	6.1	3.6	4.4	7.4	12.4	82.6
Resulting energy	**[MWh]**	**419.0**	**168.6**	**112.1**	**125.8**	**117.4**	**176.9**	**379.8**	**312.7**	**180.1**	**133.7**	**167.3**	**350.1**	**2,643.4**
Specific energy	[kWh/m2]													1,449
Specific energy	[kWh/kW]													3,525
Decrease due to obstacles	[%]	0.0	0.0	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Increase due to hills	[%]	3.0	2.2	2.1	2.6	5.0	5.9	3.2	2.0	2.0	3.4	4.6	3.7	3.2
Directional Distribution	[%]	15.9	6.4	4.2	4.8	4.4	6.7	14.4	11.8	6.8	5.1	6.3	13.2	100.0
Utilization	[%]	28.2	30.3	35.1	32.2	35.6	37.7	30.2	31.1	35.8	38.8	37.3	28.4	31.7
Operational	[Hours/year]	1,148	571	488	492	601	684	972	753	581	506	607	970	8,373
Full Load Equivalent	[Hours/year]	559	225	149	168	157	236	506	417	240	178	223	467	3,525
A- parameter	[m/s]	10.3	9.2	8.1	8.5	7.5	8.6	10.6	10.8	9.3	8.7	8.8	10.2	9.5
Mean wind speed	[m/s]	9.2	8.1	7.2	7.5	6.6	7.7	9.5	9.8	8.3	7.8	7.9	9.1	8.4
k- parameter		2.66	2.37	2.44	2.29	2.26	3.18	3.13	3.56	3.30	3.56	3.28	2.65	2.69
Frequency	[%]	13.7	6.8	5.8	5.9	7.2	8.2	11.6	9.0	6.9	6.0	7.2	11.6	100.0
Power density	[W/m2]													522

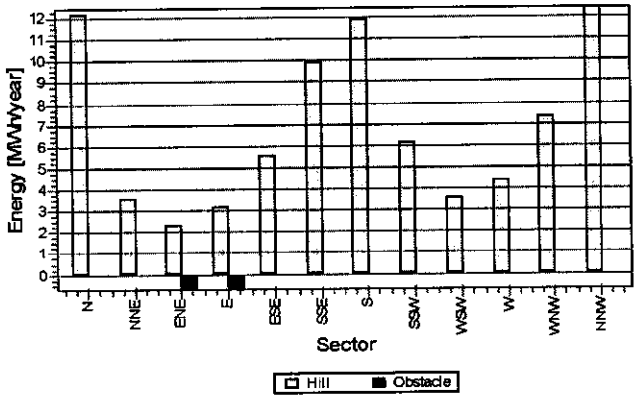
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



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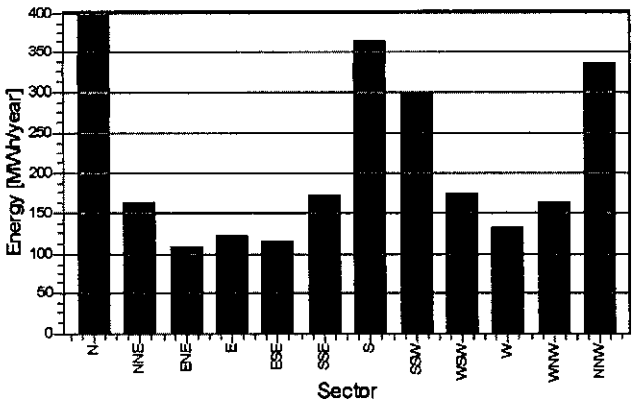
WAsP interface - Production Analysis

Calculation: Site 3 **WTG:** VESTAS V47-US 660 47.0 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

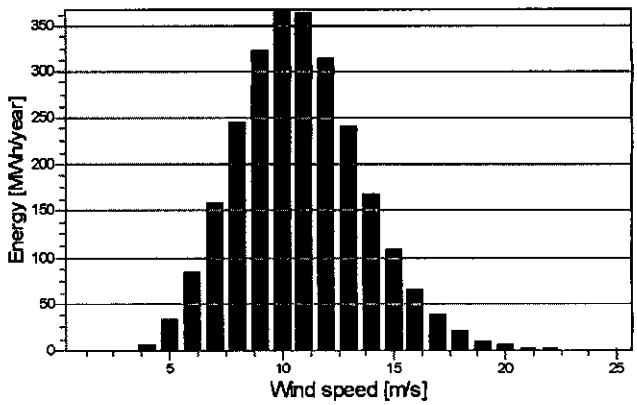
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	390.3	158.8	107.1	119.1	108.5	163.7	353.5	294.5	171.9	127.2	156.6	324.1	2,475.1
-Decrease due to obstacles	[MWh]	0.0	0.0	0.6	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
+Increase due to hills	[MWh]	11.2	3.4	2.2	3.0	5.3	9.4	10.9	5.5	3.3	4.1	6.9	11.4	76.7
Resulting energy	**[MWh]**	**401.5**	**162.2**	**108.7**	**121.4**	**113.8**	**173.0**	**364.4**	**300.0**	**175.2**	**131.3**	**163.5**	**335.5**	**2,550.5**
Specific energy	[kWh/m2]													1,470
Specific energy	[kWh/kW]													3,864
Decrease due to obstacles	[%]	0.0	0.0	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Increase due to hills	[%]	2.9	2.1	2.0	2.5	4.9	5.7	3.1	1.9	1.9	3.3	4.4	3.5	3.1
Directional Distribution	[%]	15.7	6.4	4.3	4.8	4.5	6.8	14.3	11.8	6.9	5.1	6.4	13.2	100.0
Utilization	[%]	28.4	30.6	35.8	32.6	36.3	38.8	30.4	31.4	36.7	40.0	38.4	28.6	32.1
Operational	[Hours/year]	1,148	571	488	492	601	684	972	753	581	506	607	970	8,373
Full Load Equivalent	[Hours/year]	608	246	165	184	172	262	552	455	265	199	248	508	3,864
A- parameter	[m/s]	10.3	9.2	8.1	8.5	7.5	8.6	10.6	10.8	9.3	8.7	8.8	10.2	9.5
Mean wind speed	[m/s]	9.2	8.1	7.2	7.5	6.6	7.7	9.5	9.8	8.3	7.8	7.9	9.1	8.4
k- parameter		2.66	2.37	2.44	2.29	2.26	3.18	3.13	3.56	3.30	3.56	3.28	2.65	2.69
Frequency	[%]	13.7	6.8	5.8	5.9	7.2	8.2	11.6	9.0	6.9	6.0	7.2	11.6	100.0
Power density	[W/m2]													522

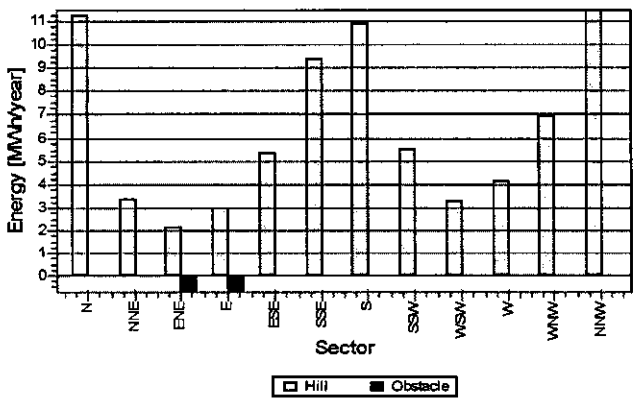
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



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WAsP interface - Wind Data Analysis

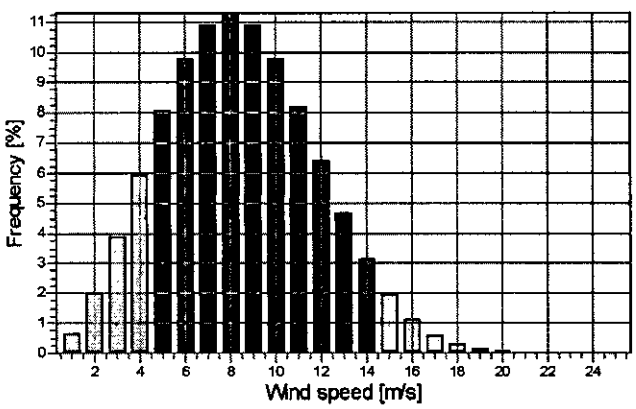
Calculation: Site 3 **Wind data:** A - WTG Site 3; Hub height: 50.0

Site Coordinates
UTM NAD27 Zone: 14 East: 453,864 North: 5,121,866
Wind statistics US 40.0 m 2257 Wishek.lib

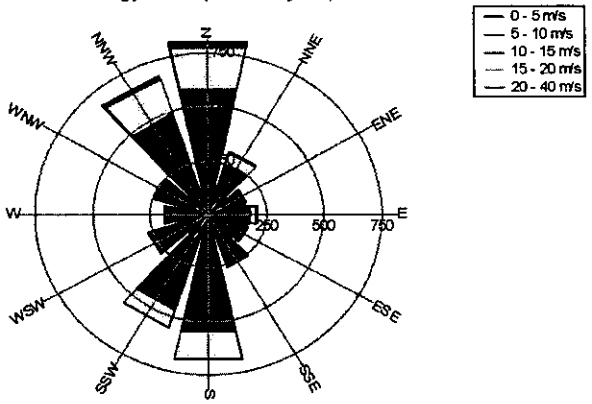
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	10.32	9.17	2.662	13.7
1 NNE	9.16	8.11	2.373	6.8
2 ENE	8.07	7.16	2.443	5.8
3 E	8.48	7.51	2.295	5.9
4 ESE	7.46	6.61	2.260	7.2
5 SSE	8.58	7.68	3.182	8.2
6 S	10.58	9.46	3.131	11.6
7 SSW	10.83	9.76	3.561	9.0
8 WSW	9.31	8.35	3.303	6.9
9 W	8.66	7.80	3.557	6.0
10 WNW	8.82	7.91	3.275	7.2
11 NNW	10.24	9.10	2.646	11.6
All	9.47	8.42	2.693	100.0

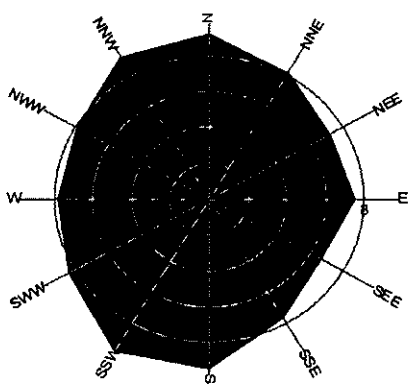
Weibull Distribution



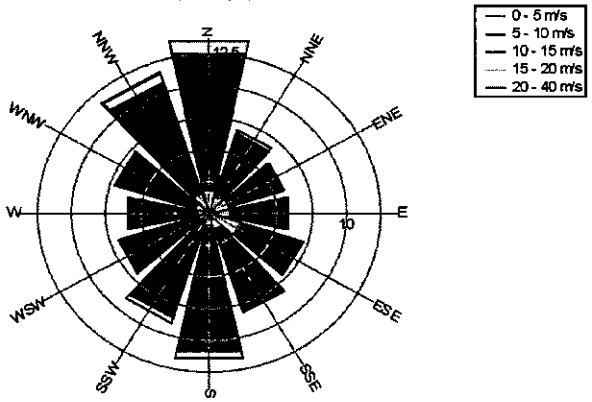
Energy Rose (kWh/m2/year)



Mean wind speed (m/s)



Frequency (%)



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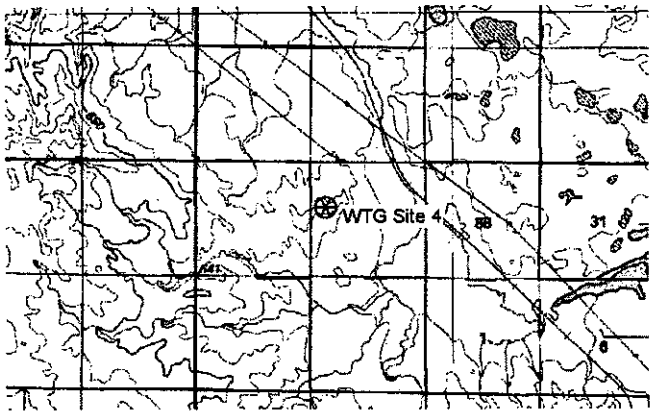
WAsP interface - Main Result

Calculation: Site 4

Name WTG Site 4
Site Coordinates
UTM NAD27 Zone: 14 East: 458,234 North: 5,117,263
Air density 1.166 kg/m3
Height above sea level 670 m
Mean temperature 6.0 °C

Calculation is based on "WTG Site 4", using WAsP (RVEA0011 1, 0, 0, 11) to convert the wind statistics and the terrain classifcation to a site specific wind speed distribution.
Using the selected power curve, the expected annual energy production is calculated.

Wind statistics US 40.0 m 2257 Wishek.lib



Scale 1:100,000

⊗ Site Data

Calculation Results

Key results for height 50.0 m above ground level
Wind energy: 4,757 kWh/m2; Mean wind speed: 8.5 m/s; Equivalent roughness: 0.9

Calculated Annual Energy

WTG type						Power curve		Annual Energy			
Valid	Manufact.	Type	Power	Diam.	Height	Creator	Name	Result	Result-10%	Mean wind speed	Capacity factor
			[kW]	[m]	[m]			[MWh]	[MWh]	[m/s]	[%]
Yes	NEG MICON	NM48/750	750/200	48.2	50.0	EMD	Windtest/Man. 09-1999	2,709.4	2,438	8.5	41.2
Yes	VESTAS	V47-US	660	47.0	50.0	USER	US version	2,611.9	2,351	8.5	45.1

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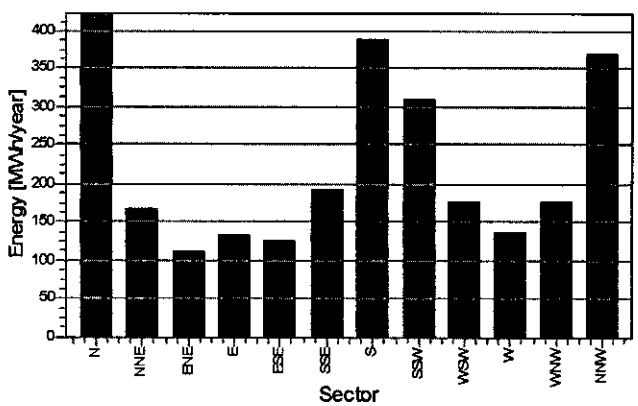
WAsP interface - Production Analysis

Calculation: Site 4 **WTG:** NEG MICON NM48-750 750-200 48.2 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

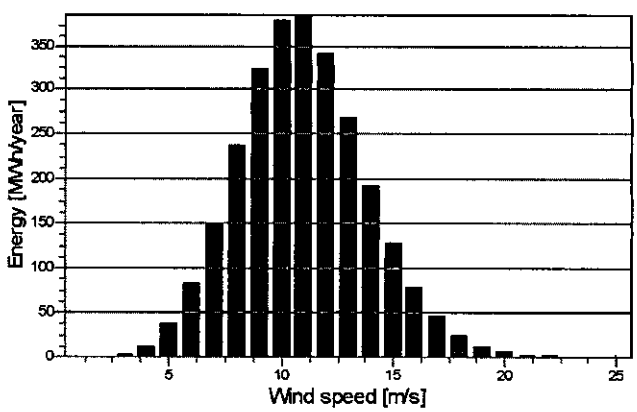
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	402.8	164.2	110.0	127.5	113.4	171.1	367.8	302.0	173.2	129.3	161.9	343.8	2,567.0
+Increase due to hills	[MWh]	19.9	4.0	2.2	5.2	11.8	21.3	20.1	6.8	3.4	7.6	15.0	24.9	142.3
Resulting energy	**[MWh]**	**422.8**	**168.2**	**112.2**	**132.7**	**125.2**	**192.4**	**387.9**	**308.8**	**176.6**	**136.9**	**176.9**	**368.7**	**2,709.4**
Specific energy	[kWh/m2]													1,485
Specific energy	[kWh/kW]													3,612
Increase due to hills	[%]	5.0	2.4	2.0	4.1	10.4	12.4	5.5	2.3	2.0	5.9	9.3	7.2	5.5
Directional Distribution	[%]	15.6	6.2	4.1	4.9	4.6	7.1	14.3	11.4	6.5	5.1	6.5	13.6	100.0
Utilization	[%]	27.7	30.0	34.9	31.3	35.0	36.9	29.6	31.0	35.9	38.5	36.8	27.5	31.2
Operational	[Hours/year]	1,142	564	480	490	610	700	974	743	572	507	615	993	8,390
Full Load Equivalent	[Hours/year]	564	224	150	177	167	257	517	412	235	183	236	492	3,612
A- parameter	[m/s]	10.4	9.2	8.1	8.7	7.6	8.8	10.7	10.9	9.3	8.7	9.0	10.5	9.6
Mean wind speed	[m/s]	9.3	8.2	7.2	7.7	6.8	7.9	9.6	9.8	8.3	7.9	8.1	9.3	8.5
k- parameter		2.66	2.37	2.45	2.31	2.26	3.17	3.13	3.56	3.30	3.55	3.28	2.65	2.70
Frequency	[%]	13.6	6.7	5.7	5.8	7.3	8.3	11.6	8.9	6.8	6.0	7.3	11.8	100.0
Power density	[W/m2]													543

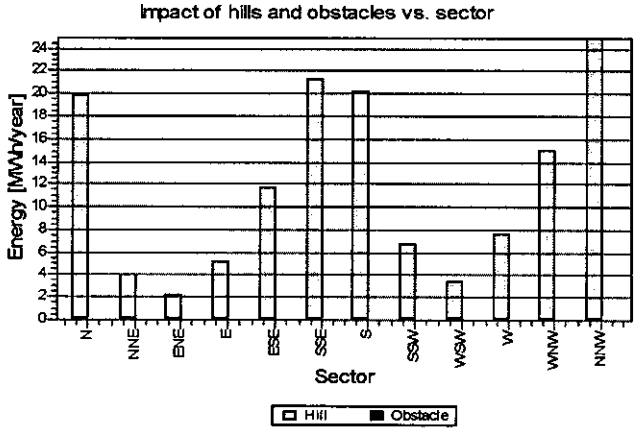
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



Project:
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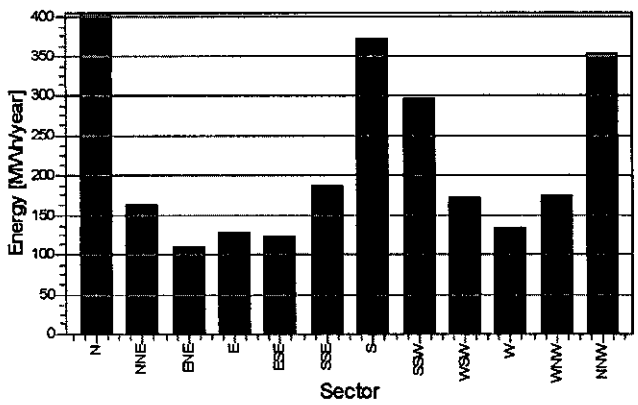
WAsP interface - Production Analysis

Calculation: Site 4 **WTG:** VESTAS V47-US 660 47.0 !O!, Hub height: 50.0 m, Air density: 1.166 kg/m3

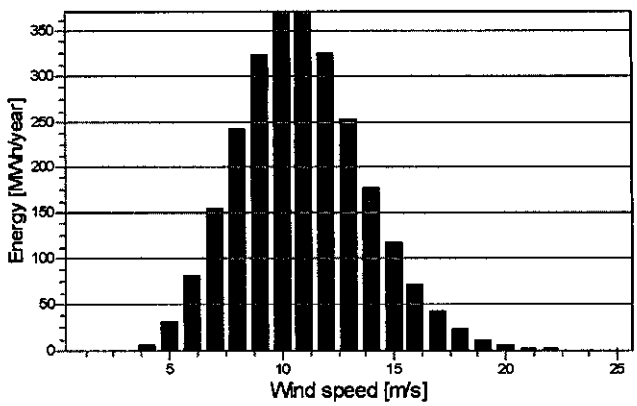
Directional Analysis

Sector		0 N	1 NNE	2 ENE	3 E	4 ESE	5 SSE	6 S	7 SSW	8 WSW	9 W	10 WNW	11 NNW	Total
Roughness based energy	[MWh]	386.4	158.0	106.7	123.0	110.0	167.7	353.5	290.2	168.6	127.2	158.5	330.0	2,479.7
+Increase due to hills	[MWh]	18.4	3.7	2.1	4.9	11.3	20.1	18.3	6.1	3.1	7.2	14.1	22.9	132.3
Resulting energy	**[MWh]**	**404.8**	**161.8**	**108.8**	**127.8**	**121.2**	**187.8**	**371.8**	**296.3**	**171.7**	**134.4**	**172.6**	**353.0**	**2,611.9**
Specific energy	[kWh/m2]													1,505
Specific energy	[kWh/kW]													3,957
Increase due to hills	[%]	4.8	2.4	2.0	4.0	10.2	12.0	5.2	2.1	1.9	5.7	8.9	7.0	5.3
Directional Distribution	[%]	15.5	6.2	4.2	4.9	4.6	7.2	14.2	11.3	6.6	5.1	6.6	13.5	100.0
Utilization	[%]	27.9	30.4	35.6	31.7	35.6	37.9	29.9	31.3	36.7	39.7	37.7	27.7	31.6
Operational	[Hours/year]	1,142	564	480	490	610	700	974	743	572	507	615	993	8,390
Full Load Equivalent	[Hours/year]	613	245	165	194	184	285	563	449	260	204	262	535	3,957
A- parameter	[m/s]	10.4	9.2	8.1	8.7	7.6	8.8	10.7	10.9	9.3	8.7	9.0	10.5	9.6
Mean wind speed	[m/s]	9.3	8.2	7.2	7.7	6.8	7.9	9.6	9.8	8.3	7.9	8.1	9.3	8.5
k- parameter		2.66	2.37	2.45	2.31	2.26	3.17	3.13	3.56	3.30	3.55	3.28	2.65	2.70
Frequency	[%]	13.6	6.7	5.7	5.8	7.3	8.3	11.6	8.9	6.8	6.0	7.3	11.8	100.0
Power density	[W/m2]													543

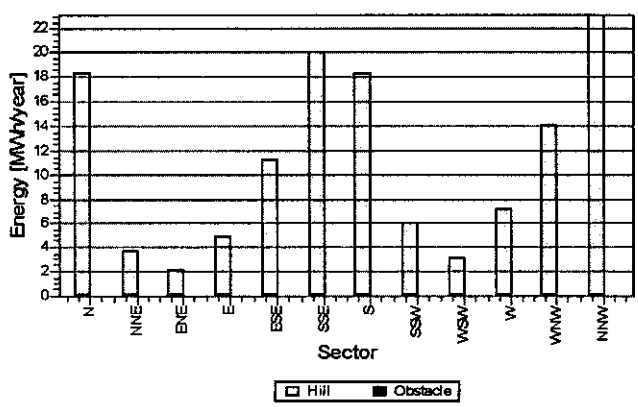
Energy vs. sector



Energy vs. wind speed



Impact of hills and obstacles vs. sector



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WAsP interface - Wind Data Analysis

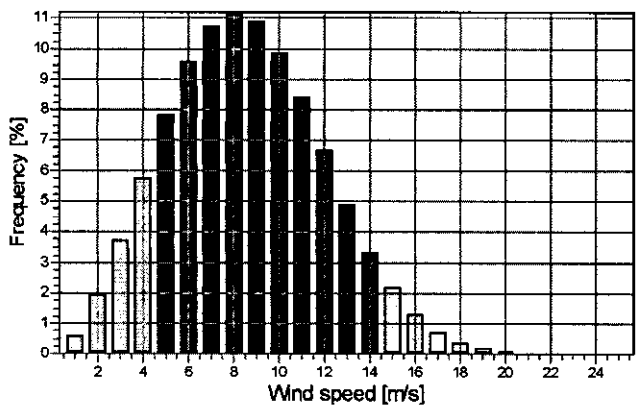
Calculation: Site 4 **Wind data:** A - WTG Site 4; Hub height: 50.0

Site Coordinates
UTM NAD27 Zone: 14 East: 458,234 North: 5,117,263
Wind statistics US 40.0 m 2257 Wishek.lib

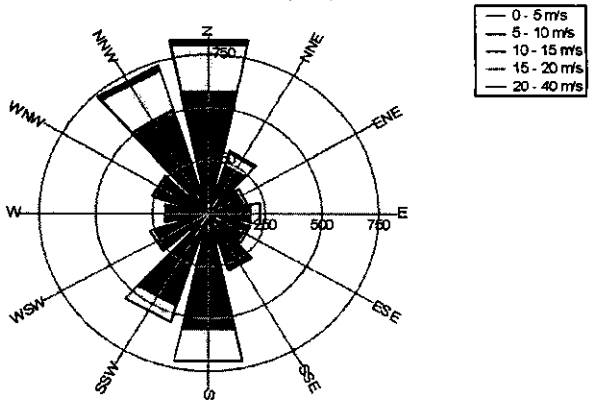
Weibull Data

Sector	Current site A- parameter [m/s]	Wind speed [m/s]	k- parameter	Frequency [%]
0 N	10.42	9.26	2.658	13.6
1 NNE	9.22	8.17	2.373	6.7
2 ENE	8.14	7.22	2.447	5.7
3 E	8.75	7.75	2.311	5.8
4 ESE	7.63	6.76	2.256	7.3
5 SSE	8.82	7.89	3.174	8.3
6 S	10.72	9.59	3.135	11.6
7 SSW	10.85	9.77	3.561	8.9
8 WSW	9.30	8.34	3.303	6.8
9 W	8.75	7.88	3.549	6.0
10 WNW	8.99	8.07	3.279	7.3
11 NNW	10.45	9.29	2.646	11.8
All	9.60	8.54	2.701	100.0

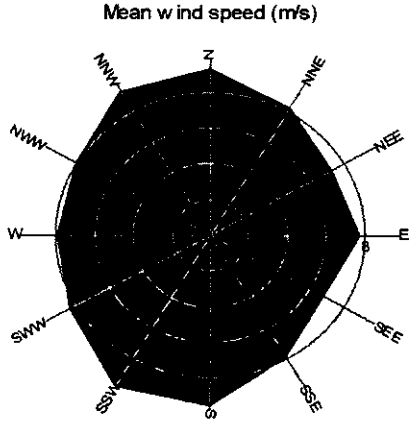
Weibull Distribution



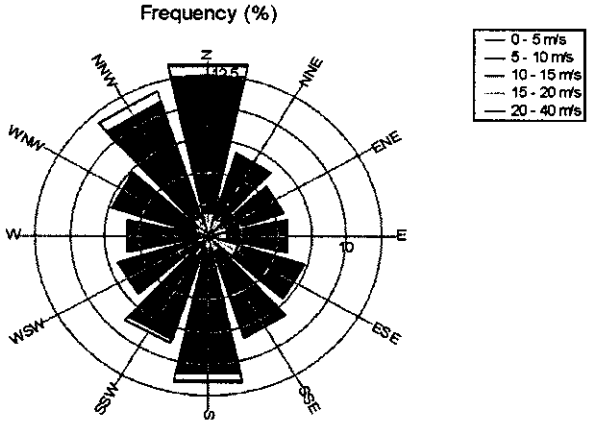
Energy Rose (kWh/m2/year)



Mean w ind speed (m/s)



Frequency (%)



Appendix C

Detailed Utility Analysis

EAPC, 3100 DeMers Avenue, Grand Forks, North Dakota, 58201 ; Telephone: 701 - 775 - 5507 ; Fax: 701 - 772 - 3605

7/22/2004

ND Public Schools
Wind Turbine Analysis

Vestas V47 660 kW Wind Turbine
50 meter hub height

Business As Usual	Average Year												Totals
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Blended Rate ($/kWh)	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	$0.0684	
Annual Usage for 2002	211,304	220,051	208,441	207,185	192,047	123,436	85,766	82,380	99,510	169,917	191,988	192,896	1,984,921
Total Utility Bill without Turbine	**$14,453**	**$15,051**	**$14,257**	**$14,171**	**$13,136**	**$8,443**	**$5,866**	**$5,635**	**$6,806**	**$11,622**	**$13,132**	**$13,194**	**$135,769**

With Wind Turbine	Average Year												Totals
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
Annual Usage for 2002	211,304	220,051	208,441	207,185	192,047	123,436	85,766	82,380	99,510	169,917	191,988	192,896	**1,984,921**
Total Energy Generated (kWh)	238,987	244,234	233,450	217,123	227,380	159,325	95,250	102,978	129,896	204,014	229,273	249,674	**2,331,585**
Energy Purchased (25% of total usage) (kWh)	52,826	55,013	52,110	51,796	48,012	30,859	21,442	20,595	24,878	42,479	47,997	48,224	**496,230**
Total Energy Sold (kWh)	80,509	79,195	77,119	61,735	83,345	66,748	30,926	41,193	55,264	76,576	85,282	105,002	**842,894**
Utility Charges (Blended Rate of $0.0684/kWh)	$3,613	$3,763	$3,564	$3,543	$3,284	$2,111	$1,467	$1,409	$1,702	$2,906	$3,283	$3,299	**$33,942**
Utility Credits for Energy Sales @ $0.015/kWh	$1,208	$1,188	$1,157	$926	$1,250	$1,001	$464	$618	$829	$1,149	$1,279	$1,575	**$12,643.4**
Total Utility Bill with Turbine	**$2,406**	**$2,575**	**$2,408**	**$2,617**	**$2,034**	**$1,110**	**$1,003**	**$791**	**$873**	**$1,757**	**$2,004**	**$1,723**	**$21,299**

Total Utility Bill without Turbine	$14,453	$15,051	$14,257	$14,171	$13,136	$8,443	$5,866	$5,635	$6,806	$11,622	$13,132	$13,194	$135,769
Total Utility Bill with Turbine	$2,406	$2,575	$2,408	$2,617	$2,034	$1,110	$1,003	$791	$873	$1,757	$2,004	$1,723	$21,299
Total Savings with Turbine	**$12,048**	**$12,477**	**$11,850**	**$11,555**	**$11,102**	**$7,333**	**$4,864**	**$4,844**	**$5,934**	**$9,865**	**$11,128**	**$11,471**	**$114,470**

Prepared By: Jay Haley, P.E.
EAPC Architects Engineers
Grand Forks, ND

Appendix D

Detailed
Cash Flow Analysis

EAPC, 3100 DeMers Avenue, Grand Forks, North Dakota, 58201 ; Telephone: 701 - 775 - 5507 ; Fax: 701 - 772 - 3605

ND PUBLIC SCHOOLS WIND TURBINE ECONOMICS

Vestas V47 660 kW Wind Turbine
50 meter hub height

Financial Inputs

Grants/Down Payment		$300,000	Mortgage Rate	(%)	6%	Simple Payback on Total Funds	8.0
Amount Financed	($)	$580,950	Mortgage Term	(Yr)	10	Simple Payback on Schools Funds	5.3
Total Cost	($)	$880,950	Rate Escalation	(%)	0%		
O&M, Insurance	($/kWh)	0.003	Inflation Rate	(%)	0%		
Landowner Payments		2%					

Project Year	Calendar Year	Gross Savings	O&M and Insurance	Landowner Payments	Net Savings	Annual Loan Payments	Interest Payments	Principal Payments	Net Cash Flow	Accumulated Savings	Total Funds Cash Flow	Project Year
1	2004	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($34,857)	($44,075)	$31,248	$31,248	($849,702)	1
2	2005	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($32,212)	($46,720)	$31,248	$62,496	($818,454)	2
3	2006	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($29,409)	($49,523)	$31,248	$93,744	($787,206)	3
4	2007	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($26,438)	($52,495)	$31,248	$124,992	($755,958)	4
5	2008	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($23,288)	($55,644)	$31,248	$156,240	($724,710)	5
6	2009	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($19,950)	($58,983)	$31,248	$187,488	($693,462)	6
7	2010	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($16,411)	($62,522)	$31,248	$218,736	($662,214)	7
8	2011	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($12,659)	($66,273)	$31,248	$249,984	($630,966)	8
9	2012	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($8,683)	($70,250)	$31,248	$281,232	($599,718)	9
10	2013	$114,470	($2,000)	($2,289)	$110,180	($78,932)	($4,468)	($74,465)	$31,248	$312,480	($568,470)	10
11	2014	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$422,660	($458,290)	11
12	2015	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$532,841	($348,109)	12
13	2016	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$643,021	($237,929)	13
14	2017	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$753,202	($127,748)	14
15	2018	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$863,382	($17,568)	15
16	2019	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$973,562	$92,612	16
17	2020	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$1,083,743	$202,793	17
18	2021	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$1,193,923	$312,973	18
19	2022	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$1,304,104	$423,154	19
20	2023	$114,470	($2,000)	($2,289)	$110,180	$0	$0	$0	$110,180	$1,414,284	$533,334	20

7/22/2004
Prepared By Jay Haley, P.E.
EAPC Architects Engineers
Grand Forks, ND

Testimony of Tom Lovik - SB 2238 Mon., Jan. 24, 2005 - Finance and Taxation Committee

Mr. Chairman, Senators, thank you for the opportunity to speak here this morning. My name is Tom Lovik. I am the econ. Dev. Coord for the City of Wishek and am speaking as a member of the McIntosh County Wind Energy Committee. We are a volunteer group of people representing all communities in McIntosh County who are interested in promoting wind energy in our county and our state.

We believe strongly in the economic and environmental benefits wind energy can provide to North Dakota, and have been actively pursuing the development of a wind farm in our area.

A few years ago when we learned that a school in Iowa had successfully erected a turbine on school grounds as a means of generating revenue to offset their electricity costs, it struck us hard as one of those "Why aren't we doing this here?" ideas. Here we sit with the number one wind resource in the nation, and small town schools that struggle to make their ends meet. What a great marriage this would make.

After talking about this idea with other proponents of wind energy in North Dakota, we learned it probably couldn't work here because of the existing arrangement utilities have for buying electricity generated from outside sources. So on our behalf, our legislators introduced a bill in the 2003 session to address the issue. As you are aware it was ultimately defeated, in part, I think, because there was no documentation to back up what we were saying.

So we regrouped and said "Okay, let's get the documentation." Our wind group applied for and received a grant from the Division of Community Services to have a feasibility study conducted using information on electricity use from seven school districts in our area. The results indicate that they can pay for a turbine in about 8 years and collectively save about $114,000 a year. Once the turbine is paid for, the annual savings for each school can keep another teacher employed, revive a dead art program or maybe buy new band uniforms...pay for a new bus.

An added benefit that often gets overlooked is that a wind energy curriculum can be added to the course offerings of these schools to educate students about renewable energy and perhaps interest them in a career that may someday keep them here. If this industry takes off like it can here, many good paying jobs may be on the horizon and this idea can begin educating these kids now and get them ready to take those jobs.

Since we first learned about this idea, school districts in several states across the country -- Minnesota, South Dakota, Iowa, Texas and Colorado to name a few -- have built turbines and are proving over and over that this works and is saving school districts thousands of dollars every year in energy costs. Gov. Hoeven has suggested the idea would be a good one for our universities to consider, so it should be a good idea for our elementary and secondary schools as well.

It's not news that rural communities are struggling to survive. Here is an opportunity to, first of all, use this tremendous, renewable, clean resource we have, to generate revenue that can help keep our schools financially solvent, which will help a little to keep our small towns a place where people want to live.

To our county wind group, this seems to be one of those "no brainer" ideas that could be terrific for our state and we encourage you support and pass this bill.

SB 2238

Legislature

Thank you. Mr. Chairmen and committee, my name is Daphne Becker and I am a senior at Ashley Public School. I heard about this idea through my dad, who's on the wind committee in McIntosh County. When he told me that they wanted to start these wind turbines in ND schools I was very interested. I'm just a High School so getting to say what I think is quite an honor. I asked to come along today testify to you. I thought about budgets of ND schools and what $25000 could do for our school. It's not what it could do really, what couldn't it do? That is, at least at our school, the clubs, committees, teams and teachers all have this what we could use or improve list. When I was told that this bill failed once before, I could understand why. It would be a huge expense and a lot of work and also a big risk, but I have to think of what it would offer. More money spent but a trustworthy investment. To my understanding, it's been very successful in other schools. But more on a general high school senior level, I want to ask you all to think about ND college graduates, I'm not one yet but I can tell you that job opportunities and small towns aren't working so well. One of the things that they talk to us about when we are senior is why we wouldn't want to stay in ND or what could be improved? This plan would give not only jobs and lower expenses, but it would give these small towns some life and some survival ideas. I have no idea what our school's budget is and it really doesn't change what we're learning. I just would like to save future kids from driving 30 miles to County High School. I'm going to graduate and I want to come back to an open improved school system, not a closed one. I think this idea is wonderful and has definite possibilities.

Testimony of Steve Schultz on behalf of Otter Tail Power Company
On SB 2238

Mr. Chairman, and members of the Committee, my name is Steve Schultz and I represent Otter Tail Power Company. I am here to oppose this bill not because of my dislike for wind generation, or to try to save load for Otter Tail Power Company. We oppose this bill because there are Federal laws that will not allow us to do what the bill asks for.

The federal Public Utilities Regulatory Policy Act (PURPA) of 1978, establishes the rules and procedures under which utilities purchase power from non-utility renewable generation such as wind. PURPA very specifically states that a utility shall pay avoided costs to the generator owner. PURPA is administered by the Federal Energy Regulatory Commission (FERC). FERC has repeatedly overturned state laws that have attempted to set standardized buyback rates across the state or buyback rates in excess of a utility's avoided costs.

PURPA does not prohibit a utility from choosing on its own to pay more than avoided cost. However, a utility such as Otter Tail Power has a regulatory responsibility to obtain capacity and energy resources to serve customer demands at the lowest cost within the regulatory rules and framework. Otter Tail Power choosing to pay more than avoided cost in any situation results in a violation of that very basic principle and results in one of two situations: 1) the utility is disallowed from passing the extra cost on to other customers and therefore suffers a loss, or 2) the utility is allowed to pass on the unnecessary cost which results in customers providing a cross-subsidy to another customer. Finally, under what rationale would a utility choose to pay more for wind generation than avoided cost, when it can obtain wind generation at or below avoided cost from another wind developer?

There are also a number of technical or operational problems that a law like this would cause. The discussion on these problems would become quite confusing and take more time than we have to spend.

In closing, at Otter Tail Power Company, we support wind and other renewable generation but we are also responsible to make prudent and ethical decisions in all purchases.

Fletcher Poling - Basin Electric Power Cooperative
North Dakota Senate Bill No. 2238
Senate Finance and Taxation Committee
January 24, 2005

Mr. Chairman and members of the committee, my name is Fletcher Poling and I am here representing Basin Electric Power Cooperative. Basin Electric opposes the passage of SB 2238.

SB 2238 is an attempt to provide a funding mechanism for schools to afford placing wind turbines in their district. These turbines would then be used to provide a learning experience for school children in those districts. Our concern is that placing single wind turbines in scattered locations across the state is not the most efficient way to provide that learning experience.

The profitability of wind energy in North Dakota at this time lies in the ability to use the Federal Production Tax Credit (PTC), and to build large-scale, multi-turbine projects. To my knowledge, school districts have no way to use the current federal PTC. They also plan to install single units, which would not allow them to take advantage of the benefits of placing multiple turbines in a single area.

To purchase and install a wind turbine and its infrastructure is a substantial undertaking. The estimated cost for a one or two wind turbine project is $1.2 million per mega-watt or $1,200 per kilowatt. Since the schools can't use the PTC and would only be installing single units the price they would need for their electricity would be very high.

Unless there are state or federal grants available to purchase these wind turbines, it will be the counties that pay for these units. Since Basin Electric has all-requirement contracts with its member cooperatives, Basin would be the purchaser of the wind power, not the local distribution cooperative. The additional cost per KWH paid for the schools wind turbines would be deducted from gross receipts taxes that Basin pays. The revenue from those gross receipt taxes is distributed to the counties where Basin Electric has certain facilities. Depending on where the school wind turbines are placed, residents in one county my see a decrease in their gross receipt revenues to pay for a school wind turbine in another county.

We believe there is an easier way to provide a learning experience for wind energy. On Basin Electrics website we allow access to the real time and historic operating performance of our wind energy facilities in Minot and Chamberlain South Dakota, and FPL's facilities near Edgeley. The website also allows access to a webcam we have set up at the Chamberlain site. Basin Electric would also be happy to work with any school that would like to visit the actual sites. We feel these options would be a more efficient way to provide a learning experience on wind energy then the one proposed in HB 2238.

This concludes my testimony and I would be happy to try and answer any questions.

Lobbyist # 351

Testimony, Senate Bill 2238
January 24, 2005

Chairman Urlacher and members of the Senate Finance and Taxation Committee.

Dakota Resource Council submits this testimony in support of SB 2238, which will create a credit against rural electric cooperative gross receipts taxes and a credit against corporate income taxes for electricity purchased from school districts that generate electricity using wind turbines.

This bill will help the residents of North Dakota keep pace with it's neighboring states of Minnesota, Iowa, and Wisconsin. These and other states are moving forward with this innovative means to help their rural school districts offset some or all of their electricity costs and allow the schools to redirect some of there financial resources to be used for other much needed school needs.

In May 2004 the state of Minnesota passed a bipartisan state bill that allowed school districts to own and operate wind turbines up to 3 megawatts and to sell the excess electricity back to their electrical service provider.

To see if this would be a possibility in North Dakota the McIntosh County Wind Energy Committee, LCC commissioned a 'ND Public Schools Wind Turbine Study', which was completed on July 22, 2004. The Ashley, Ellendale, Kulm, Napoleon, Strasburg, Wishek and Zeeland public school districts were involved with this study.

This study concluded that this type of project (using a 660 kilowatt wind turbine) would be financially feasible and would save North Dakota taxpayers money. Also this study estimated an eight to ten year payback period with a savings of $114,470 per year for these school districts.

In addition there are educational benefits, which would allow students to be involved in the planning and operation of the wind turbine(s) as well as being a great teaching tool for renewable technology. School wind projects would also be a great opportunity to link rural schools with non-rural schools, which may not be able to have a wind turbine close to their school, in teaching about renewable energy and how to build a clean sustainable North Dakota future.

Allowing school districts to generate electricity from wind would be a great way to help supply our rural schools with much needed economic resources. Currently schools in neighboring states are doing this and making money with much less wind energy resources.

Dakota Resource Council urges the committee vote a "Do Pass" on SB 2238
Respectfully submitted by the Dakota Resource Council