



# Need A Smaller Carbon Footprint? Saving Energy & Saving \$Millions



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The NRV Plant, Dublin, VA

# Considerations

## before starting your energy project:

- Do you have mandates or goals for energy reductions or GHG emissions?
- Are you facing the project alone? Can you create a team?
- Is there a Champion in senior management?
- Does using other professionals help sell programs or projects?
- Should they make the presentation to management?
- Some options for teaming:
  - ✓ **Consultants**
  - ✓ **Contractors**
  - ✓ **Universities**

# AB Volvo

## Corporate Energy Goals

- Reduce energy consumption per unit by 15% 2011 (ref.2007)
- CO2-neutral production for all main plants 2010
- A phase out plan must be drawn up for no oil/coal heating

# Our Driver?



## For the New River Valley Plant:

- Performance based contracts
- Return on investment (ROI) period
  - Less than two years

## For the other Volvo & Mack Plants:

- Do-it-yourself...but years later.

*Do you really want to wait, find time to do-it-yourself...  
or benefit now with the bottom line?*

# Volvo Truck Plant

## Focus of our Energy Projects

- **Energy Management – Building vs Process**
  - » Demand Side
- **Alternative Energy**
  - » Wind Power
- **Heating Management**
  - » Using Landfill Gas for Processes
  - » High Efficiency Heating & Ventilation
  - » PCH / Biomass

# Volvo Truck Plant

## Environmental Management Program (EMP) implemented:

### Energy Management:

- Demand Side Management (DSM) with Siemens:
  - Phase I (2002)      **Gain Control**
  - Phase II (2007)      **Energy Recovery**
  - Phase III (Current)      **Manage Energy Demand**

# Volvo Trucks



## Phase I - The basic program:

- Replace 5,811 light fixtures
  - more energy efficient fluorescent lights; and
  - high intensity discharge (HID) fixtures
- Install temperature & area lighting controls
- Building Automation System - BAS

# Savings Summary



- Investment
  - Siemens DSM Management Project
    - Vendor Investment = **\$2.9 MUSD**
- Overall Savings
  - Approximately **\$7 Million USD** for 6 years of operation
- Excess Savings to NRV
  - **\$2.5 Million USD**
- Mid-2008–Lease Ended–All savings to NRV going forward

# Phase I - Siemens DSM Program

## Actual Energy Savings – 2007

- Electricity – 21,101,897 KWH
- Electricity Demand - 9,864 KW
- Natural Gas – 1,298,836 therms

## Electric Utility Emissions Avoided - 2007

(<http://www.epa.gov/cleanenergy/index.html>)

- CO2/GHG = 11,000 to 18,000 tons based on emissions calculator applied (or [www.questline.com](http://www.questline.com))

## Phase II – Heat Recovery Units include exhaust fans



# Phase II - Siemens DSM Program

## Project elements:

- Expand lighting and controls to buildings not addressed in Phase I
- Main Assembly Exhaust Heat Recovery
  - Add closed loop glycol coils for heat reclaim on 16 H&V units and 16 exhaust fans
  - Integrate to Siemens Building Automation system controls
- Cost Savings late 2006 through 2007
  - ~\$20,000

# Phase III - Siemens DSM Program

## Current Condition:

- Plant demands an average up to **12,000 KWD** of electricity
- Billed at a rate of **\$8.35 to \$12.29 per KWD**
- Demand comprised half or more of monthly bill

## Project Elements:

- Install electrical demand control project in Siemens BAS
- Monitor demand & shed nonessential electrical loads during periods of high plant demand

## Projected Savings:

– **966 KWD / 1,159,200 KWH / up to \$131,000/yr**

# Actions for Reductions in Energy & Green House Gas (GHG) Emissions

Energy Committee evaluating options

1. **JUNE 2007** - Wind turbine installed, and operational by October '07. Evaluating installation of additional units.
2. **MAY 2007** - Evaluation report from Durr for energy reductions in air supply to spray booths, and landfill gas use for heating in paint shop.
3. **SEP 2008** – Approved pilot project for Globe Energy



**Volvo Trucks**

NRV Environmental Department

14 September 2008



# Wind Turbine

- Volvo looked at hiring a consultant to perform wind study.
- Price tag **\$50,000 to \$100,000 for 5 year study** from engineering firm.
- Volvo attended JMU wind seminar in 2006.
- Applied to JMU for Grant.
- Grant Awarded to Volvo in January 2007.

# Wind Turbine

- Volvo contracted with Chesapeake Renewable to install 10kw wind turbine in order to perform wind study.
- Wind turbine cost **\$36,000**. Feed power back into the grid (AEP is our battery).
- Volvo received wild estimates (from experts) to install solar/wind. Upwards of 2 million for wind and 200k for Solar to perform the same task as the **\$36,000** wind turbine (Stay involved, do your homework, and think for yourself) .
- Wind turbine installed **June 2007**.

# BWC EXCEL

## 10KW CLASS

### WIND TURBINE



- 5-YEAR WARRANTY
- AMERICA'S BEST SELLING RESIDENTIAL SYSTEM
- CERTIFIED BY CALIFORNIA ENERGY COMMISSION
- SIMPLE DESIGN - 3 MOVING PARTS
- PATENTED POWERFLEX® ROTOR SYSTEM
- AUTOFURL® AUTOMATIC STORM PROTECTION
- DIRECT-DRIVE PM ALTERNATOR
- NO SCHEDULED MAINTENANCE REQUIRED
- HEAVY-DUTY CONSTRUCTION
- DESIGNED FOR 30+ YEARS
- POLYURETHANE AIRCRAFT-QUALITY PAINT
- PROVEN, OVER 50 MILLION OPERATIONAL HOURS

The Bergey BWC Excel is a rugged and reliable small wind turbine that has been proven in hundreds of installations around the world. It comes from the world's leading manufacturer of small wind turbines and is backed by the longest warranty in the industry. Whether you want to reduce the electric bills at your home or power a critical load far from the power grid, the BWC Excel will deliver years of "worry-free" power.

Excel-S: Grid-Intertie Applications (10kW)  
 Excel-R: Battery Charging Applications (7.5kW)  
 Excel-PD: Pumping Applications (10kW)



Excel-S GridTrek 10  
Power Processor  
(AC output)



Excel-R OptiCharge  
Voltage Regulator  
(DC output)



23 ft (7 meter)  
Rotor Disassembled

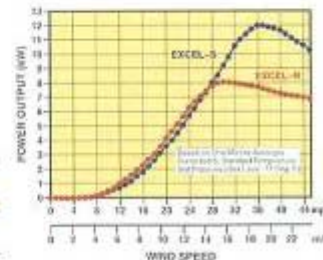


Net Weight: 1,050 lbs  
Shipping Weight: 1,200 lbs

**THE ONLY MOVING PARTS ARE THE PARTS YOU SEE MOVING**

### PERFORMANCE

Start-up Wind Speed... 7.5 mph  
 Cut-In Wind Speed... 8 mph  
 Rated Wind Speed... 31 mph  
 Rated Rotor Speed... 310 RPM  
 Furling Wind Speed... 35 mph  
 Max. Design Wind Speed... 125 mph  
 (with Extra-Stiff Blades... 150 mph)



**POINT, CLICK, LEARN,  
 ANALYZE & BUY WISKLY!**  
[WWW.BERGEY.COM](http://WWW.BERGEY.COM)

### Predicted Monthly Energy Production

Wind Speeds Taken at Top of Tower

Average Wind Speed	4 mph	9 mph	10 mph	11 mph	12 mph	13 mph	14 mph
Excel-S (DC kW/mo)	216	327	523	700	928	1,175	1,524
Excel-R (DC kW/mo)	150	225	344	460	600	770	1,004

Wind Speeds Taken at 10 meters (per standard wind resource maps)

Average Wind Speed	4 mph	9 mph	10 mph	11 mph	12 mph	13 mph	14 mph
40 ft	Excel-S	220	339	519	712	930	1,193
	Excel-R	148	222	338	450	580	750
30 ft	Excel-S	433	628	844	1,070	1,376	1,770
	Excel-R	283	390	520	670	860	1,100
100 ft	Excel-S	450	706	950	1,220	1,540	1,910
	Excel-R	304	470	630	810	1,030	1,300
120 ft	Excel-S	558	780	1,030	1,340	1,700	2,120
	Excel-R	360	540	720	930	1,190	1,500

Assumptions: Standard Site, Roughness Distribution, Shear Exponent = 0.18, Altitude x 1,000 ft.

Note: Battery charge regulators (batteries full) will reduce actual Excel-R performance.

Your Performance May Vary.



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**Volvo Trucks**

NRV Environmental Department

17 September 2008

# WindCad Turbine Performance Model

**BWC EXCEL-S, Grid - Intertie**

GT10-SH3055-22-BWC

Prepared For: **Customer**  
 Site Location: **Customer Site**  
 Data Source: **Wind Map**  
 Date: **8/12/2008**

10 kW

Inputs:
Ave. Wind (m/s) = 2.875
Weibull K = 2
Site Altitude (m) = 665
Wind Shear Exp. = 0.180
Anem. Height (m) = 5
Tower Height (m) = 24.39
Turbulence Factor = 0.0%

Results:
Hub Average Wind Speed (m/s) = 3.82
Air Density Factor = -6%
Average Output Power (kW) = 0.43
Daily Energy Output (kWh) = 10.3
Annual Energy Output (kWh) = 3,775
Monthly Energy Output = 315
Percent Operating Time = 51.4%

**Summary**

NRV PLANT to date  
**8.55** mph avg wind  
 7/7/2008  
 at 80 feet  
 At 120' we should have 11.98  
 Our Goal is 12 mph annual

**Weibull Performance Calculations**

Wind Speed Bin (m/s)	Power (kW)	Wind Probability (f)	Net kW @ V	Weibull Calculations:
1	0.00	10.26%	0.000	Weibull Calculations: Wind speed probability is calculated as a Weibull curve defined by the average wind speed and a shape factor, K. To facilitate piece-wise integration, the wind speed range is broken down into "bins" of 1 m/s in width (Column 1). For each wind speed bin, instantaneous wind turbine power (W, Column 2)) is multiplied by the Weibull wind speed probability (f, Column 3). This cross product (Net W, Column 4) is the contribution to average turbine power output contributed by wind speeds in that bin. The sum of these contributions is the average power output of the turbine on a continuous, 24 hour, basis. Best results are achieved using annual or monthly average wind speeds. Use of daily or hourly average speeds is not recommended.
2	0.00	17.45%	0.000	
3	0.03	19.96%	0.006	
4	0.24	18.22%	0.044	
5	0.53	13.98%	0.074	
6	0.94	9.25%	0.087	
7	1.52	5.34%	0.081	
8	2.36	2.71%	0.064	
9	3.28	1.21%	0.040	
10	4.31	0.48%	0.021	
11	5.63	0.17%	0.010	
12	7.00	0.05%	0.004	
13	8.24	0.01%	0.001	
14	9.15	0.00%	0.000	
15	9.58	0.00%	0.000	
16	9.42	0.00%	0.000	
17	9.23	0.00%	0.000	
18	8.59	0.00%	0.000	
19	8.17	0.00%	0.000	
20	7.79	0.00%	0.000	
2008, BWC		Totals:	99.09%	0.431

**Instructions:**

**Inputs:** Use annual or monthly Average Wind speeds. If Weibull K is not known, use K = 2 for inland sites, use 3 for coastal sites, and use 4 for island sites and trade wind regimes. Site Altitude is meters above sea level. Wind Shear Exponent is best assumed as 0.18. For rough terrain or high turbulence use 0.22. For very smooth terrain or open water use 0.11. Anemometer Height is for the data used for the Average Wind speed. If unknown, use 10 meters. Tower Height is the nominal height of the tower, eg.: 24 meters. Turbulence Factor is a derating for turbulence, site variability, and other performance influencing factors -- typical turbulence has already been incorporated into the model. Use 0.00 (0%) for level sites with limited obstructions. Use -0.10 (negative 10%) for flat, clear sites on open water. Use 0.05 to 0.15 (5% to 15%) for rolling hills or mountainous terrain.

**Results:** Hub Average Wind Speed is corrected for wind shear and used to calculate the Weibull wind speed probability. Air Density Factor is the reduction from sea level performance. Average Power Output is the average continuous equivalent output of the turbine. Daily Energy Output is the average energy produced per day. Annual and Monthly Energy Outputs are calculated using the Daily value. Percent Operating Time is the time the turbine should be producing some power.

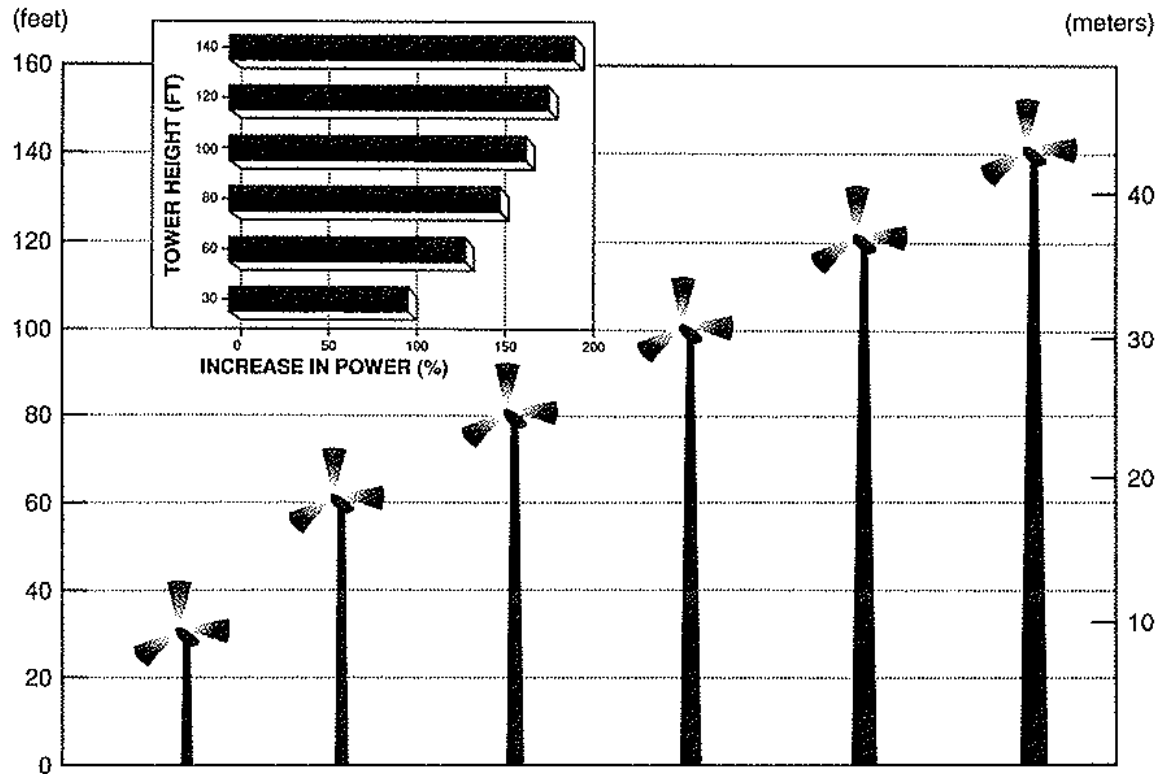
**Limitations:** This model uses a mathematical idealization of the wind speed probability. The validity of this assumption is reduced as the time period under consideration (ie, the wind speed averaging period) is reduced. This model is best used with annual or monthly average wind speeds. Use of this model with daily or hourly average wind speed data is not recommended because the wind will not follow a Weibull distribution over short periods. The data used in creating the power curve was generated at the BWC test site in Norman, OK. Consult Bergey Windpower Co. for special needs. *Your performance may vary.*



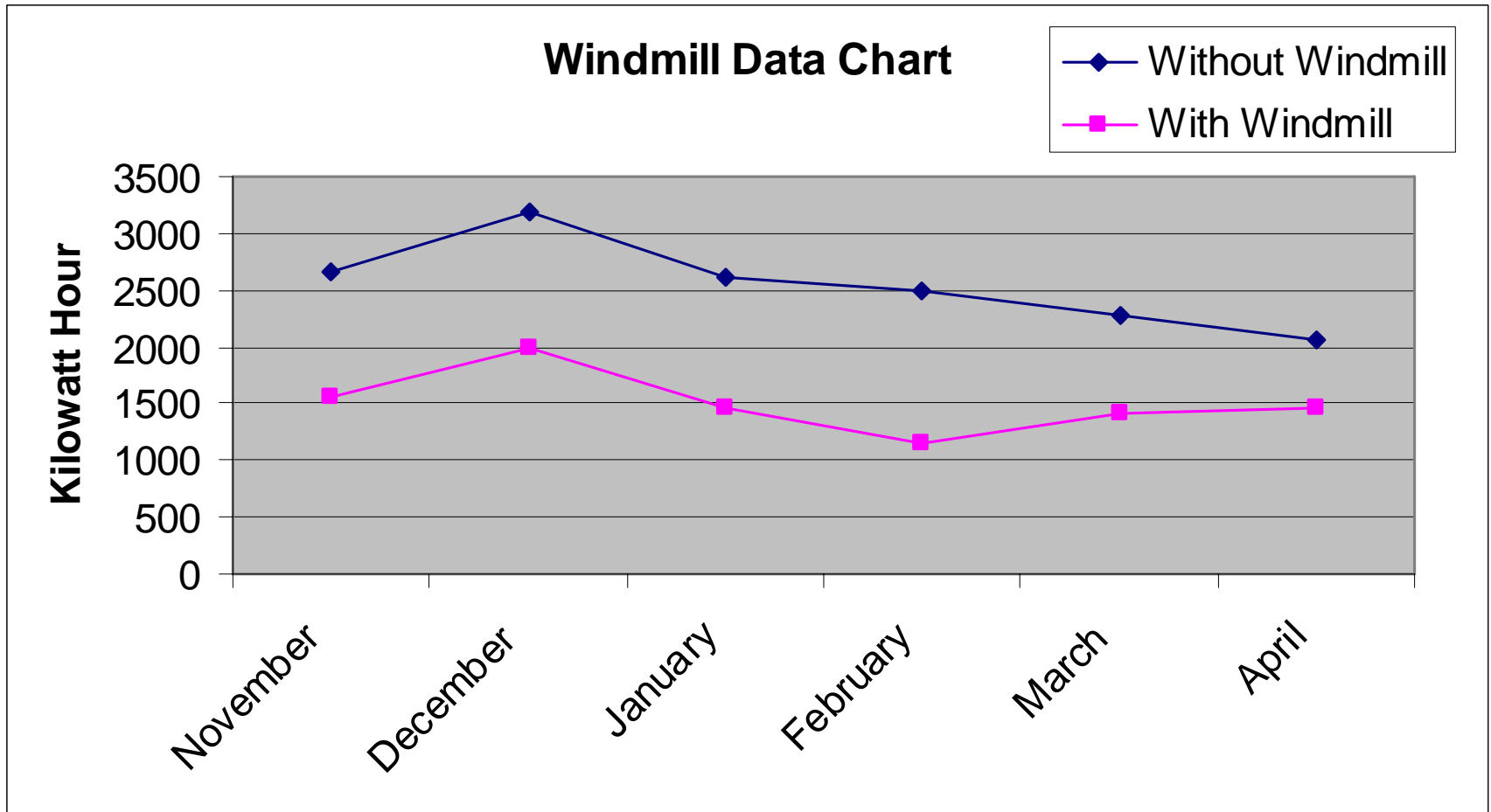
# Wind Turbine

- Wind Turbine tied into the AEP grid in late October 2007.
- Produced 4000 kW/h of electricity as of July 2008.
- Cut power bill by 36%
- Average wind Speed at hub (80') as of July is 8.55 mph - Goal is 12 mph
- At 140 feet, it should be 12 mph

# Increase in power with height above 30 ft (10 m)



*Power available to a wind machine increases with height. Power available at 80 ft (24 m) above ground is 150% of that at 30 ft*



# Globe Energy

- Performed previous project in 1990s at Renault Blainville plant
- Contracted to perform Pilot Project in Shipping building
  - Not a performance contract
- 100 percent Space Heating in high volume building with extended open door times
- Baseline of energy use developed in advance of project
- Anticipated Benefits:
  - Rapid heat recovery after extended door openings
  - 75%+ energy saving compared to the existing conventional warm air “Space” heating

# IN SUMMARY

- Find the organizational driver, is it:
  - Financial, or
  - Environmental, or Other
- Find a Champion at the operating/task level
- Find management support and commitment. Contracted work helps confirm this commitment. Allow plenty of time for Legal!
- Recordkeeping is important – Provides metric and feedback
- For carbon reductions, develop baseline data before project is implemented. Use 3<sup>rd</sup> party certification?
- **IT'S EASIER THAN YOU THINK!**

# Questions? Call or Write

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