

# Regional Field Verification - Case Study of Small Wind Turbines in the Pacific Northwest

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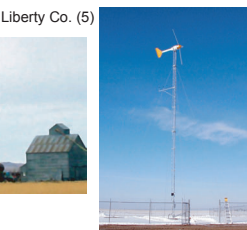
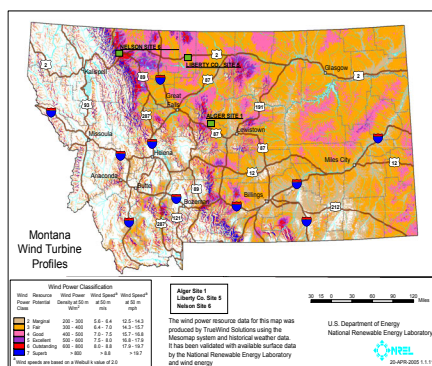
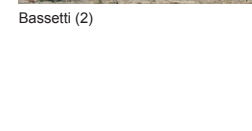
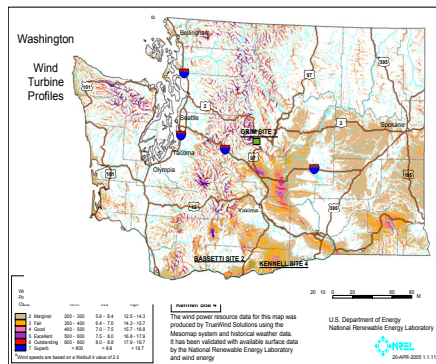
## PURPOSE

Regional Field Verification (RFV) supports industry needs for initial field operation experience with small wind turbines and verifies the performance, reliability, maintainability, and cost of small wind turbines in diverse applications.

Under RFV, Bergey 10-kW wind turbines were installed at a number of sites in the Pacific Northwest. Each installation was instrumented with a Data Acquisition System to collect a minimum of two years of operating data. In addition, a detailed understanding of the turbine system and balance of system (BOS) costs will be calculated for each site.

## HOST SITES

Six systems were installed in Washington and Montana under the RFV subcontract.



## PERFORMANCE

Production has varied from site to site. Technical problems, especially with inverters, have contributed to reduced performance.

Table 1. Estimated Annual Production Compared to Actual Annual Production

Host Site	Elevation	Tower type	Months of data	Estimated annual production (kWh) (1)	Average recorded wind speed (mph)	Average recorded production per month (kWh)	Actual annual production (kWh)
1 Alger	1219m	100ft guyed	18	18,000(2)	13.1	964.2	11,600
2 Bassetti	632 m	120ft guyed	7	13,000	9	730.6	8,800
3 Grim	610 m	100ft latticed free standing	15	8,000	4.3	49.4	600
4 Kennell	670 m	80ft guyed	16	13,000	12.4	1033.1	12,400
5 Liberty Co.	969 m	80ft tilt up	15	10,000	10.1	616.7	7,400
6 Nelson	1474 m	60ft guyed	13	18,000	12.6	689.3	8,300

(1) Source: Site Development Letter Reports submitted by NWSEED to NREL  
(2) Source: Independent Energy Quarterly, winter 2003

## COSTS

Another objective of the RFV project is to understand the overall costs of installing small wind turbine systems. Overall system costs are comprised of two major categories - hardware (turbine/tower) costs and BOS. BOS costs comprise 3 major areas: 1) permitting/fees; 2) site preparation; and, 3) miscellaneous. The majority of the variability of overall system costs occurs in BOS.

Host Sites	RFV BOS Costs (preliminary)					
	Alger	Bassetti	Grim	Kennell	Liberty Co.	Nelson
<b>Permitting/Fees</b>						
County		\$110				
Building		\$655		\$116		
CUP		\$300		\$475		
SEPA			\$160			
Geologist review			\$650			
Electrical permit	\$45			\$76		
Business license						\$50
Insurance (host's risk)			\$50			
Utility (meter inspection)			\$74			
<b>Subtotal (Permits/Fees)</b>	<b>\$45</b>	<b>\$475</b>	<b>\$2,019</b>	<b>\$667</b>	<b>\$0</b>	<b>\$50</b>
<b>Site Preparation</b>						
Grading/Backfill				\$10	\$171	
Trench/retail			\$130			
Trenching, backhoe, & pipe installation labor	\$333		\$86	\$1,620	\$983	
Excavation				\$787		
Conduit				\$402		
Concrete for foundation	\$596	\$402	\$4,147	\$613	\$1,380	\$500
Rebar	\$56	\$83		\$26	\$116	\$119
Misc foundation materials					\$418	
Erection						
Crews/Contractors	\$875	\$642	\$4,353	\$4,432	\$1,050	
Electrical						
Materials (wire, conduit, etc)	\$1,564		\$1,350	\$265	\$341	\$859
Hook up/inverter		\$3,980		\$3,426		\$1,350
Inspections						
Contractor Labor	\$3,405	\$800	\$5,460	\$260	\$5,000	\$4,500
Contractor's Travel Time						
<b>Subtotal (Site Preparation)</b>	<b>\$6,828</b>	<b>\$5,907</b>	<b>\$18,098</b>	<b>\$7,362</b>	<b>\$12,841</b>	<b>\$8,378</b>
<b>Miscellaneous Costs</b>						
Paint			\$163	\$415	\$158	
Oil Off fee	\$9					
Contractor Trade	\$80					
Site Recovery					\$350	
Fencing materials					\$6,145	\$1,497
Inverter shed				\$265		
Freight	\$1,378	\$1,400	\$1,637	\$1,134	\$1,524	\$1,073
<b>Subtotal (Misc)</b>	<b>\$1,466</b>	<b>\$1,563</b>	<b>\$2,092</b>	<b>\$9,052</b>	<b>\$3,060</b>	<b>\$1,073</b>
<b>TOTAL BOS</b>	<b>\$8,341</b>	<b>\$7,945</b>	<b>\$22,169</b>	<b>\$16,081</b>	<b>\$15,861</b>	<b>\$9,501</b>
Turbine	\$22,900	\$22,900	\$22,900	\$22,900	\$22,900	\$22,900
Tower	\$6,900	\$8,100	\$11,600	\$6,000	\$8,700	\$5,400
Tower Raising Kit	\$930	\$990	\$930	\$860	\$1,890	\$800
Tower Wiring Kit	\$930	\$990	\$930	\$860	\$1,890	\$800
<b>TOTAL Turbine/Tower</b>	<b>\$30,730</b>	<b>\$31,990</b>	<b>\$35,430</b>	<b>\$29,760</b>	<b>\$34,260</b>	<b>\$29,100</b>
<b>TOTAL Turbine/Tower/BOS</b>	<b>\$39,071</b>	<b>\$39,935</b>	<b>\$57,599</b>	<b>\$45,841</b>	<b>\$50,121</b>	<b>\$38,601</b>
Bergey Matchline Fund	\$7,746	\$7,852	\$1,600	\$7,552	\$8,528	\$7,552
<b>System cost w/o discount</b>	<b>\$46,817</b>	<b>\$47,787</b>	<b>\$59,199</b>	<b>\$53,393</b>	<b>\$58,649</b>	<b>\$46,153</b>

