

Off-Grid Distributed Wind Systems Webinar

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Mission

- To promote and foster all aspects of the distributed wind energy industry.

Importance of Membership

- Support Federal Policy Initiatives
- Support State Policy Program

Benefits of Membership

- Networking with industry leaders
- Discounted registration to DWEA and partner events
- Receive current market strategy and development updates
- Support for common industry barriers such as permitting and zoning
- Access to best practice documents and industry reports

For more information visit www.distributedwind.org/about-membership or contact Britton Rife at brife@distributedwind.org



Off-Grid Distributed Wind Market

- Developing countries with weak transmission infrastructure or no centralized utility grids
 - Cost-effective replacement for diesel generators
- Rural areas where building transmission lines is cost-prohibitive

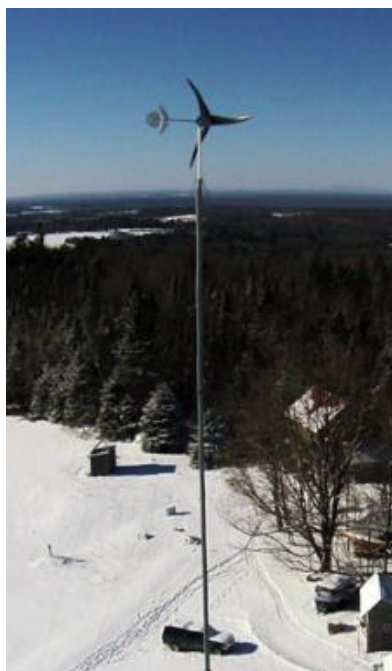
- An estimated 1.16 billion people (17% of the world's population) currently live without access to electricity (IRENA, 2015)

2015 Distributed Wind Market Report: “An estimated 91% of turbine units in 2015 distributed wind applications were deployed to charge batteries or power off-grid sites such as remote homes, oil and gas operations, telecommunications facilities, boats, rural water or electricity supply, and military sites.”





Excel 1 Turbine
1,000 Watts



T701 Turbine
1,500 Watts



Air X Turbine Line
200-500 Watts



Excel-1 1 kW Battery-Charging System



Copper Mountain, CO



Remote installation

Cathodic Protection, NM



Hybrid installation, Saskatchewan

Andrew Hickok Pika Energy



Where wind outshines solar

- Higher capacity factors in alpine and arctic
- Less theft-prone in remote areas
- Better withstands high winds!
- Smaller footprint

Pika T701 turbine at 9,000' telecom site in BC, Canada >



Better together: wind-solar hybrid

- Extend battery life
- Reduce reliance on generator
- Reduced battery capacity needed
- Use same wire and charger for savings

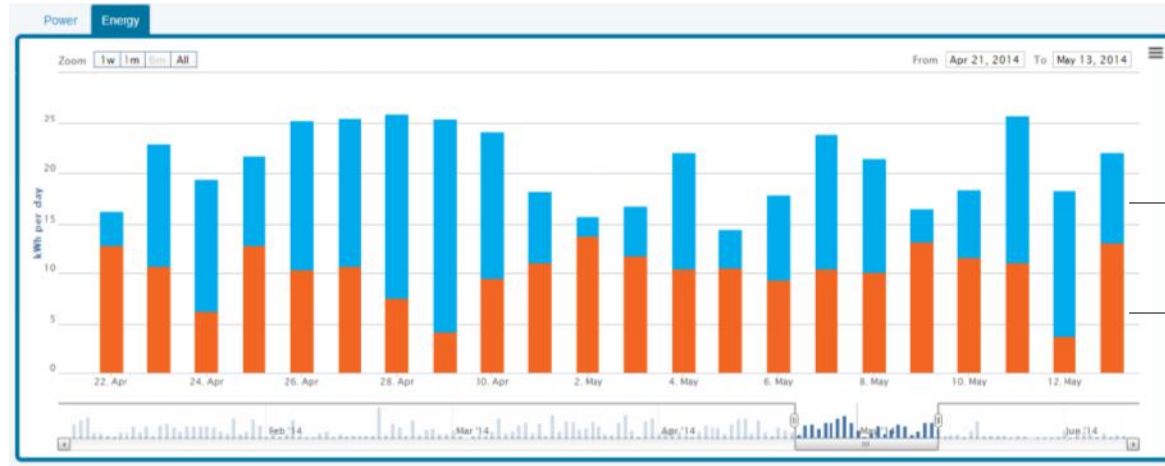


Pika Hybrid System in western Kansas

The Hybrid Advantage

Shown on Pika REview Web Monitoring

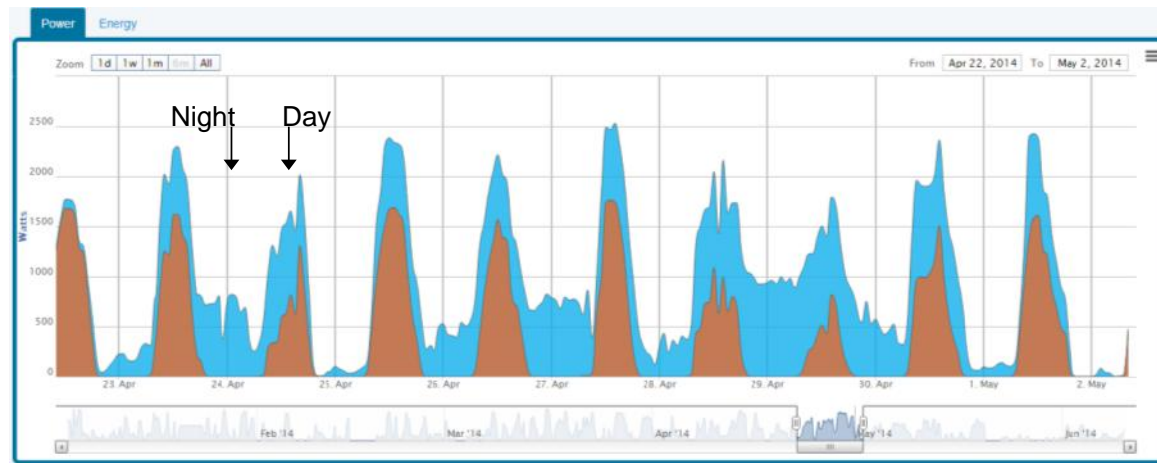
Daily Energy
In kWh



Wind

Solar

Power Readout
In Watts



Designed for off-grid

380 VDC power transmission
for flexible system design

2 moving parts
+ Sealed bearings
+ Weather sealed

Primary + Backup Braking

Cogless direct-drive
alternator + injection-
molded blades



Pika
ENERGY

Tested for off-grid



Pika turbines at National Wind Technology Center

- ✓ Duration
- ✓ Power performance
- ✓ Safety & function
- ✓ Structural analysis
- ✓ Acoustics





Ken Kotalik

Primus Wind Power



*primus***windpower**



COMPLETES ANY OFF GRID SYSTEM

Ken Kotalik

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*primus***windpower**

PRIMUS WIND POWER HYBRID WEBINAR

Next full webinar will be October 25th – 1 PM – MST – AZ time

www.primuswindpower.com

- Support tab
- Attend a webinar (live) or watch a webinar (recorded)

*primus***windpower**

Primus Aerospace announced the acquisition of the AIR Wind Turbine product line from Southwest Windpower in Jan. 2013. Primus is located outside Denver, Colorado and is a leading provider of high-precision, high-complexity components and assemblies for the energy, aerospace, defense and medical industries. Established in 1989, Primus serves customers worldwide with its diversified products and engineering services. Customers include industry leaders such as Lockheed Martin, U.S. Dept. of Defense, United Technologies Corporation, NASA, Ball Aerospace and Eaton Corp. Primus is continually expanding its offerings every year and maintains a growth strategy focused on the products and services deemed most important to our customer base. The acquisition of Primus Wind Power is an extension of these same values and business practices.

AIR SILENT X MARINE TURBINE



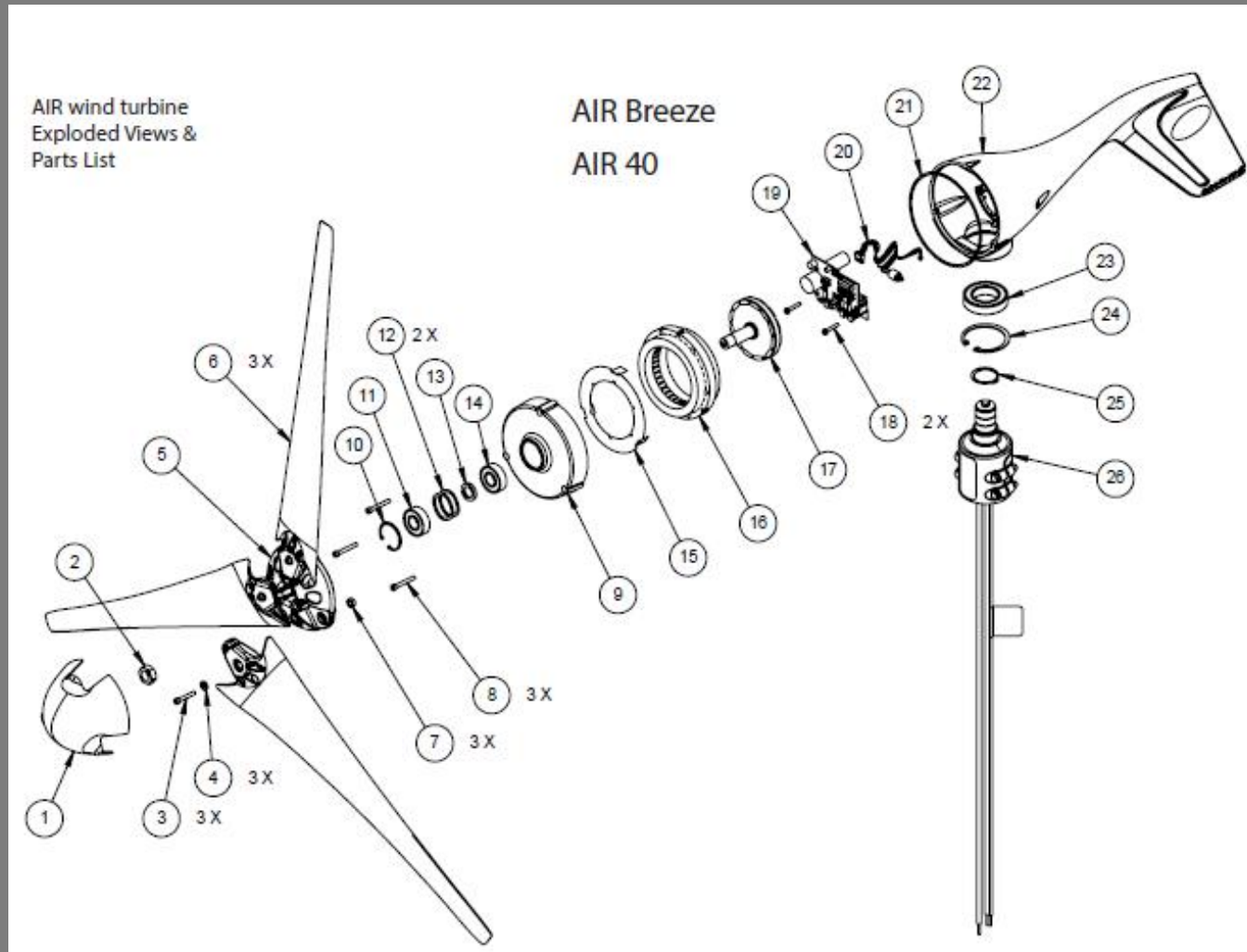
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AIR SILENT X MARINE TURBINE



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AIR WIND TURBINE – EXPLODED VIEW



From Primus Manual

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A LOOK INSIDE THE TURBINE

- ▶ [Primuswindpower.com](http://www.primuswindpower.com) – Service and Repair
- ▶ <http://www.primuswindpower.com/maintenance-service/warranty1-2/>
- ▶ Trouble Shooting
- ▶ Cleaning and basic Maintenance
- ▶ Circuit Replacement

AIR LAND

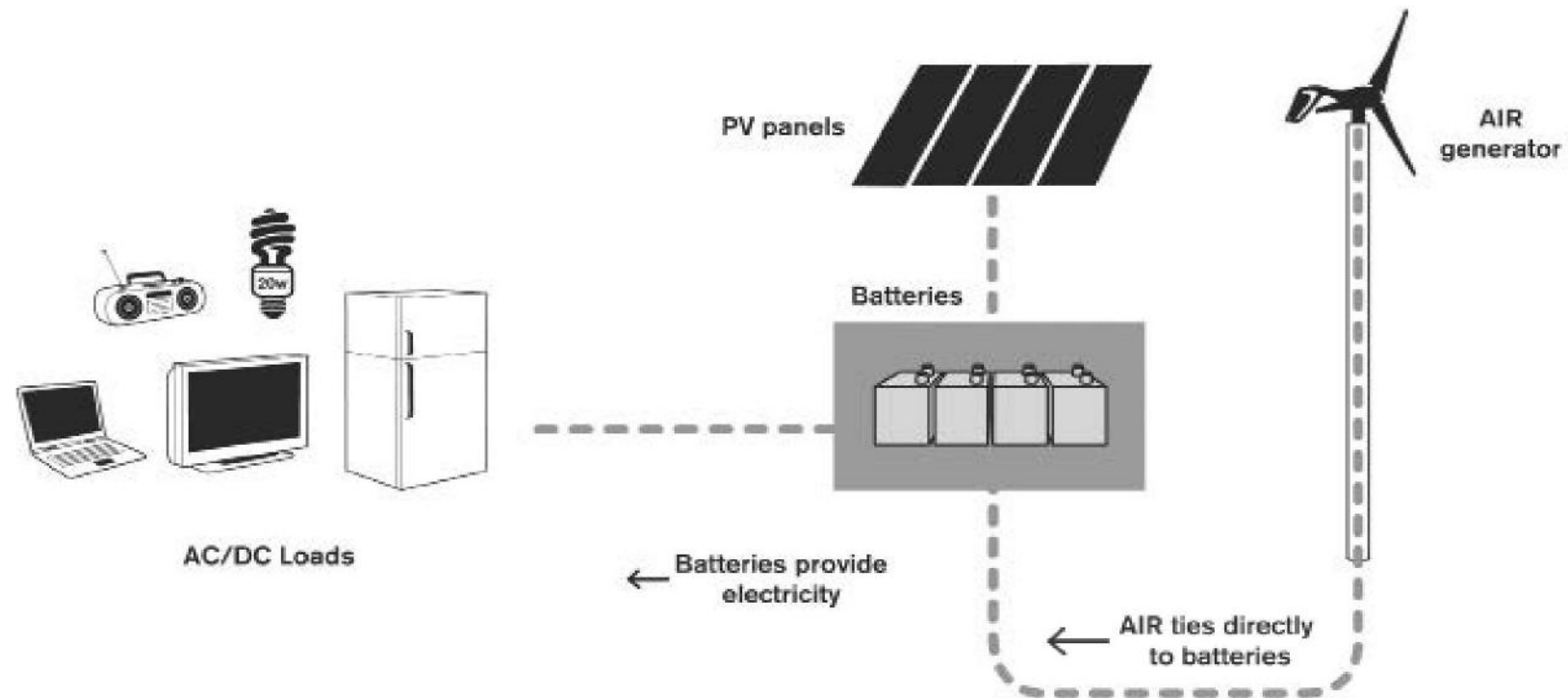
AIR MARINE



- 1) Air Land wind turbines have a “grey cast-aluminum housing w/ a basic finish
- 2) Air Marine wind turbines have a “white-aircraft quality paint” w/ a clean “Marine Grade” finish
- 3) Turbines range from 160-400 W rated power – all are 1.2 M rotor diameter

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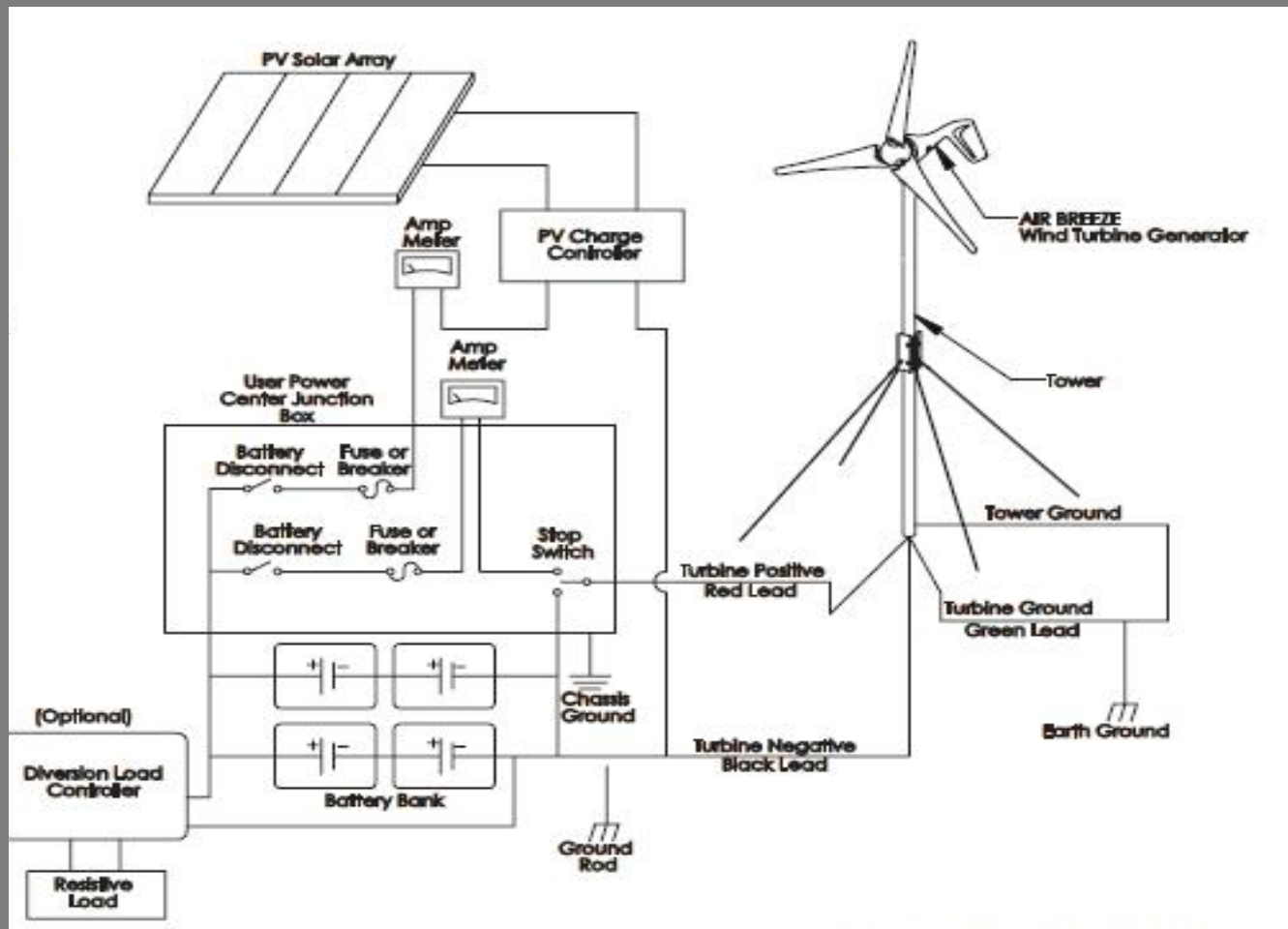
HYBRID SYSTEM OVERVIEW



Load capacity for basic Hybrid system.

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STANDARD HYBRID SOLUTION



POTENTIOMETER

ADJUSTING REGULATION VOLTAGE

System Voltage	Factory Set Point	Voltage Regulation Set-Point Adjustment Range*	Voltage Change due to 1/8 Turn of Potentiometer**
12 Volt	14.1 Volts	13.6 – 17.0 Volts	0.56 Volts
24 Volt	28.2 Volts	27.2 – 34.0 Volts	1.12 Volts
48 Volt	56.4 Volts	54.4 – 68.0 Volts	2.24 Volts

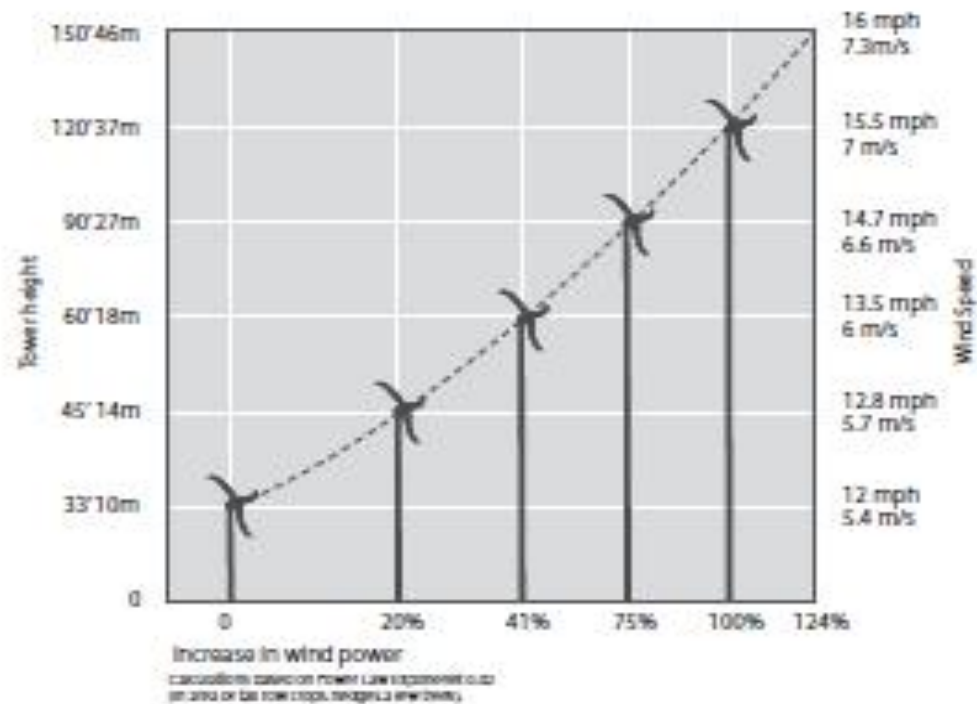
* Adjustment ranges are approximate; actual ranges may be greater.

** Turn clockwise to increase voltage, counter-clockwise to decrease voltage.

CAUTION: Increasing the voltage regulation set point above the initial factory setting will NOT increase the power output of the AIR wind turbine. This adjustment changes the point at which the turbine stops charging the batteries. By setting the voltage too high, probability of overcharging and damaging the batteries may increase significantly.

TOWER HEIGHT

Wind speed increases with height. Higher towers also raise generators above the air turbulence that can exist close to the ground.

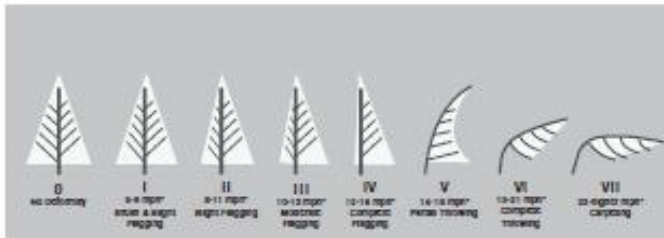


SITING A WIND TURBINE

Siting Tips for Permanent Installations



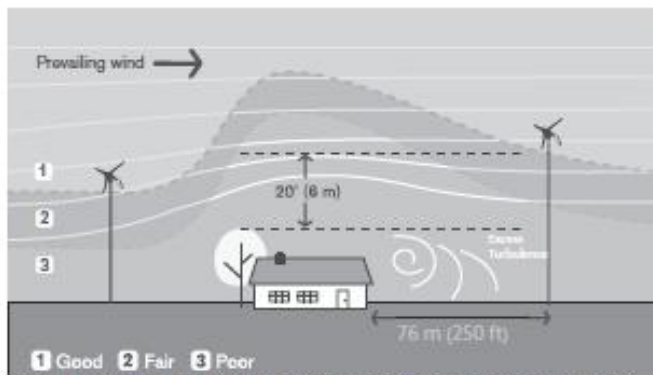
PROPER SITING = Better Performance & Increased Longevity
Look at vegetation deformation to determine best area and prevailing wind direction.



Griggs-Putnam Index. *Probable mean annual windspeed. Data prepared by E.W. Hewson, J.E. Wade, and R.W. Baker of Oregon State University



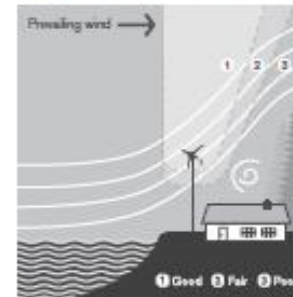
EXCESSIVE TURBULENCE = Fatigue Damage & Shorter Turbine Life



Turbine should be a minimum of 76m (250 ft) away from and 6m (20 ft) above obstacles.

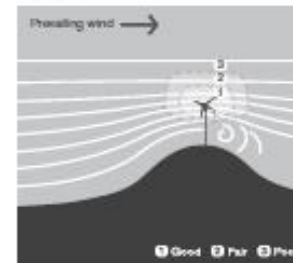


ATYPICAL SITING CONSIDERATIONS



Coastal or Lakeside

Trees and taller structures can be down-wind.



Ridge Tops

Wind compresses as it blows over the top of a hill, increasing the wind speed.



Plateau/Mesa

Site the generator far enough from the cliff to avoid turbulent wind.

THE HYBRID (SOLAR AND WIND) SOLUTION

WIND IS ESSENTIAL FOR MOST OFF-GRID SYSTEMS

SOLAR is utilized for nearly all off-grid systems, solar is critical, however:

- **Solar has low output during winter months**
- **Solar has diminished output during inclement weather**
- **Solar has no output at night**

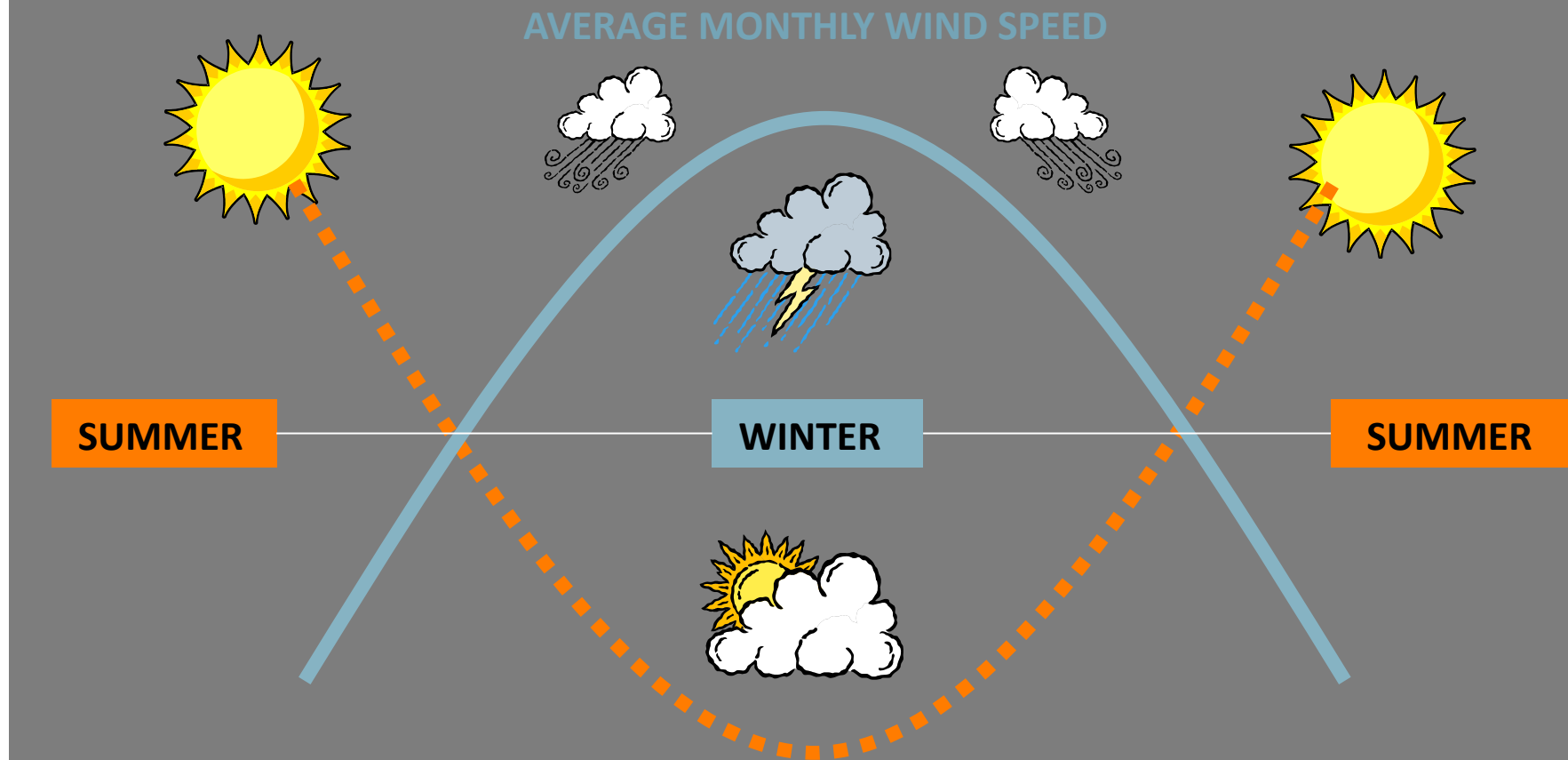
WIND POWER is most essential during the winter (when solar is reduced)

- **Average wind speed is highest during winter months**
- **Air density is highest during winter months**

(WIND POWER = $\frac{1}{2} \times \text{Air Density} \times \text{Wind Velocity}^3 \times \text{Swept Area}$)

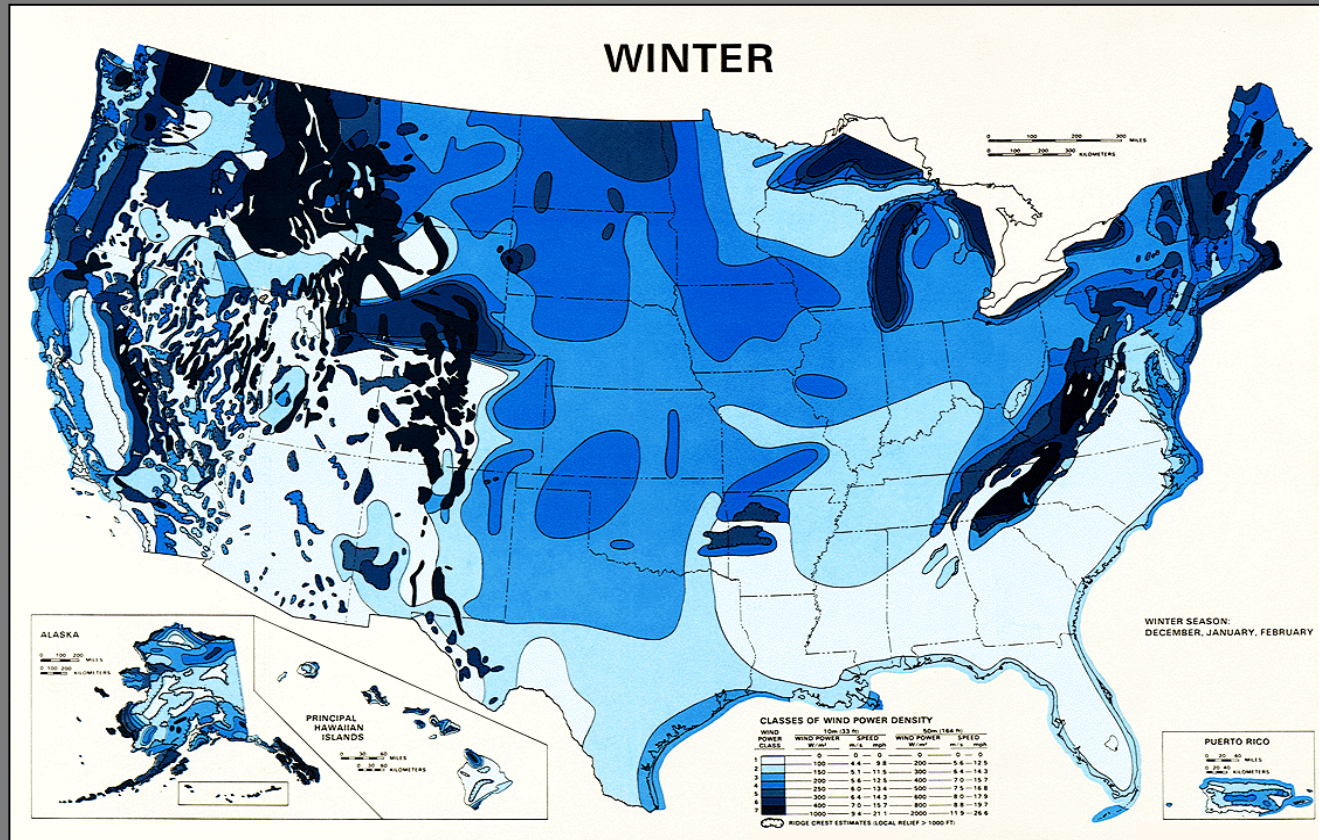
- **Wind on average, is stronger during inclement weather**
- **Wind more frequently blows during long, winter nights**

HYBRID SYSTEMS ARE COMPLIMENTARY



AVERAGE MONTHLY INSOLATION HOURS

WIND RESOURCE MAP (WINTER)



DETERMINING ANY WIND RESOURCE

AWS TRUE POWER – Wind Resource Assessment Tool

Needed: Address or Decimal Data Coordinates or GPS

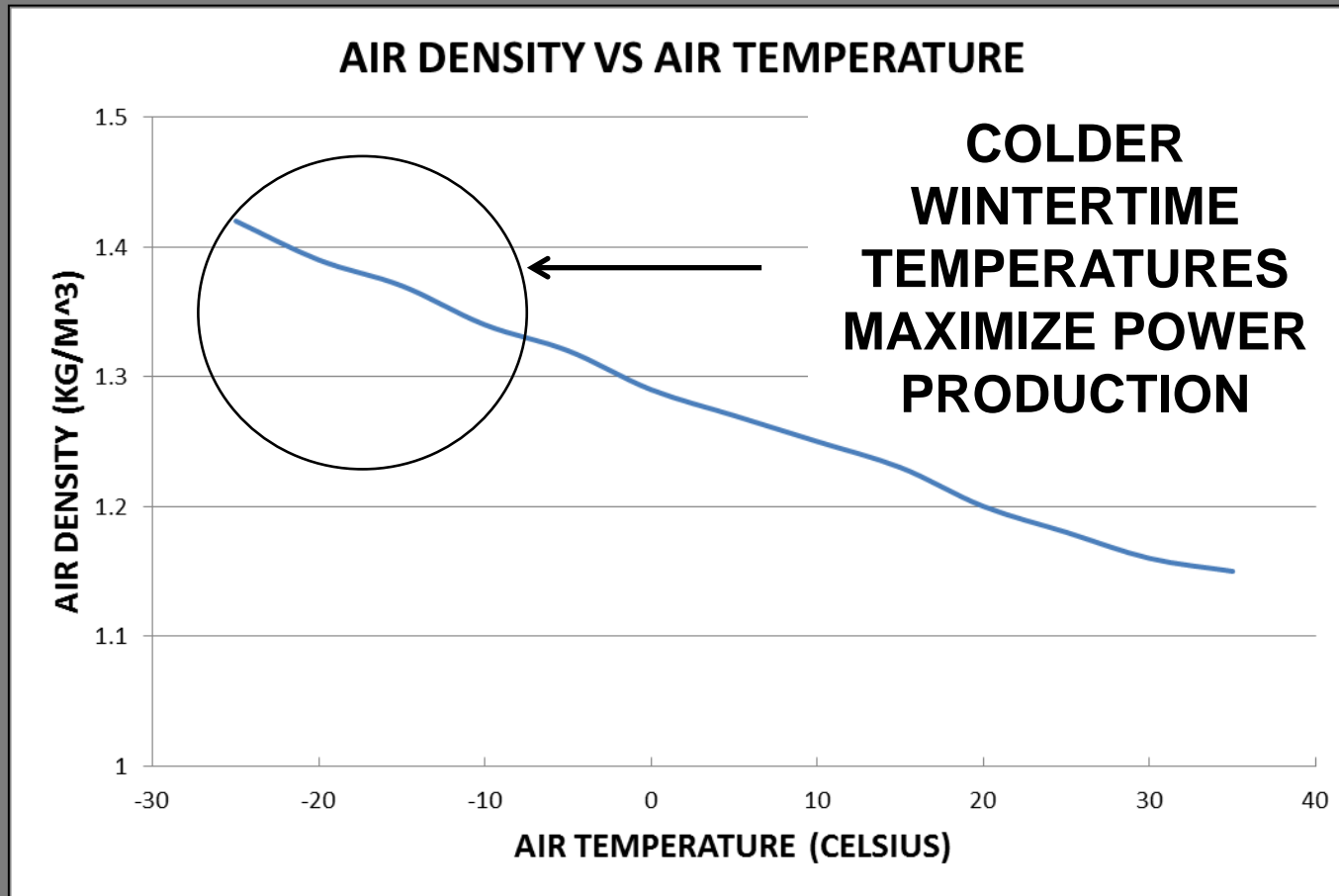
Send to me – kkotalik@primuswindpower.com or customer service

Or

<http://primuswindpower.com/whats-my-wind-resource/>

Data: 200 M resolution – as low as 10 M tower height

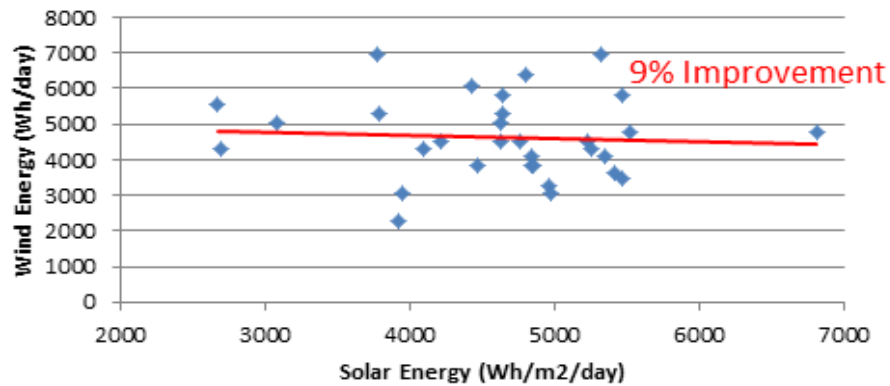
WINTERTIME FACTORS



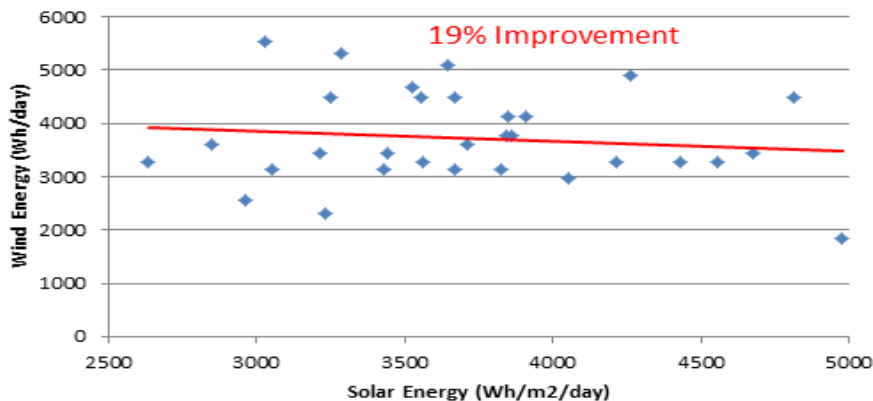
Higher air density during colder months increases wind turbine energy production

WINTER WINDS DURING INCLEMENT WEATHER

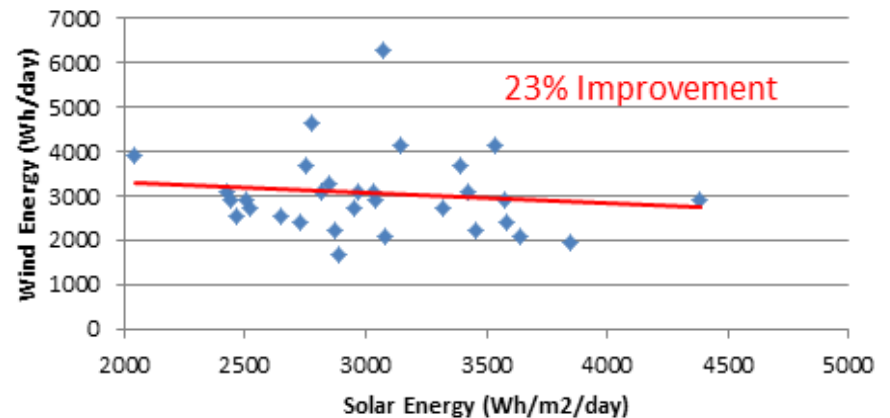
Amarillo TX 1961-1990
December Solar and Wind Resource



Cheyenne Wyoming 1961-1990
December Solar and Wind Resource

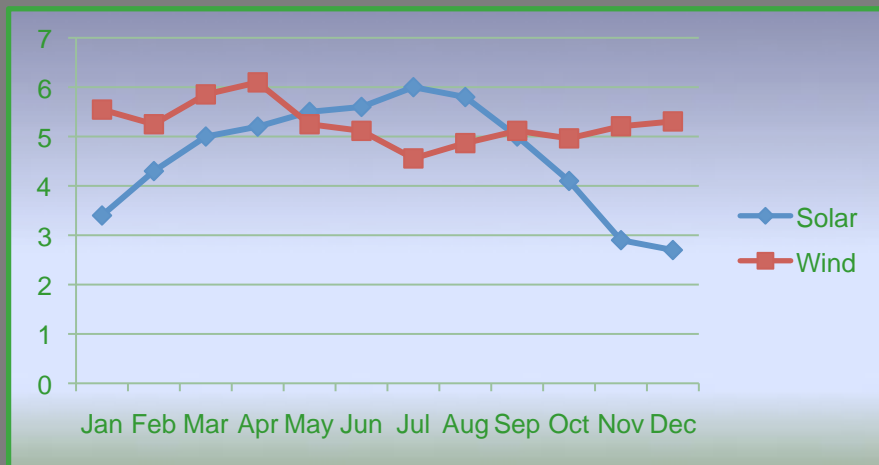


Rapid City SD 1961-1990
Solar and Wind Energy Resource

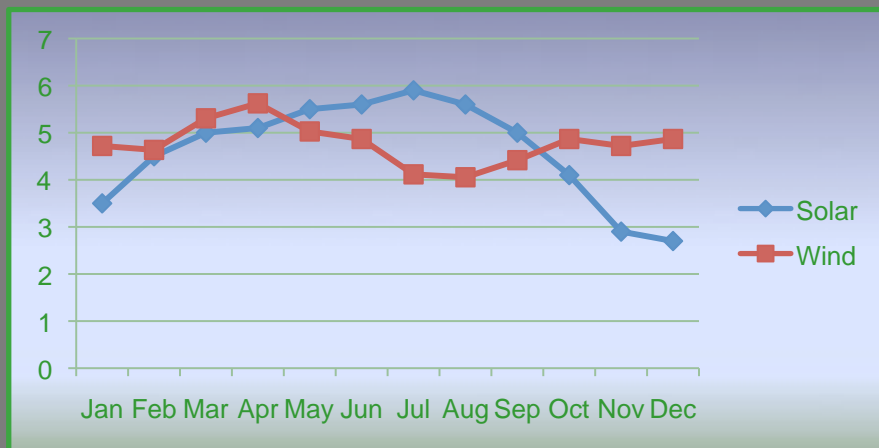


NREL Sites December Average - 30 years of data
CONCLUSION – when its less sunny, it is more windy on average during inclement weather conditions.

Fargo, North Dakota

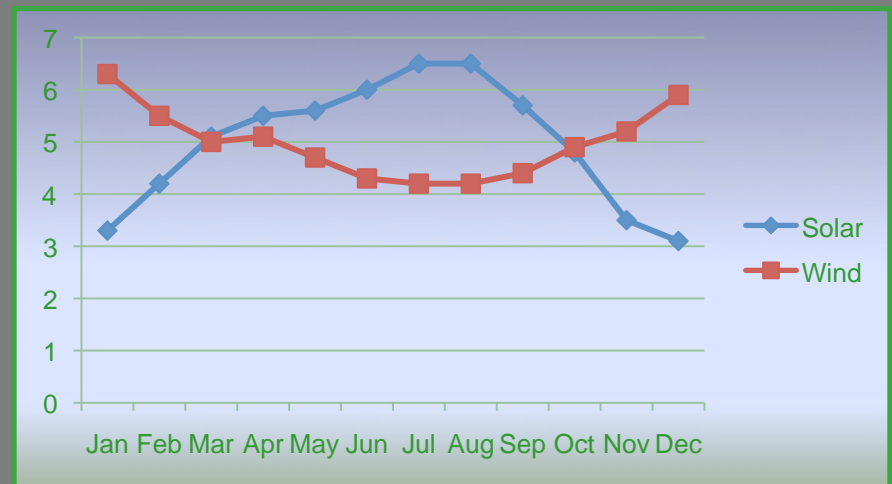


Minneapolis/St. Paul, Minnesota



SOLAR AND WIND RESOURCES

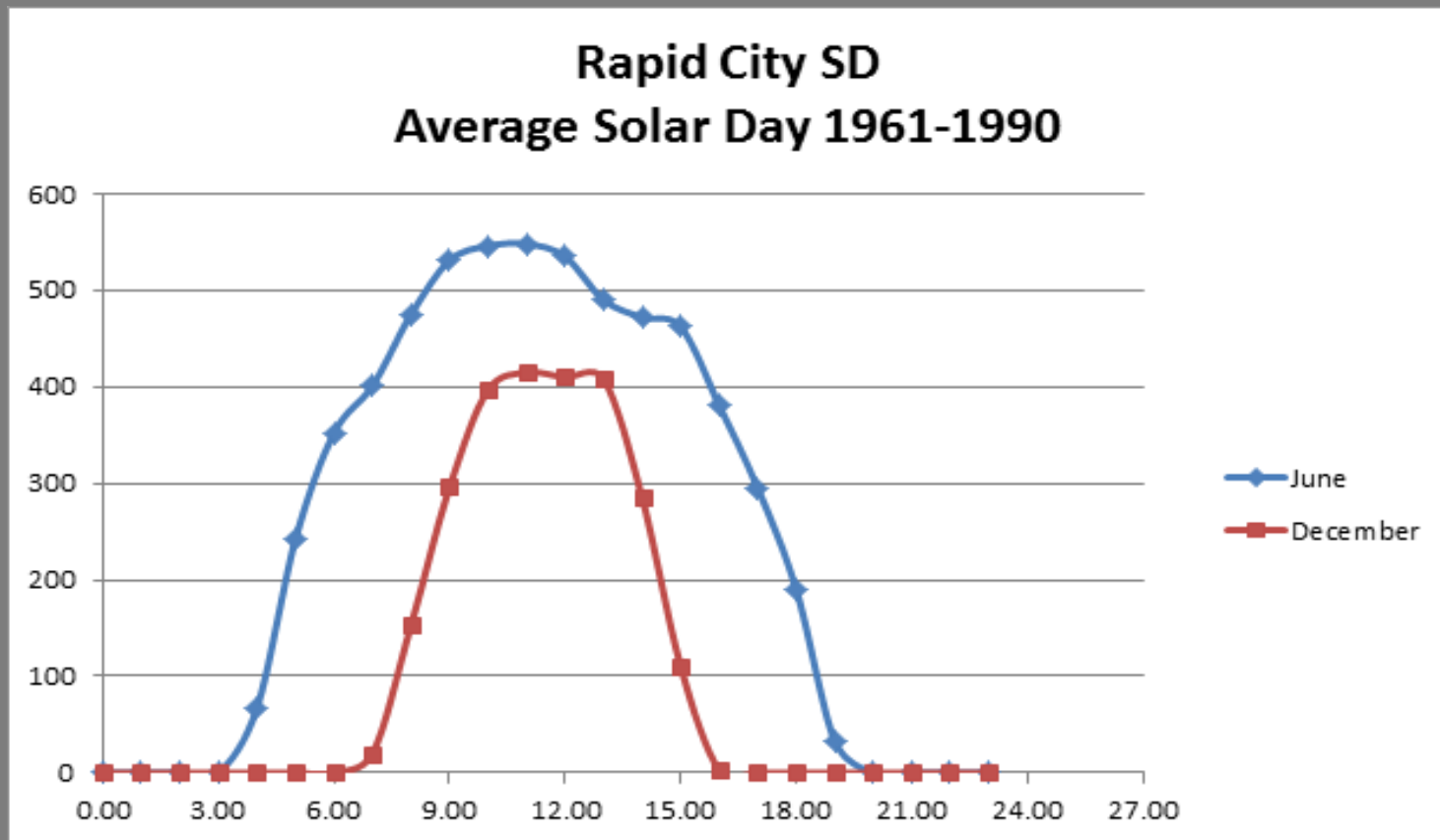
Billings, Montana



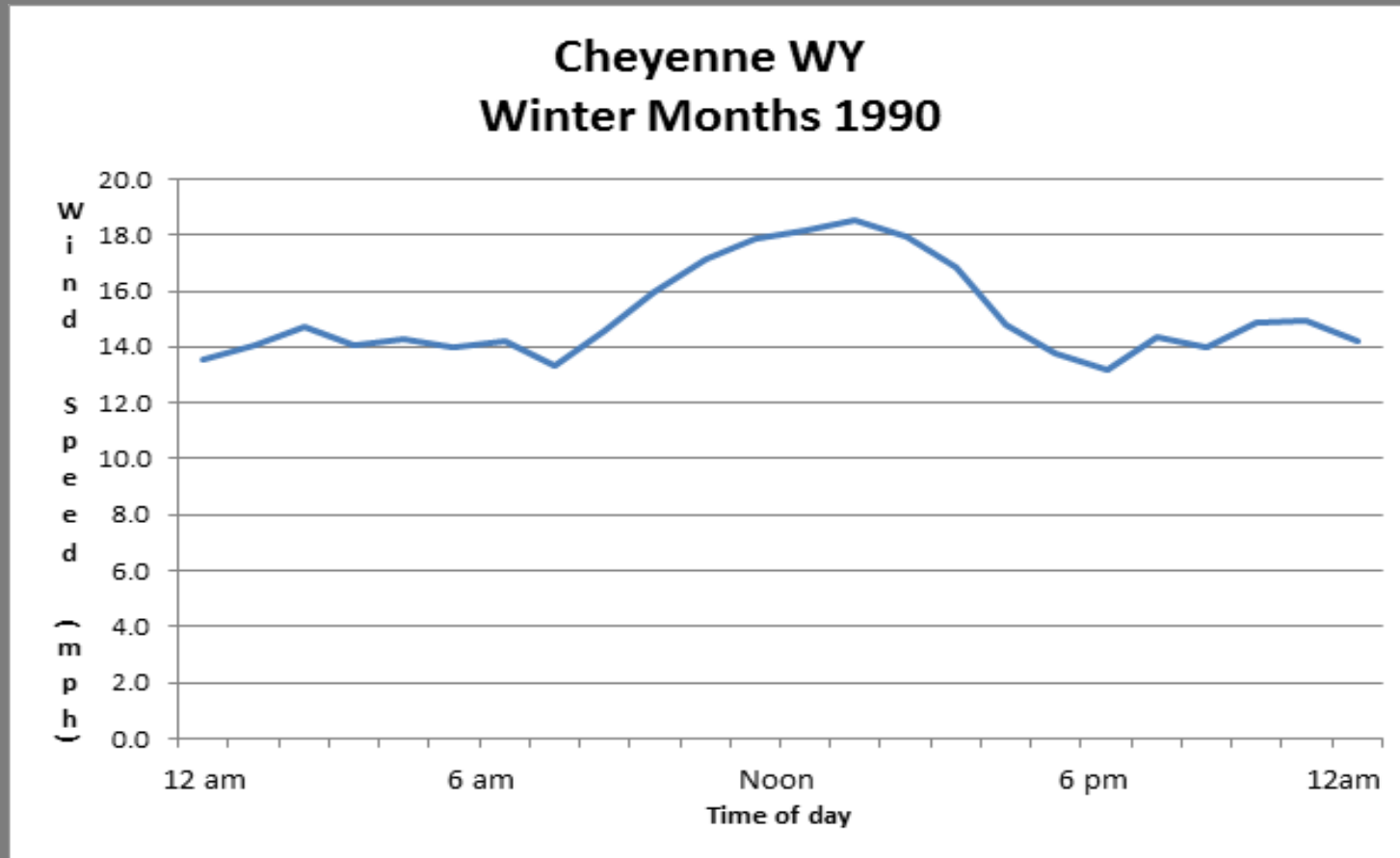
AIR is ideal for hybrid systems with solar to offset cloudy, low sun or winter conditions and lengthens battery life by reducing Depth of Discharge.

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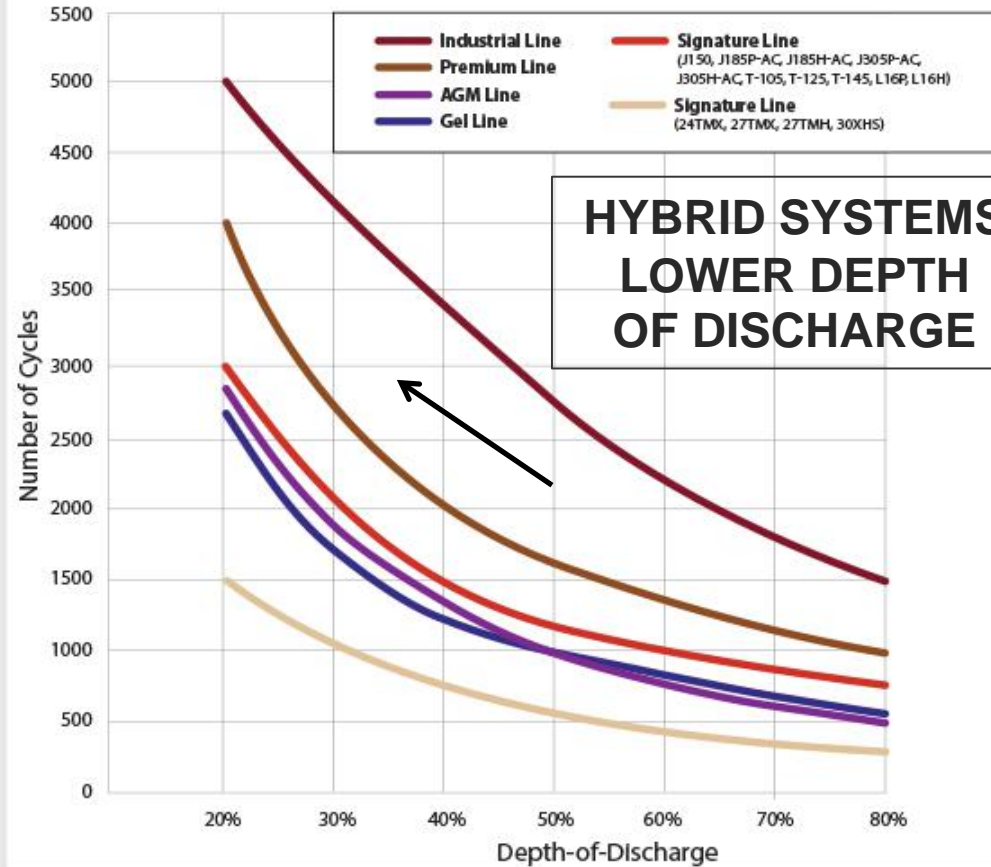
THE SOLAR DAY



NIGHTTIME POWER PRODUCTION



WHY HYBRID SYSTEMS ARE BETTER



This chart illustrates the cycle life ratings for the Trojan lines of deep-cycle batteries for renewable energy applications.

HYBRID SOLUTIONS MAXIMIZE BATTERY LIFE

If nightly discharge rates are reduced, battery life will be extended.

* Trojan Brochure

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AIR PRODUCT LINE & HISTORY



AIR 303
1995-1998



AIR 403
1998-2001



Air-X
AIR 30 (2011)
2001- present



AIR Breeze /
AIR 40 (2011)
2008 – present



AIR Silent
X (2015)

- AIR was introduced in 1995
- Total sales of over 150,000 units and the most of any small scale wind turbine
- Today's models benefit from five generations of improvements



VERSATILITY, RELIABILITY & VALUE

***LEADING THE WORLD IN SMALL SCALE ,
OFF-GRID WIND TURBINES***

AIR APPLICATIONS & PHOTOS

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END

for more information visit

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Questions?



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