Small Wind Systems for Green Power for Mobile



BERGEY WINDPOWER

Wind for Telecom

- Good broadcast sites often have good wind resources due to their elevation and exposure
- Not all sites will have sufficient wind resources
- Unlike solar, reliability is product / manufacturer specific – not all turbines are equal.
- Most small wind turbines are not reliable and rugged enough for telecom. Recommend Bergey (USA) and Proven (Scotland)
- Must have tall tower: 24 – 40 m

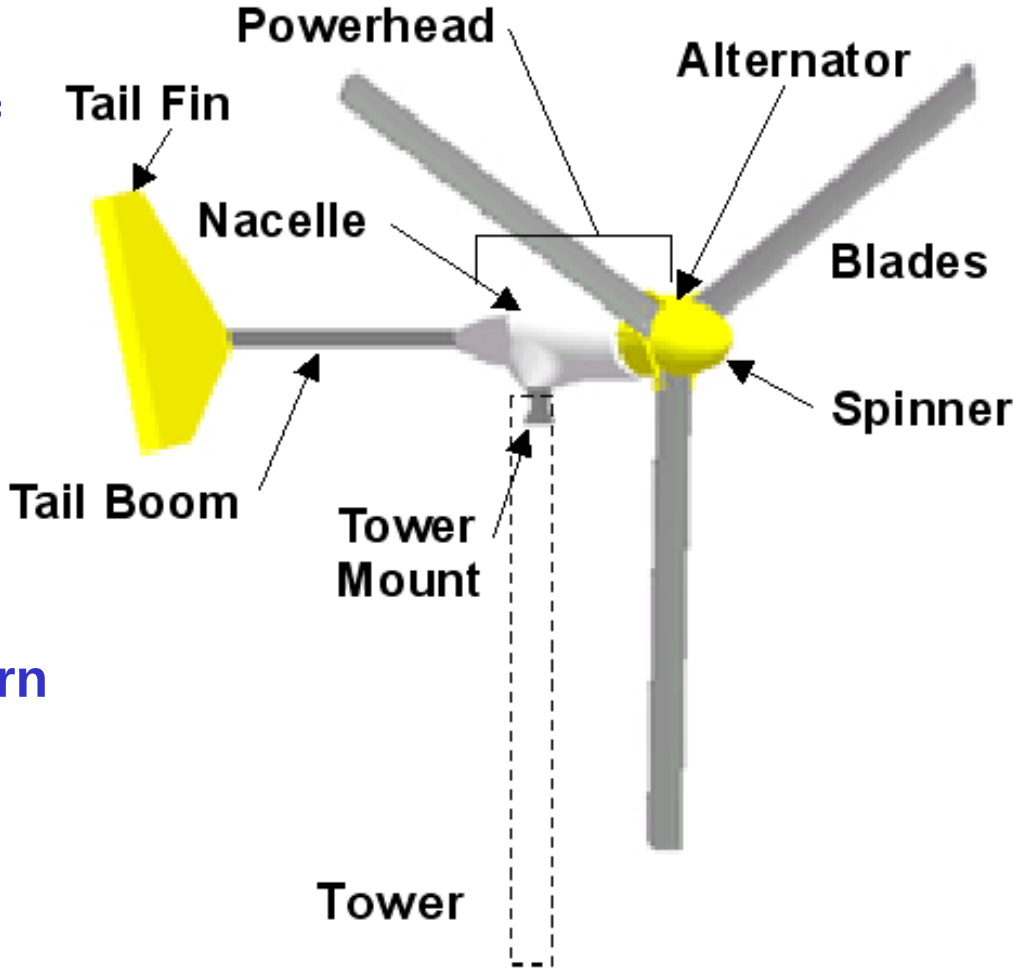


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How They Work

Mechanical Simplicity ... Few Moving Parts

- The blades act like wings of an airplane – capturing the energy in the wind
- The blades turn a generator that converts blade rotation into electricity
- The tail keeps the blades facing the wind
- In high winds, the blades turn sideways to limit speed



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Hybrid Systems

Wind Turbines and Diesels are Complimentary:

Characteristic	Wind	Diesel
Capital Cost	High	Low
Operating Cost	Low	High
Logistics Burden	Low	High
Maintenance Requirements	Low	High
Available on Demand	No	Yes



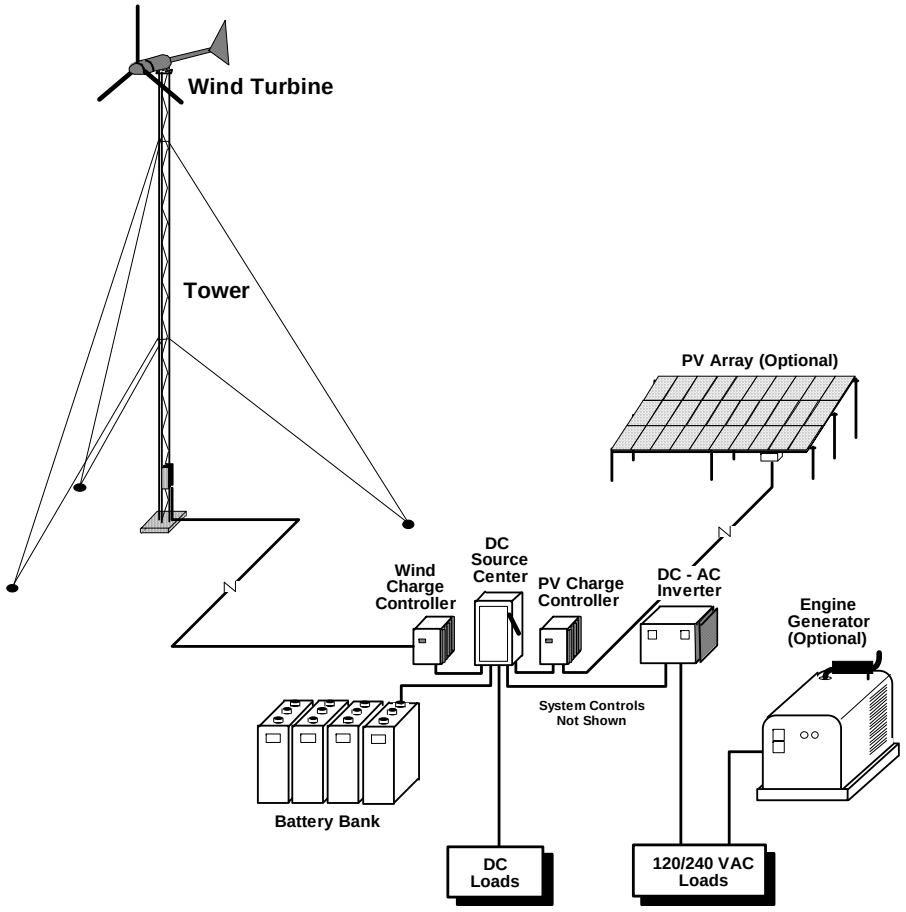
Together, They Provide a More Reliable and Cost-Effective Power System Than is Possible With Either Wind or Diesel Alone



Hybrid Systems

The New Way to Power BTS

- One or More Variable Speed Wind Turbines
- One or More Solar Arrays
- DC Bus Architecture
- 1 - 5 Days of Battery Storage
- Sinewave Static Inverters for DC-AC Conversion
- Back-up Diesel Generator for Low Wind / Solar Periods
- Renewables Typically Supply 50 - 90% of Energy
- Provides 24/7 Power with Diesel Run Times Reduced to ~10 - 20%



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Bergey Windpower Co.

A World Leader in Small Wind

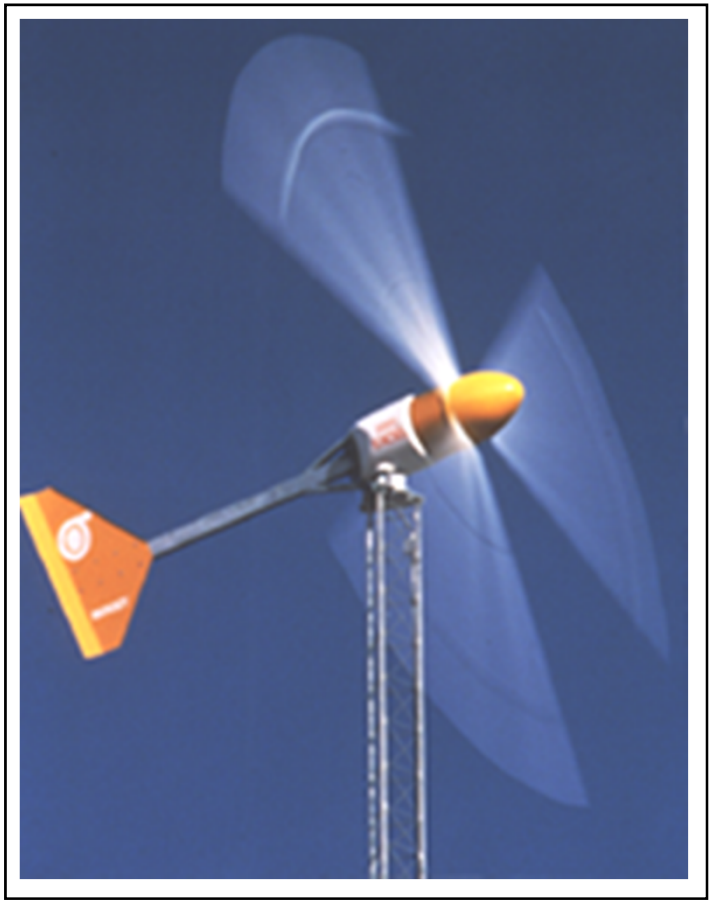
- Oldest and largest manufacturer of commercial / industrial small wind turbines
- Over 5,000 installations, 100+ countries, all 7 continents
- Best-selling 7.5 kW model has demonstrated 20+ years with zero operating cost
- Award winning installation and training support – most extensive field experience in the industry
- Strong dealer network (e.g. – PowerCity, Philippines)
- Beijing Bergey Windpower



Bergey Small Wind Turbines:

High Tech, High Reliability, Low Maintenance

- **Configuration:** Up-Wind, Horizontal Axis, 3 Blades, Aligned by Tail
- **Blades:** Pultruded Fiberglass (70% Glass), Custom Airfoil, Very Low Noise, Can run Unloaded
- **Generator:** Direct-Drive Permanent Magnet Alternator, 3Ø AC Output, Inverted Rotor
- **Structure:** Galvanized Steel, Integrated Design, Yaw Axis Slip-Rings
- **Overspeed Protection:** Brakeless, Passive Horizontal Furling, No Springs
- **Result:**
  - Simple, Rugged Design
  - Only 3-4 Moving Parts
  - No Regular Maintenance Required
  - 30+ Year Design Life

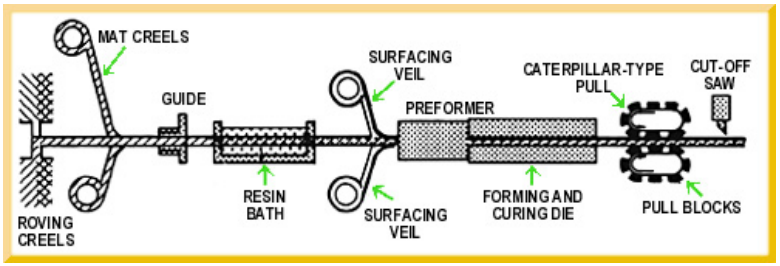


BWC EXCEL, 10 kW

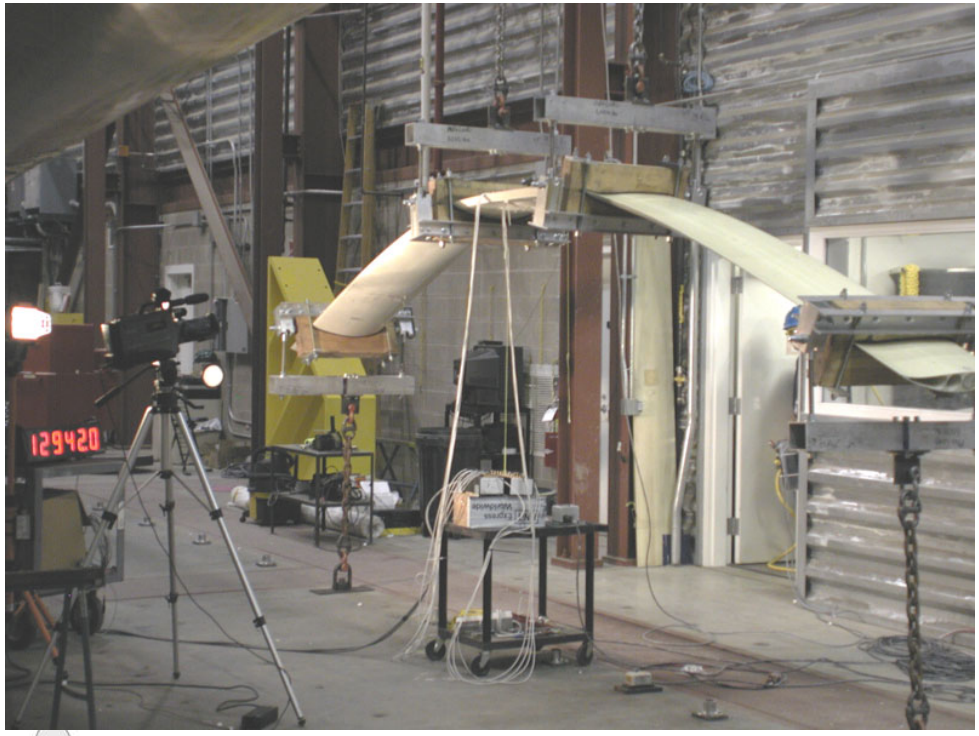
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Super Strong “Pultruded” Blades

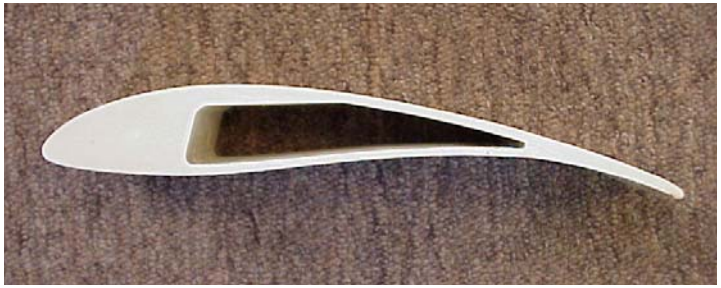
- 70% Full-Length Glass Fiber
- 100,000 psi Strength







XL.50 blade strength test, NREL July 2001



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Military
Atlantic Ocean

Residential
Montana

Residential
California



Cell Site
Kenya



Telecom Experience Since 1984

Gem State Utilities, Duncan Mountain, Idaho

- **Equipment:** BWC 7.5 kW Wind Turbine, 2 kW Solar, ~ 60 kWh Battery Bank, 15 kW Diesel
- **Performance:** ~ 40 kWh / Day at 120 VDC
- **Customer:** PP&L / OnSite Energy
- **Installation:** October 1984
- **Results:** PP&L initially installed three brands of wind turbines. After a 5-year test period, in which the BWC turbine was 100% available without maintenance, the other two brands were removed. The BWC turbine still powers the site.



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GSM Experience



Haiti



Chile

BERGEY WINDPOWER

GSM Experience



Greece



Kenya

GSM Experience



Romania

China





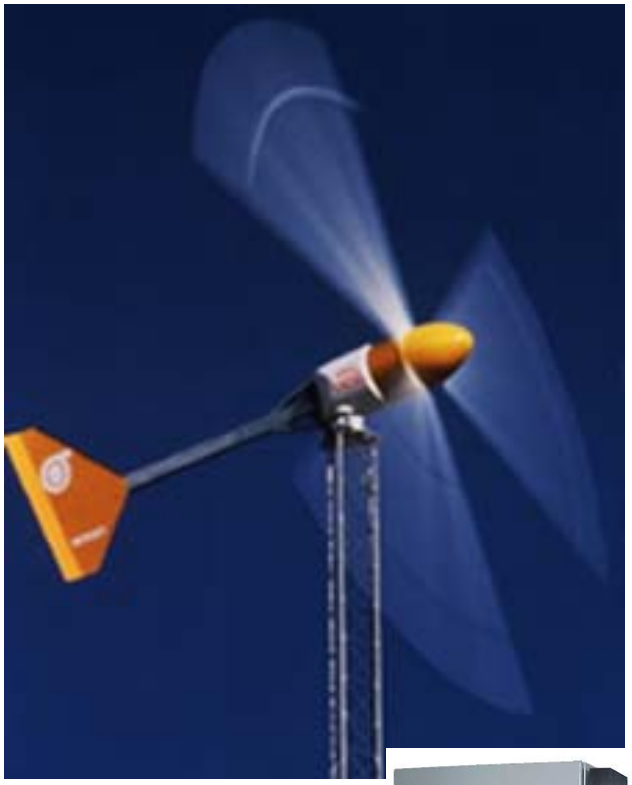
Philippines

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BWC Excel-R Wind Turbine

Proven Performance, Reliability, and Longevity

- Rated at 7.5 kW, 22 ft rotor diameter, 450 kgs
- ~ 1,500 Installed, in more than 50 countries
- Units have operated over 20 years without any service
- Leading World Market Share in the 5 – 15 kW Size Range
- CAPEX: $40,700 with 30m unguyed lattice tower
- Output: 25 – 50 kWh/day

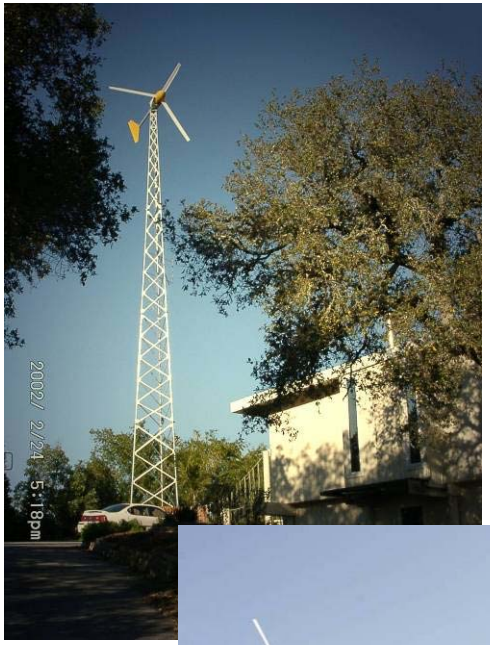




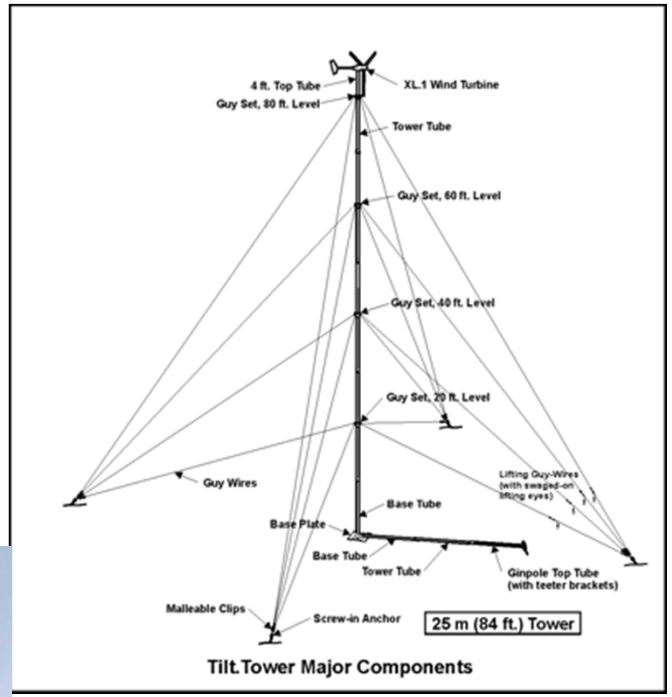
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Full Range of Engineered Towers









18m – 49m:

- Guyed Lattice
- Tilt-up Guyed Lattice
- Self-Supporting Lattice
- Tapered Pole

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BWC Equipment & Services

A Full Service Systems Integrator - Worldwide

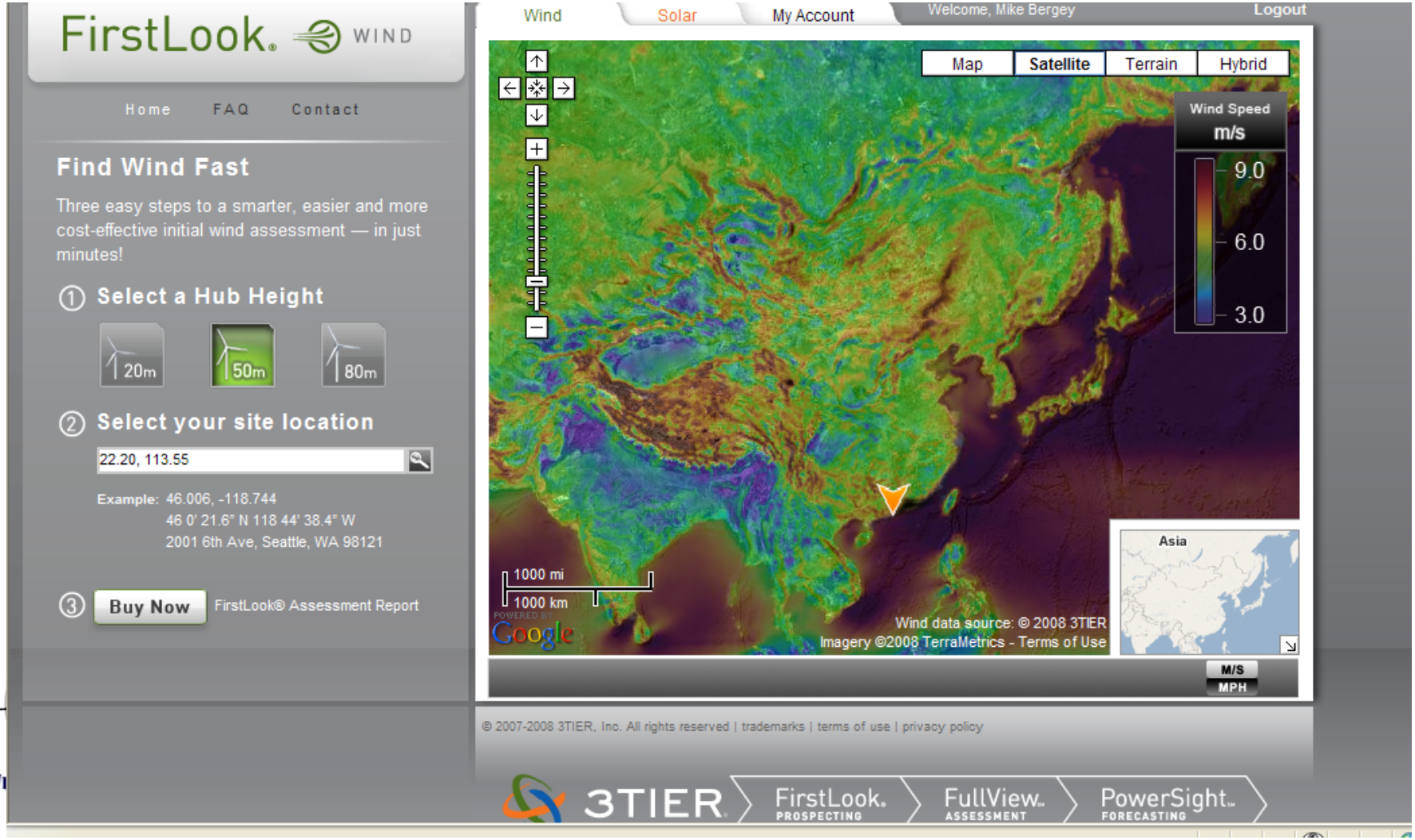
- Free Preliminary Design and Budgetary Estimates
- Full Renewable Energy and Power Systems Engineering and Supply Capabilities
- Installation Supervision and Training (>20 years experience)
- Custom Design for Turbine and Solar Mounting, Controls, Shelters, Etc.
- Advanced WindCAD Performance Modeling
- Worldwide Wind Resource Database



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Wind Resource Information

www.firstlook.3tier.com



Improving CAPEX – Wind Turbine

- Most expensive component
- Technology to increase performance:
  - NdFeB “super magnet” alternators
  - Larger rotors for better low wind power (possible reliability risk)
  - Buck / Boost controllers
- Volume production to lower costs
  - Value of system standardization

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Improving CAPEX – Towers

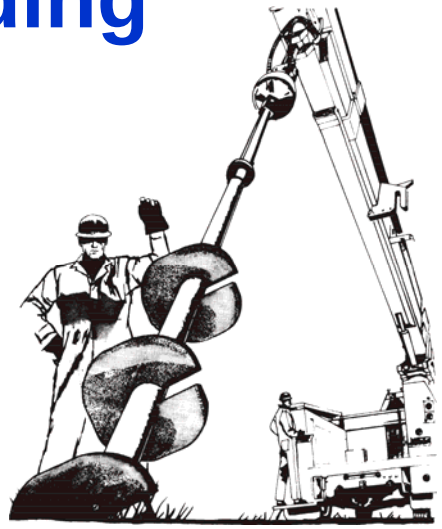
- Single tower for turbine and antennas (saves ~ $25,000 with 43m tower and provides better performance)
- Tall guyed towers
- Solar on tower?
- Tower integrated equipment enclosures?

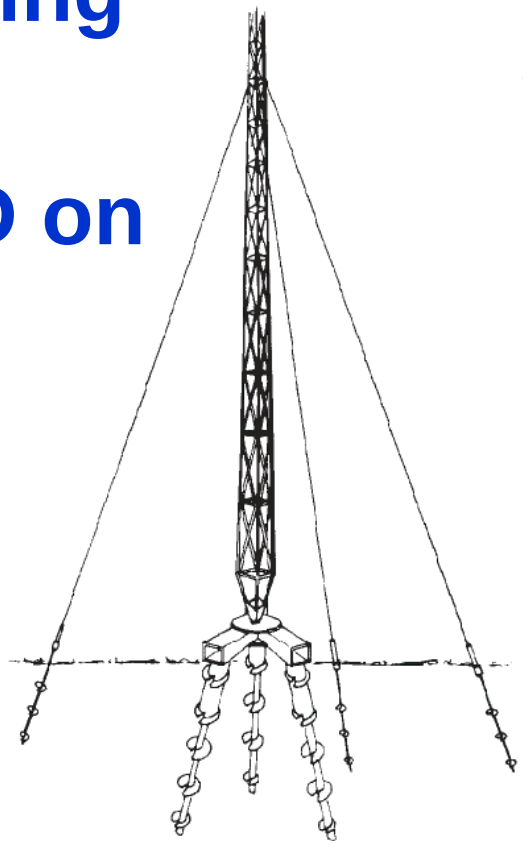


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Improving CAPEX – Installation

- **Power-installed screw anchors – no concrete**
- **For guyed and free-standing towers**
- **BWC has sponsored R&D on dynamic loading**





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Improving CAPEX – Financing

- 3 – 15 year financing of Bergey equipment available from commercial lenders with U.S. EXIM Bank backing
- EXIM Bank priority given to environmental technologies
- IFC finance window?

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EXPORT-IMPORT BANK of the UNITED STATES

Your Green Power for Mobile Partner



Mike Bergey, President
Bergey Windpower Co.
2200 Industrial Blvd.
Norman, OK 73069 USA
Tel: +1-405-364-4212
E-mail: mbergey@bergey.com
Web: www.bergey.com