

Generation Clean

Commercial – Municipal – Agriculture



Renewegy

***VP-20 Wind Turbine**
Commercial grade wind
power designed specifically
for your business needs*



*Manufactured in
Oshkosh, Wisconsin*

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Why are Customers Considering Wind Power?



*Offset rising energy costs
Marketing and increased sales
Currently the lowest cost renewable
Provides a reasonable return on investment
Reduce dependence on fossil fuels*



**“Make it
where you use it!”**

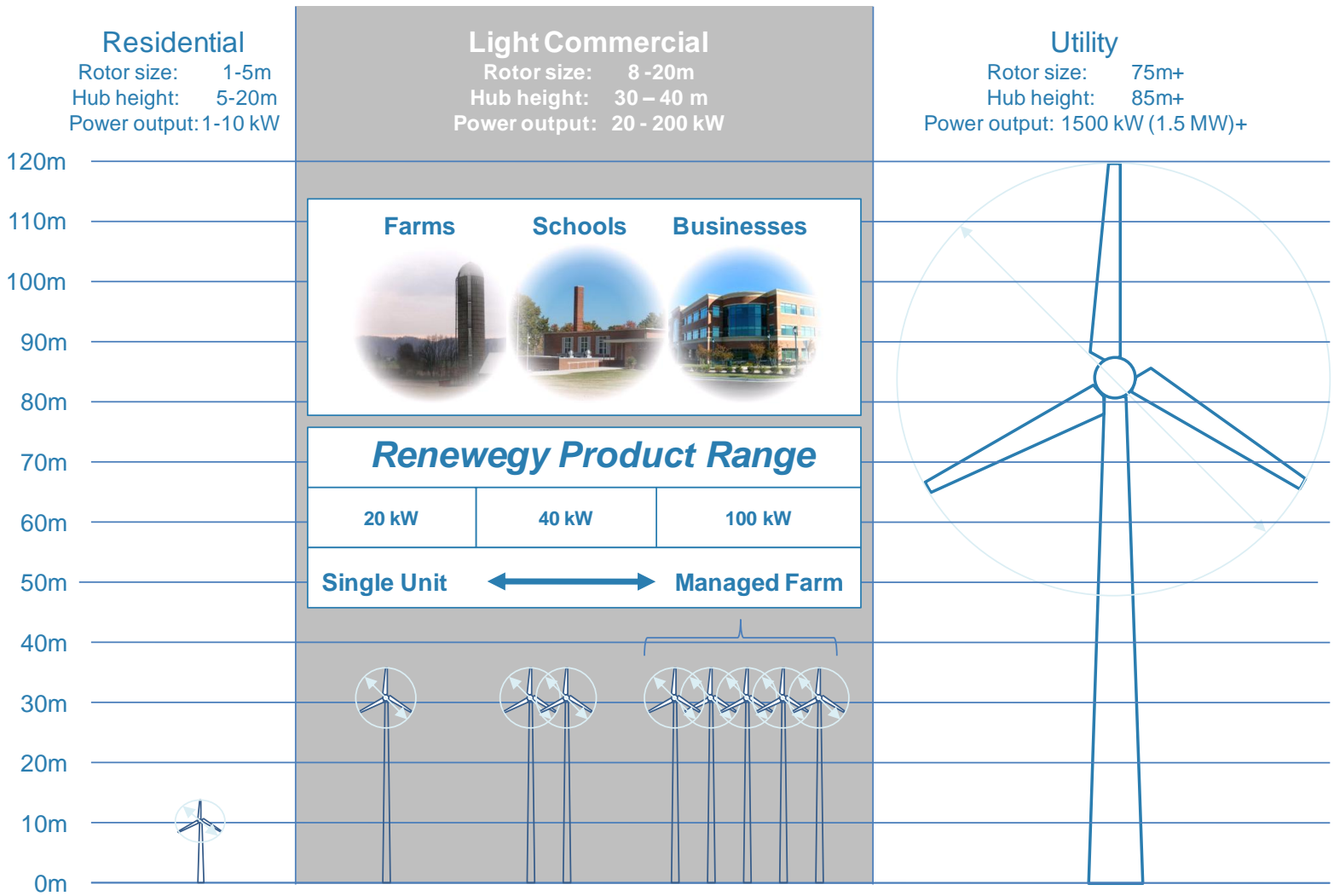
Mike Dillon - SCA Tissue

**“It’s just the
right thing to do”**

Dick Bergstrom - Bergstrom Automotive

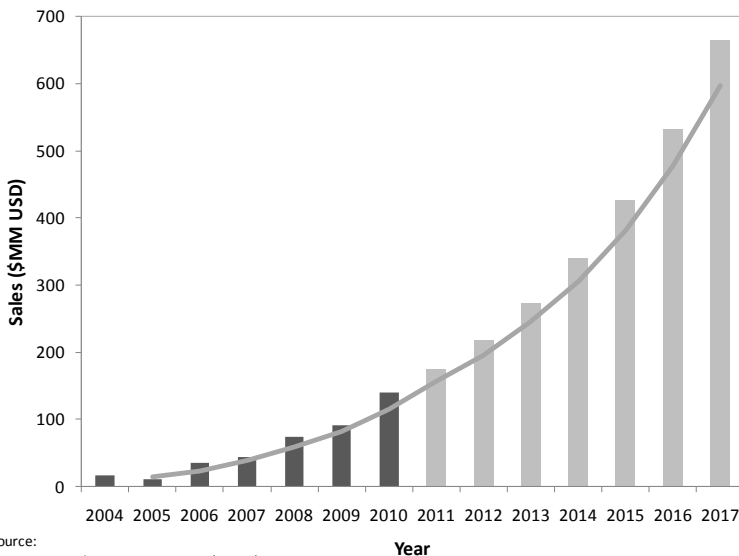


Intelligently Scalable to Meet Your Needs



Renewegy has brought big turbine technology and reliability into the light commercial market. Now businesses, schools, municipalities, and farms can enjoy the same renewable energy that our utilities have been harnessing for years. Whether you are looking for 20 kilowatts (single turbine) or 100 kilowatts (5 turbines) of wind power, Renewegy has a solution for you.

U.S. Small Wind Growth (<100 kW)



Source:
American Wind Energy Association (AWEA)
2010 Small Wind Turbine Global Market Study

Who's Installing Wind Power

- Commercial Businesses
- Industrial Businesses
- Agricultural Businesses
- National Retailers
- Schools and Universities
- Municipalities
- Non-profit Organizations

Unique Tip-Down Tower for Ease of Service

Our monopole tower system has been custom designed specifically for our 20kW turbine to provide simple and cost-effective installation and serviceability. The hydraulic tip-up design eliminates the expense of large cranes and service equipment. Renewegy's hydraulic cylinders and power supply are fit to the tower during installation and servicing. When the tower is erected and securely bolted in place, the cylinders are removed. The result is a reduction in installation and service costs that saves time and money.



Tower Delivery



Tower Assembly



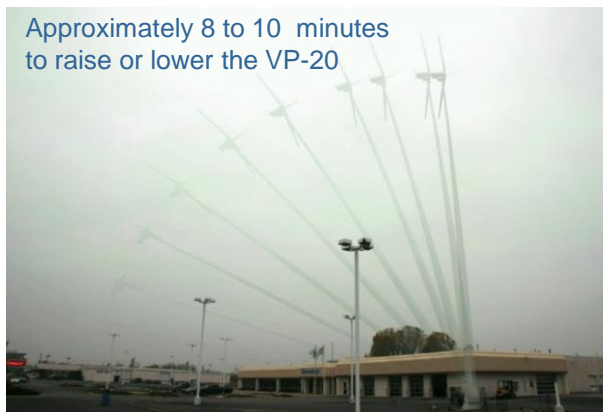
Turbine Head Attachment



VP-20 ready for tip up

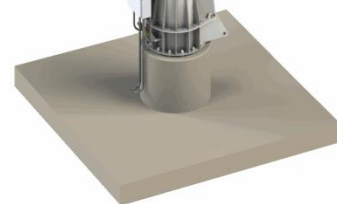


Hydraulic Tip-up System

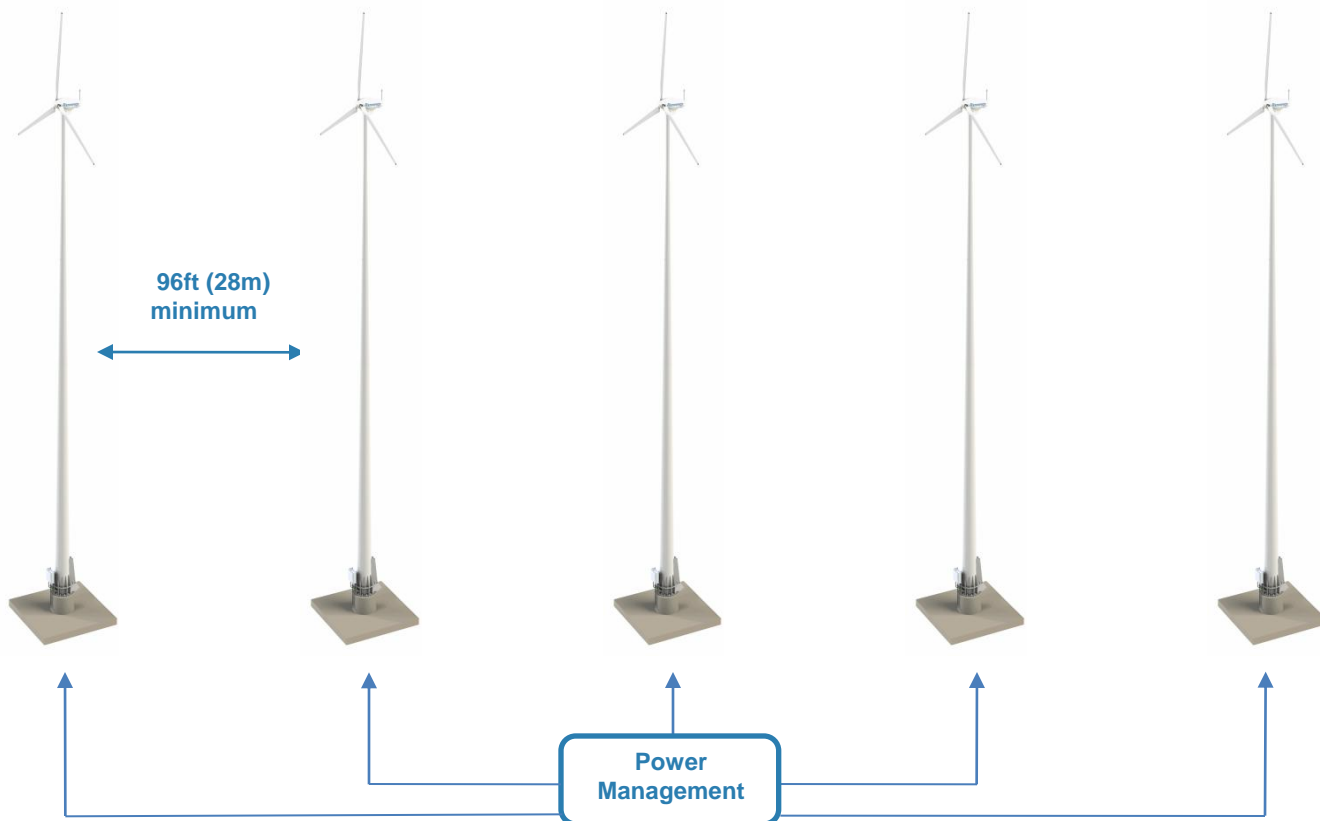


Approximately 8 to 10 minutes to raise or lower the VP-20

Note: The hydraulic cylinders and power supply shown are used for installation and service events. They are not included in the standard package; however, may be purchased separately.



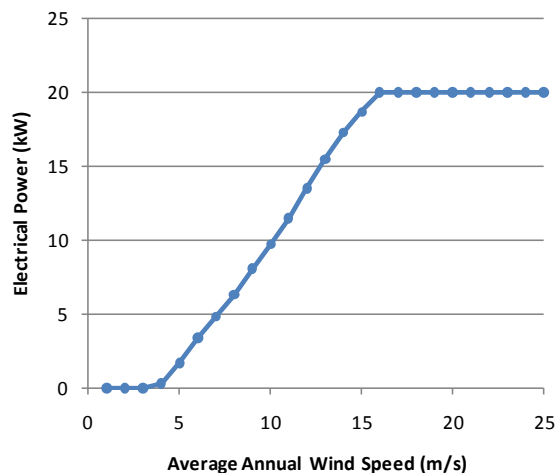
Mini Wind Farms – Easy to Install and Service



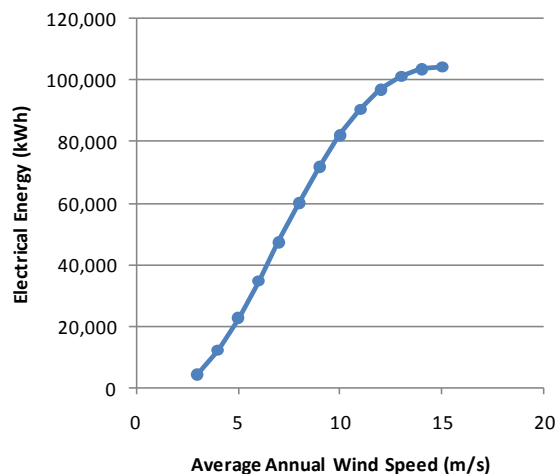
What drives the economics for a typical project?

- Average wind speed
- Electricity costs
- Available incentives
- Number of turbines installed
- Marketing value to your business

Electrical Power Curve



Estimated Annual Energy Production



Annual Energy Estimator	Average Wind Speed		Average Turbulence			
	m/s	mph	Ideal	15%	20%	25%
	4.5	10.1	17,190	14,612	13,752	12,893
	5.0	11.2	22,654	19,256	18,123	16,990
	5.5	12.3	28,501	24,226	22,801	21,376
	6.0	13.4	34,632	29,437	27,705	25,974

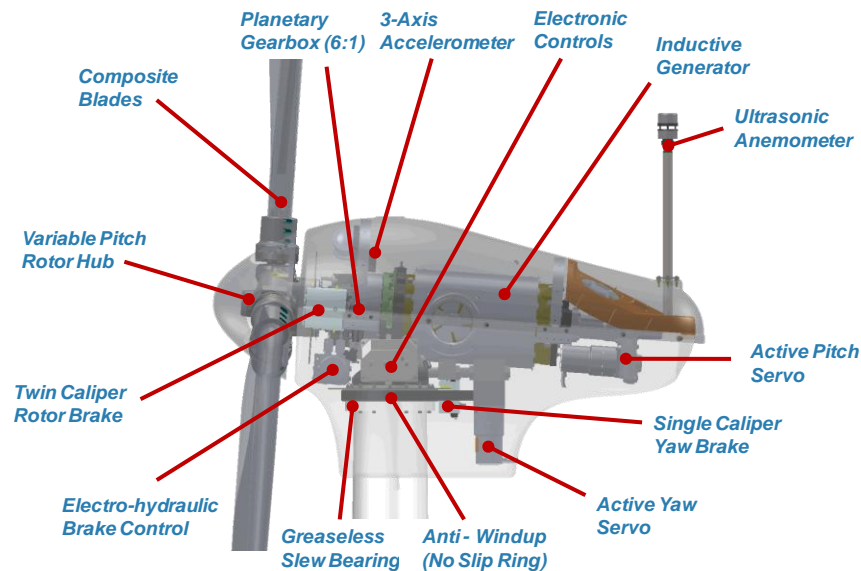
Estimated Annual Energy Production (kWh)

Leading the Light Commercial Market

Optimal

Electronic Pitch Control

The VP-20's electronic Variable Pitch (VP) control system is unique in the Light Commercial market. Why is Variable Pitch important? Every wind turbine needs a way to control and optimize its performance over the wide range of wind speeds and environmental conditions. Like its Utility scale counterparts, the VP-20 actively controls the pitch of each blade within 1/100th of a degree while pitching at speeds up to 15 degrees per second. This unique capability allows the VP-20's control system (seven microcomputers working in unison) to optimize the turbine's performance while ensuring safety and reliability.



Safe

Three Axis Accelerometer

What if Renewegy could put an engineer on top of every one of our VP-20 products to ensure the safety and performance of the turbine? Well – that's probably a little impractical; however, we've done the next best thing. Each VP-20 turbine head comes standard with an electronic 3-Axis Accelerometer to measure the key vibrations from your turbine head. This information is processed 10 times per second by the VP-20's master controller to ensure that your turbine is operating safely under all conditions. If anything abnormal is detected, a warning is triggered. If the condition worsens, the master controller will automatically shut the turbine down until a service technician can evaluate the situation.



Smart

Internet Connectivity – Remote Monitoring

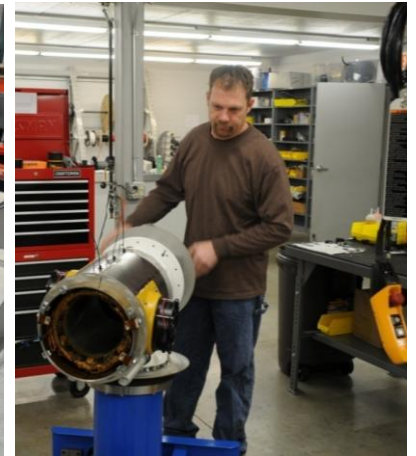
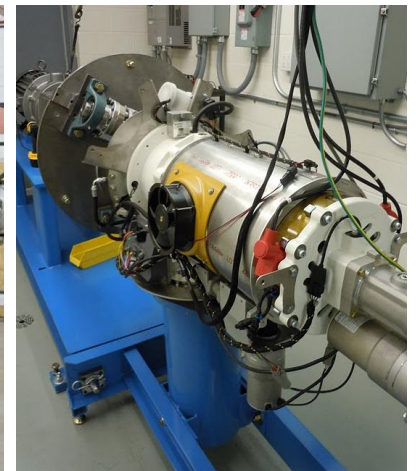
Like its larger counterparts, each VP-20 turbine is connected to the internet. Not only can you monitor the performance of your turbine through any web browser (like the screen to the right), but Renewegy service technicians can remotely do a deep dive into your turbines systems to monitor and/or diagnose any issues that may arise. Additionally your VP-20 turbine can be remotely setup to analyze itself by acquiring up to 8 Megabytes of data (15 channels of data at up to 10 times per second). Once the data is captured, your VP-20 is smart enough to automatically upload the data to Renewegy's technicians for review.

Parameter	Value	Units
Operating Mode	RUN	
Instantaneous Power	19.200	kW
Lifetime Total Energy	4036.130	kWh
Cycle Energy	161.176	kWh
Cycle Time	14:10:40	time (hh:mm:ss)
Wind Speed	17.69	m/s
Wind Direction	305.92	degrees
Pitch Angle	77.68	degrees
Yaw Angle	-62.8	degrees
Air Density	1.115	Kg/m ³
Air Temperature	0.50	C
Barometric Pressure	87.7	kPa
Generator Speed	654	RPM

Proudly Designed and Manufactured in the USA



- American Ingenuity → Building USA's clean energy technology
- American Steel → Proud to partner with USA based suppliers
- American Jobs → Manufactured in Oshkosh, Wisconsin



VP-20 Data Sheet

Operating

	<u>Standard</u>	<u>Metric</u>
• Maximum Power:	27 HP	20 kW
• Rated Power @ 11 m/s:	15.4 HP	11.5 KW
• Rated wind speed:	35 MPH	15.8 m/s
• Freewheel Speed:	5.6 MPH	2.5 m/s
• Cut-in Speed:	7.8 MPH	3.5 m/s
• Cut-out Speed:	55.9 MPH	25.0 m/s

Rotor

• Number of Blades:	Three	
• Rotor Speed:	100 – 110 RPM	
• Diameter:	31.5 ft	9.6 m
• Swept Area:	779 ft ²	72.4 m ²

Generator

• Type:	Asynchronous Inductive
• Rated Speed:	600 - 660 RPM
• Voltage:	480VAC 3-phase

Gearbox

• Type:	Single Planetary
• Ratio:	6.00:1

Control

• Type:	Microprocessor based
• Pitch:	Active closed-loop electric servo control
• Yaw:	Active closed-loop electric servo control
• Algorithm:	Proprietary Synergistic Pitch/Generator Control
• Connectivity:	Cellular, 802.11, wired Ethernet
• Managed:	Master or Slave (wind farm capable)

Braking System (fail safe)

• Rotor Aerodynamic:	Active blade pitch control (fully feathered)
• Rotor Mechanical:	Dual caliper spring loaded disc brake
• Yaw Mechanical:	Single caliper spring loaded disc brake

Lightning Protection

• Grounding:	Coherent ground path from turbine to Ufer grounded foundation
• Strapping:	Dedicated braided strapping to ensure low resistance ground path
• Surge:	Standard suppression installed in all electronics

Tower Options

• Monopole:	30 meter hydraulic tip-down system
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