The RED HILL Breezy 5.5 INFORMATION

The Basics:

The Red Hill Breezy 5.5 is a grid-tie wind turbine designed to work in conjunction with the utility company to offset or eliminate your electricity cost. The Red Hill Breezy 5.5 was designed by Pairie Home Turbines and there are currently over 50 breezy wind turbines flying around the world. This is a tried and true wind turbine that will be spinning for many years. The design is very simple and reliable. The Breezy is built with off-the-shelf parts that can be purchased locally and are readily available. The generator can be either a 5.5 kW or a 9.9 kW depending on your power needs. The biggest advantage of our wind turbine is the cost. Most wind turbines of this size, cost in excess of $30,000 - but not the Breezy. We wanted to produce a turbine that would be affordable to the common person. With this, I would like to present to you the Red Hill Breezy 5.5 kW wind turbine.

The Red Hill Breezy (RHB) 5.5 uses a 7.5 horsepower inverter grade and a 3 phase industrial motor as the generator. The generator sits atop a 60 foot tower and is turned by four 10 foot long blades that measure 12 inches wide. The blades are constructed of laminated yellow-poplar, cut and shaped here in our community. Each blade is shaped to create an airfoil that produces lift like an airplane. This lift allows the blades to spin faster than the blowing wind. The blades will start to turn in a 9 to 10 mile an hour wind and will slowly get faster and faster until the blades are spinning at 120 rpm. The speed of the turbine blades are monitored by a small single board computer inside the control box at the base of the tower. Once the speed of 120 rpm is reached, the turbine connects to the power grid. At this point the turbine starts producing electricity. The amount produced depends on the speed of the wind. More wind equals more power. The power is first sent to your breaker box to be used by you. If you do not need all the power that is being produced it then flows out of your house through the meter and back to the main grid to be used by someone else. This happens automatically. The only requirement is an occasional inspection (usually in the fall and spring) to ensure everything is in working order.

The best part? **The fuel used to power this machine is FREE.**

Grid-Tie, Net billing and The Power Company:

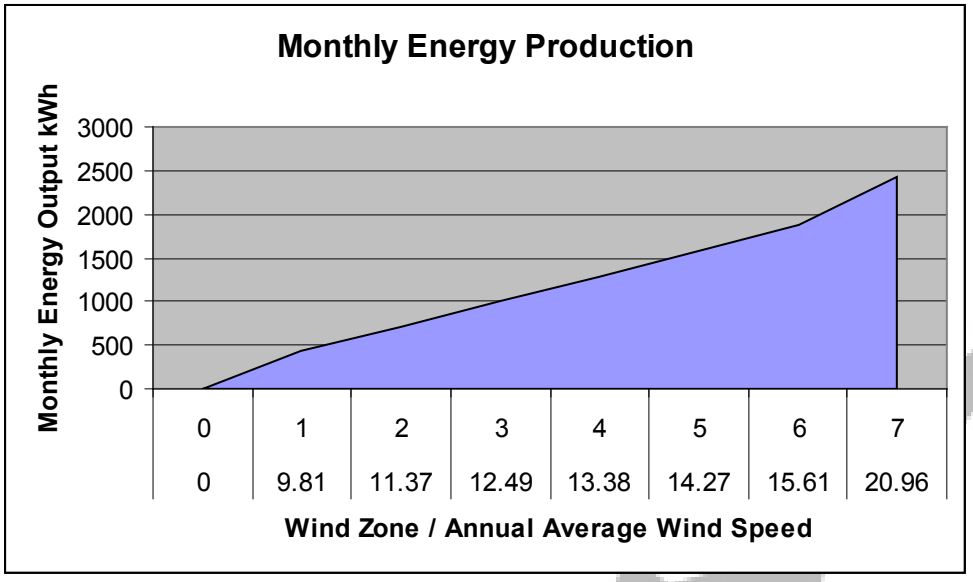
The RHB 5.5 is a grid-tie wind turbine. Being tied to the power grid gives us a few advantages. First, we have a place to send the extra electricity when we don't need it. Second, we have a way to get power when the wind is not blowing or when we are using more power than the turbine is producing. If we did not send the power back to the grid we would have to store it in batteries for future use. This would be very expensive. When we send power to the grid through the meter, the meter spin backwards ,taking off the amount of power that we have used.

For example, during the day we used 10 kWh (kilowatt-hours) of power. Of that 10 kWh the wind turbine produced 5 kWh, so we had to get 5 kWh from the power company. That night the wind continued to blow and generated another 6 kWh that were not used. Those 6 kWh were sent back to the grid. This continues and at the end of the month we pay for the power we used. If we produced more than we used the balance is zero. The overage amount is carried forward to the next month for us to use. This process is called net billing and was made into law by the Virginia General Assembly a few years ago.

How much Electricity Will The Red Hill Breezy 5.5 Produce?

To approximate the production of the turbine we must know the average wind speed of the site. Wind speeds are classed in 7 zones, number 7 being the best. This can be taken from wind maps or measured over time with an anemometer. The Red Hill Breezy 5.5 at Fancy Gap is located in a wind zone 3 so we will use zone 3 to base our numbers. The chart on the following page shows the different production levels at different wind zones.

The Red Hill Breezy 5.5 Information



The annual production is based on a wind zone 3 at 60 feet high. The power output for the Breezy is 1000 kWh per month or 12,000 kWh per year. An increase in height to 100 feet would increase the power output to 16,000 kWh per year or more. **The Red Hill Breezy 5.5 can be monitored via the internet at www.redhillgeneralstore.com/energy/.** You can follow along and see the true electrical output and wind conditions helping you get a better understanding of this turbines capability.

Technical Specifications for The Red Hill Breezy 5.5

* 9.9 kW Breezy is shown in red if different from 5.5 breezy.
Capacity: 5.5 kW , 9.9 kW
Rotor Diameter: 20 ft
Weight: 1500 lb , 2000 lbs
Type: Up wind rotor with stall regulation control
Blades: (4) Laminated Yellow Poplar
Rated Speed: 120 rpm
Generator: 7.5 hp induction gear motor, 15 hp induction gear motor
Passive Yaw Control:
Grid Feeding: 120/240 VAC 60 hz
Braking System: Electronic stall regulation with redundant relay switch control
Cut-in Wind Speed: 8-10 mph
Rated Wind Speed: 24 mph
User Monitoring: Wireless interface, pc or internet
Warranty: 1 year limited warranty

How much does the Red Hill Breezy 5.5 Cost?

A portion of the cost is based upon the location of the turbine. Until we know the turbine site it is hard to provide an exact total. However, the cost information we can provide for the Red Hill Breezy 5.5 is that the total installed cost will start around $15,000.00. The NEW Breezy 9.9 producing double the energy should start around $20,000.00. The Federal Government will reimburse you 30 percent of the total cost. With that in mind, the Red Hill Breezy 5.5 will cost a little over $10,000.00 and the Red Hill Breezy 9.9 KW will cost around $14,000.00 .

How many years will it take to payoff?

The "payoff" is dependent on the location of the wind turbine and for this purpose we are assuming there will be NO increase in the price of electricity from the power company. Our estimated payoff time ranges from 5 to 10 years before your wind turbine will be making free electricity. After such time and with proper maintenance you should enjoy many years of free power. **We cannot think of any product that will fully pay for itself in 5 to 10 years and then keep paying.** It is important to note that when you purchase a wind turbine it will produce the same ammount of electricity for life of the turbine which is 20 + years. This means instead of paying a high price for power - you get to sell it back to the power company at the same high price (and we really like that idea).

Frequently Asked Questions

Are wood blades a good choice?
Wood is one of the best materials when comparing fatigue properties. The majority of builders are comfortable working with wood. Wood was designed to bend but it has limitations. There are people who think carbon fiber, titanium, aluminum, or other materials are better. It is a fact that wood is an excellent material for blades. If properly finished and maintained they will last a very long time.

Do 4 blades in a rotor cause problems?
We feel most problems associated with four blade rotors resulted when they were used in downwind systems. The problems resulted from what is called "shadow wake turbulence". Shadow wake turbulence is when the airflow has been disrupted or partially blocked by the tower. When the blades (being down wind) pass through this void or disrupted air, the force that had been applied to them would momentarily be gone. The opposite blade is now at the

Frequently Asked Questions (Con't)

12:00 position and still has the full force of the wind against it. This imbalance of lift caused abnormal stress in the hub and yaw assemblies and led to premature failures. Breezy 5.5 being an upwind design is not affected by shadow wake turbulence.

It is easy to see that vibration in one blade could travel across the hub and be present in the opposite blade. This would be impossible if there were an odd number of blades. If that were a major problem we would not be able to use any rotors with an even number of blades. Airplanes and choppers are frequently designed to have an even number of blades on them.

In addition to the above, The Red Hill Breezy 5.5 rotor is not up there turning 500-600 rpm. Our rotor and generator are locked to the line and geared so that the rotor speed is held at 120 rpm. At 120 rpm it isn't as critical that everything be perfect and that all blades match precisely. Because of this, we do have some margin for error.

Is blade efficiency not a problem?
This is where some of the older grid-tied asynchronous generators failed miserably. They spent a lot of effort in making highly engineered airfoils with controls that would correct the pitch with varying wind speeds. These controls were the doom of most of those designs. It really doesn't matter how "high-tech" something is if it is broken. The blades on the Breezy 5.5 do their job extremely well. Having a 4-blade rotor Breezy 5.5 can generate power at wind speeds lower than any asynchronous machine out there. The rotor of the Breezy is specifically designed to operate in wind speeds up to 23 mph and it must loose efficiency above 23 mph or the generator will overheat. At low wind speeds power is mostly about blade surface area. At high wind speeds, if you are designing for that, it's all about pitch control and blade profile. If your day to day wind speeds are between 6 and 23 mph Red Hill Breezy's blades will do an impeccable job for you.

Why are the blades black?
The blades are painted black to melt snow and ice.

Is the motor brake electrically activated or electrically released (in other words, if there is a grid power failure, do you lose brake function)?
The brake is electrically released. If the power fails the brake is set and the turbine will stop.

Is this a furling design or do the blades stay oriented to wind?
This blade design has a considerable amount of drag at high wind speeds. Since the generator operates at a near constant speed once on-line, drag in the blades helps to control the output of the generator. This allows the generator to create a lot of lift at low wind speeds without overpowering it at high wind speeds.

Is this generator capable of 60 Hz at all ranges? Whether it's 8 mph or 30 mph?
Red Hill Breezy 5.5 requires no inverters or batteries. It locks on the grid at 60 Hz. This is how 95% of the big turbines work and a lot of them are putting out 300+ kW.
We feel that wind chargers that require grid tie inverters are not cost effective. A grid tie inverter for 5.5 kW DC machines would cost over $5,000. Red Hill Breezy 5.5 is an AC generator. This turbine is not made for off the grid. Breezy 5.5 does not care if the wind is blowing 8 mph or 30 mph; the turbines still turns 120 rpm. And still puts out 60 Hz AC (it just puts out more power at 30 mph wind).

If the utility goes down will the Breezy 5.5 continue running?
No. If the power company losses power the breezy shuts down. This is to protect the safety of the power company employees.

Can I place my wind turbine at my friend's farm in Fancy Gap that has excellent wind and have the power company install a meter so I can connect it to the grid? Then, can any excess power that is produced be credited to another account in my name?
No, this is called consolidated net billing. Some states have approved this type of billing but Virginia is not one of them. This is a prime example of how the power company can advertise how they are supporting renewable small energy. But by preventing us from using the power grid for consolidated billing they are preventing real energy freedom and insuring that small wind will never succeed to its fullest potential. Only a few people live where the wind blows strong enough to support a wind turbine. If the power company would allow consolidated net billing - we could all have a wind turbine that produced enough power to offset or erase our power bill.

If you are looking for a way to help cut your power bill and don't live in a good wind area or beside a creek for water power, then take time and tell the power company you want consolidated net billing. Contact your state representatives and tell them you want consolidated net billing. Folks this is the key to really doing something about your electric bill. With this you could be guaranteed that your wind turbine would produce the maximum amount because you could place it where the wind blows the best.

How do residential wind turbines work?
A wind turbine is installed on top of a tall tower and it collects kinetic energy from the wind and converts it to electricity that is compatible with a home's electrical system. In a normal residential application a home is served simultaneously by the wind turbine and a local utility. If the wind speeds are below cut-in speed (7-10 mph) there will be no output from the turbine and all of the needed power is purchased from the utility. As wind speeds increase, turbine output increases and the amount of power purchased from the utility is proportionately decreased. When the turbine produces more power than the house needs the extra electricity is sold to the utility. All of this is done automatically. There are no batteries in a modern residential wind system. Small wind systems for remote applications operate somewhat differently.

Will a small wind turbine save me money?
The wind turbine typically lowers your electricity bill by 50 to 90 percent. It is not uncommon for wind turbine owners with total-electric homes to have monthly utility bills of only $8 to $15 for nine months of the year. In northern parts of the country where less air conditioning is used the bills can be even lower year-round. The amount of money a small wind turbine saves you in the long run will depend upon its cost, the amount of electricity you use, the average wind speed at your site, and other factors.

What size turbine would I need for my home?
Homes use approximately 9,400 kilowatt-hours (kWh) of electricity per year (about 780 kWh per month). Depending upon the average wind speed in the area a wind turbine rated in the range of 5 to 15 kilowatts would be required to make a significant contri-

bution to meet this demand.

Who should consider buying a wind turbine?
The economics of a wind system are very sensitive to the average wind speed in the area and to a lesser extent -the cost of purchasing electricity. A residential wind turbine can be a relatively large device and is not suitable for urban or small-lot suburban homes. A property size of one acre or more is desirable. If economics are a concern a turbine owner should have at least 10 mph average winds and be paying at least 10 cents/kWh for electricity.
Residential wind turbines have been installed in at least 47 of the 50 states.

Will it help the environment if I install a wind turbine at my home?
Yes. Wind turbines produce no pollution and by using wind power you will be offsetting pollution that would have been generated by your utility company. Over its life, a small residential wind turbine can offset approximately 1.2 tons of air pollutants and 200 tons of greenhouse gases (carbon dioxide and other gases which cause climate change).

Do wind turbines make noise or interfere with TV reception?
Wind turbines do make some noise, but not enough to be found objectionable by most people. A typical residential wind system makes less noise than the average washing machine. Wind turbines do not interfere with TV reception.

Will my utility allow me to hook up a wind generator?
Federal regulations (specifically, the Public Utility Regulatory Policies Act of 1978, or PURPA) require utilities to connect with and purchase power from small (less than 80 MW) wind energy systems. The Red Hill Breezy 5.5 is connected to Appalachian Power Company through a net metering interconnect agreement.

Will I have to change any of the wiring in my house?
No. A wind turbine is easily retrofitted to virtually any home without the need to change any wiring or appliances. The Breezy connects to a 220/240 vac 30 amp breaker in your breaker box just like a clothes dryer.

What about towers?
The Red Hill Breezy sets atop a 60 foot tower. This would be a minimum height and in other areas should be at a height of 80 to 100 feet. Towers this tall are necessary to raise the wind turbine above turbulence generated by obstacles on the ground and trees. Wind velocity and wind turbine performance increases with altitude.

How reliable is the Red Hill Breezy 5.5 wind turbine? Will I have to perform much maintenance?
The Red Hill Breezy 5.5 has very few moving parts and requires a check every six months. They are designed for a long life (20 years+) and operate automatically.

How do wind turbines perform as an investment?
The wind system will usually recoup its investment through utility savings within 5 to 10 years and after that the electricity it produces will be virtually free. Over the long term a wind turbine is a good investment because a well located wind system increases property value similar to any other home improvement. Many people buy wind systems in preparation for their retirement because they don't want to be subject to unpredictable increases in utility rates.

What happens when the wind is too strong? Can the windmill turn out of the wind so the speed goes down?
The turbine's speed is held constant by being "inductively" locked to the 60 Hz grid. The shape of the blades result in no or very little increase in power output of the rotor with increased wind after a certain point. However, there are limits. If it were forecast that prolonged very strong winds, say in excess of 50 -75 mph, we would shut the turbine down rather than place it at risk. Even though the Breezy would survive this wind, the added stress should be avoided if at all possible. (There are several ways to solve wind survivability problems, rotor furling, blade pitch or just shutting the turbine down at high wind speeds. Red Hill Breezy 5.5 uses a fourth method, brute strength. This is probably the heaviest turbine of its size out

Circuit theory

This circuit theory description may be used when required in conjunction with the grid-tie diagram to aid builders and utility personnel to better understand the operational and safety features of the Breezy 5.5 grid interconnect control. It should be understood that the control takes advantage of unique characteristics of asynchronous induction generation and features inherent with this type of generation.

Generator: 240V, 3-phase (connected 1-phase), 60hz, 5.5kw, 4-pole, these generators are actually industrial 3-phase gear motors with an electromagnetic brake (electrically released) mounted so that when power is applied to the brake it releases the generator shaft allowing it rotate. The rotational speed of the shaft is closely monitored by the micro-controller. This is depicted in the one-line diagram as a line from the generator to the micro-controller.

Use the grid interconnect one-line, theory. and wiring diagrams to follow the circuit description. Note: the use of an over/under voltage relay may not by required by all utilities.

Condition: From an open, un-energized circuit to generator power up. When closing the disconnect or breaker in the customer service panel, power is supplied to the generator interface panel. The panel routes one side of the incoming 240V supply through the generator windings and back to one side of the interconnect (main) relay. The remaining incoming 240V supply lead is connected to the remaining contact on the interconnect relay so that when the relay is energized the circuit is complete. The 240 V supply is also connected to the brake relay in the same manor. The over/under voltage relay monitors

the return or application of line voltage and after a length (adjustable) of time completes a path so that power is applied to the micro-controller. At this time the micro-controller is powered up and after software initialization and self-test is brought to control the operation of the generator. The micro-controller will energize the brake relay which will in turn energizes the electromagnetic brake allowing the generator to turn. As the turbine is turning the micro-controller will monitor the generator shaft speed via the hall-device.

Condition: Generator bought on-line with sufficient wind speed.
As the wind speed increases and the generator shaft speed has increased above 1800 rpm as determined by software settings in the micro-controller the interconnect (main) relay is energized connecting the generator windings to the utility. Should the wind speed drop to a level which a shaft speed over 1800 rpm cannot be maintained the interconnect relay in de-energized and the cycle is allowed to repeat.

Condition: Loss of utility voltage, generator online not generating.
When there is a loss of utility voltage the field holding the electromagnetic brake collapses, applying the brake to the generator shaft. This in turn stops and holds the turbine rotor. The generator is held in this condition until utility power has returned.

Condition: Loss of utility voltage, generator online and generating.
When there is a loss of utility voltage while the generator is online and generating the generator will be brought to a stop by de-energizing the electromagnet brake because one of three conditions: First, local loads pull the generator below 1800 rpm, micro-controller releases interconnect relay, source of all controller and brake voltage is lost, and the turbine is locked by brake. Second, if local loads are light or the wind is very strong which in this case, there being no reference voltage in which to lock the generator (generator runaway), an over speed condition will be detected by the micro-controller. The interconnect and brake relays will be de-energized causing the electromagnetic brake to be de-energized locking the turbine rotor. Third, the voltage monitored by the over/under voltage relay falls outside set parameters. This relay removes voltage from the control circuits releasing the interconnect and brake relays in turn applying the electromagnetic brake. Maintaining a self-excited mode of generation with this size and type of generator without specialized control circuits is extremely unlikely or very close to impossible but may be tested for at installation with standard islanding tests.

Frequency control: An inherent feature of the asynchronous induction generator is that frequency is controlled entirely by the utility line frequency. Magnetism required for generation is created in the generator by reactive current flowing into the circuit from the utility. When this reactive current is present the rotor within the generator is said to be "magnetically locked" to the utility. The actual rotor speed may "slip" forward or turn slightly faster than 1800 rpm but the generator will remain locked to the utility line frequency. It is this rotor slip that will allow the generator to follow the utility below 60HZ and remain online since the micro-controller is monitoring actual generator shaft speed.

Over/Under voltage relay. The circuit described here incorporates an over/under voltage relay. This relay is connected across the line just after the disconnect and monitors the voltage at the load side of the disconnect. Should the voltage fall or rise above the set point the relay will remove power from the micro-controller and shut the turbine down. The relay will continue to monitor line voltage and return the micro-controller to operation a certain (adjustable) length of time after the voltage returns to normal.

Voltage control: The voltage levels at the turbine interconnect may be slightly higher then those measured at the utility transformer. The actual voltage will be at a level equal to line voltage plus the voltage drop in the conductors supplying the turbine. Conductor sizes should be adjusted to compensate for voltage drop to keep the voltage level within limits. Utility line levels essentially control the voltage levels. The 5.5 KW generators will not "over volt" the grid, as may be a concern with the larger turbines.

Power Factor: Capacitance has been added to correct power factor. Values have been chosen which will produce adequate power factor correction at a point below circuit resonance. Capacitance may be adjusted for individual installations if power quality becomes an issue.

Flicker: Flicker and abnormal or visible changes in light levels from incandescent lighting is usually not problematic with the 5.5 KW turbine. If flicker becomes an issue the use of solid state "zero-cross" relays for the interconnect relay can minimize the effect. These relays turn on at the zero volt crossing point of the 60HZ sine wave .

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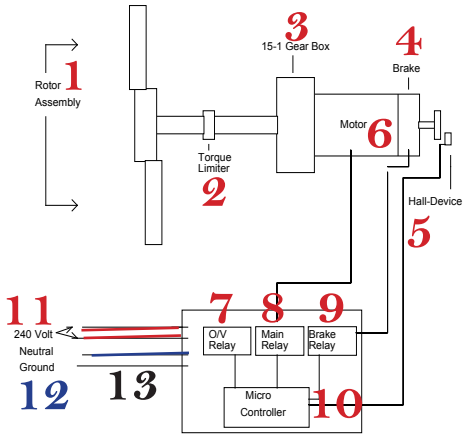
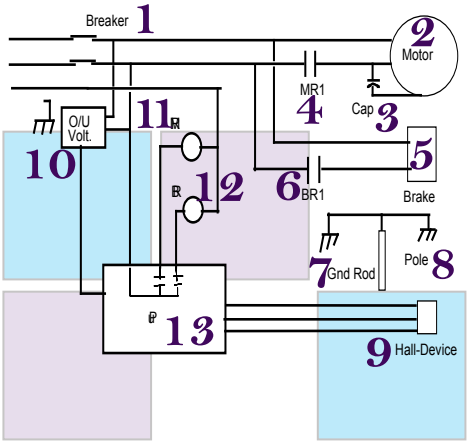


1.Rotor Assembly 2.Torque Limiter 3.15-1 Gear Box 4. Brake 5.Hall-Device 6.Motor 7.O/V Relay 8.Main Relay 9.Brake Relay 10.Micro Controller 11.240 Volt 12.Neutral 13.Ground



1.Breaker 2.Motor 3.Cap 4.MR1 5.Brake 6.BR1 7.Gnd Rod 8.Pole 9.Hall-Device 10.O/U Volt 11.MR 12.BR 13.uP

If the wind is not blowing - maybe you have water flowing!

Red Hill Energy Presents:

Hydro Power

The Hydro Turbine is perfect for smaller plots of land that have water flowing and little wind blowing.

Water turbines are based upon the total height of the flow and the volume (amount of water) flowing. Find out if your site is a candidate for Hydro Power by contacting Red Hill General Store.

The price range is $1,000 to $5,000. These systems will pay for themselves in 6-36 months.

Hydro Power runs 24/7 - 365 meaning smaller systems can be used to produce more energy. The sizes range from a 500 watt system to a 3,000 watt system.

Red Hill General Store currently has a hydro turbine operating at an off-grid cabin in Carroll County. For more information please contact Sarah Jones at 1-800-251-8824 ext. 2015 or jones@redhillgeneralstore.com

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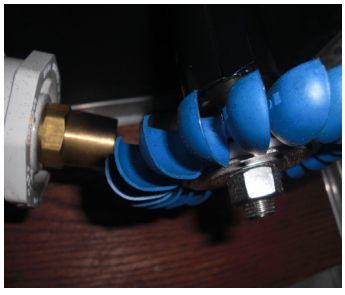

Wind Tubines - What is my next step?

1. Determine the wind energy at the site you wish to install the wind turbine. 10 mile an hour average wind speeds are recommended. See someone from Red Hill General Store to do this. We can look up the average wind speed of your home today or you can contact us at jones@redhillgeneralstore.com or call Sarah Jones at 1-800-251-8824 ext. 2015 to find out your wind speed.

2. You will need a sufficient piece of land to erect a wind turbine. In most cases this will be an acre or more.

3. Have Red Hill General Store complete a wind site assessment. After this meeting recommendations can be made.

4. Once the wind assessment is completed we will discuss the next step in the process. Payment terms are 50% down at the beginning of the project and the rest is to be paid upon completion of the project.

Hydro Turbines - What is my next step?

1. For a hydro turbine it is best if your site has a 20 ft total fall and a 50 gallon/minute flow rate. If you need help determining this information please contact Sarah Jones at 1-800-251-8824 ext. 2015 or jones@redhillgeneralstore.com to schedule a site assessment.

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