Information on Wind and Wind Turbines

Why should I buy a small wind turbine?

Usually, the main motivations are to make money or save on electricity bills while improving the environment.
There are other motivations: One is energy security. You can be somewhat protected from brownouts.
Another is to make a statement of what you stand for.
Another is if you intend to live off the grid completely.
Another, particularly for utilities and governments, is that wind can often solve the peak power problem. See our blog posting for more information on that.

What makes Flower Turbines special?

We try to solve all the issues of small wind turbines that could prevent them from being used in a tight environment, near people, and near and on buildings. As a starter, they must be quiet and pleasing to the eye.

We use a drag-type vertical axis turbine. There are several types of small wind turbines. Lift types tend to be noisier and have other negative characteristics but are the usually more cost-effective for placement in an open field, if one does not care about the bird issue. “Lift” means that the turbine operates like an airplane wing; differences in pressure on each side of the wing enable it to work efficiently but they create turbulence and noise. All horizontal axis turbines are lift type. Drag type work by the pushing of the wind and have some variety of a cup shape.

This table shows some basic characteristics.

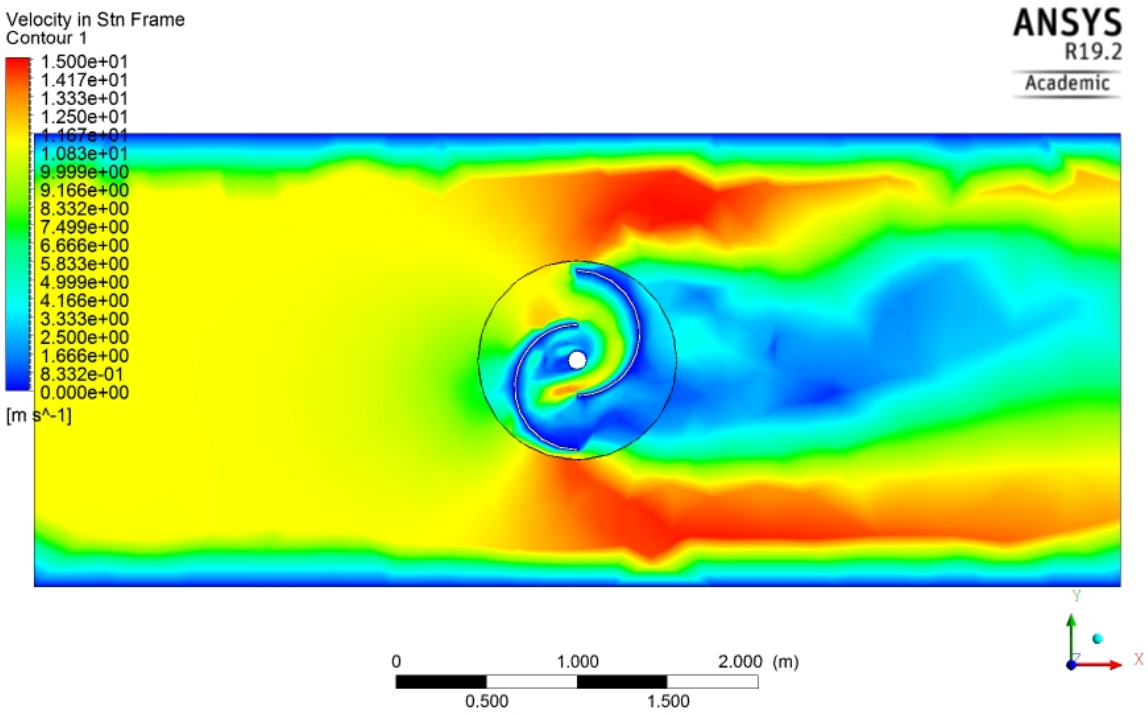
Type	Efficiency	Noise	Birds	Starting Speed
Horizontal axis	30%+	High	Dangerous	3 meters per second
Vertical axis lift	15-25%	High	Dangerous	3 meters per second
Vertical axis helix	5-10%	Medium	Dangerous	5 meters per second
Vertical axis drag	7-10%	Low	Safe	2-3 meters per second

Flower Turbines	35% alone; when including the cluster effect, the performance increases so that it performs 20-50% better; technically, that is not “efficiency”	Low	Safe	1.2 meters per second

Note that vertical axis drag turbines have rightfully acquired a poor reputation in the past for their efficiency. Flower Turbines has retained the positive characteristics of that type of turbine, in particular, the “Savonius” variation, and made aerodynamic design improvements to increase the efficiency substantially.

This is not the place to go into technical details, but it is noteworthy that the efficiency of a traditional Savonius turbine, according to scientific literature, can vary from 5-30% according to how it is built. Unfortunately, most companies do not build them correctly. When Flower Turbines improvements are added, the efficiency is much higher. This is a game changer for the industry.

To give an idea of the technical issues involved, our variation does a better job of enabling the wind to hit one blade of the turbine and pass through it and push the opposite blade also. Here is an engineering simulation showing how it looks in a horizontal cross-section, with the turbine rotating clockwise, the shaft in the middle, red the highest velocity wind (see how it becomes red for a short distance in the center), and the wind coming from the left side:



This simulation also shows another value of Flower Turbines. By placing adjacent turbines on the side of this turbine according to a patent-pending formula, the adjacent turbine benefits from higher velocity wind. We call this the “cluster effect”.

This changes the game for small wind turbines. It means we can put many small turbines together, and make every step, from efficiency of the wind farm to the installation, more cost-effective by enabling more to be made and installed at one time.

What determines the cost-effectiveness of wind turbines?

1. Wind speed
2. Cost of turbine
3. Efficiency of turbine
4. Cost of installation
5. Price/value of the turbine

We will discuss these below.

How do I buy batteries for going off grid?

If you currently have batteries, we need to know what voltages they handle. The reason is that wind produces varying voltages. Even with a charge controller, there needs to be some degree of matching of voltage from the turbine with the voltage of the batteries. Our residential 250-watt turbine should work well with the fairly standard 24 volt battery

systems that come with solar. Our larger models, when they are producing more power, require higher voltages, preferably 96 and higher.

What is meant by capacity and how is it related to the electricity I actually get?

A turbine comes with a maximum capacity of the generator. Let us say it is 2 kilowatts. (1000 watts = 1 kilowatt) That means that when the turbine is performing at its highest capacity, it can produce 2 kilowatts. If it performs at that capacity for one hour, it produces 2 kilowatt hours. This is commonly misunderstood. Turbines are often sold according to capacity, sometimes called the "rated" production at a certain speed, the "rated" speed. That does not mean that you actually get that production from your turbine, because most of the time winds are lower and you get much less. When you read that a wind or solar farm has added 100 megawatts (1 megawatt = 1000 kilowatts = 1,000,000 watts) of capacity to the grid, it does not mean that it is actually producing that amount.
A practical result of understanding these distinctions is that you need to use kilowatt-hours to calculate the return on investment of the system you buy. So if you buy a turbine for $1000 and it produces $200 worth of electricity per year, then you are getting a 200/1000 return (20%) on your money per year. That figure of $200 worth of electricity comes from taking the number of kilowatt-hours produced each year times their value. So 2000 kilowatt-hours (kwh) per year at $0.10 value per kilowatt-hour means a value of $200.

How can I evaluate the wind at my location?

First, look at some free online resources to get a feeling as to whether or not you are in a high wind area. There is a caution that comes with all these resources. Wind can be very specific to a specific location and height. Many of these resources don't tell you exactly where they were measured and at what height. They are useful as a starting approximation.
International information: Weather Underground: https://www.wunderground.com/
USA.com: www.usa.com
Enter your location, then click on Others, and scroll down to the bottom of the page for the wind graph.
International information: Meteoblue: https://www.meteoblue.com To take full advantage of this site, click on the left side bar where it says Archive Climate and then under it Weather Archive. It takes you to a page where you can get wind speed measurements or projections over the course of a year.
US Department of Energy: https://windexchange.energy.gov/
This site has useful information in general and has links to wind maps of each state.
Many countries have their own meteorological services and provide data to the public.

You can take that approximation and generalize by asking yourself questions: Are those websites generally accurate about what I feel the wind is? Is my location open on all sides so the wind can come through easily? Is my location in a geographical wind tunnel that accelerates the wind and makes it higher that in my area?

Ultimately, the best solution is to invest a small amount of money and get data from a weather station. Look for one that produces a spreadsheet so that the data can be analyzed. The more often the weather station can take readings, such as every 10 seconds instead of every minute, the better. We do not make these weather stations. We simply recommend any of the reputable models that are in the price range of $100-200 each. If you are building a wind farm involving megawatts, then you should approach one of the commercial testing services.

How do I assess what size system I need?

First, let's define size. Usually that is an easy way to talk about the capacity of the turbines. If it's simply to sell to the grid, the size should be as large as possible.

What are the prices?

Version	Capacity	Price in dollars, Euros, or British pounds
2 meter high	250 watts	1,000
4-meter high	2 kilowatts	7500
	3 kilowatts	10500
	5 kilowatts	14,000
5.5 meters high	2 kilowatts	7,500
	3 kilowatts	10,500
	5 kilowatts	14,000

What version should I buy?

We currently recommend the 5.5-meter high version for the ground or very strong roofs only.
For most roofs, or for the ground, we recommend the 4-meter high version.
Both require a flat surface on the ground or on the roof.
The residential size can be bolted to a slanted roof by your local contractor.

How do I know how many kilowatts to order for the larger versions?

In general, that depends most on your wind speed. Here is a table

Wind Speed Average	Recommended version in kilowatts
<5 meters per second	2
5-6 meters per second	3
>6 meters per second	5

There are other factors in addition to average wind speed. For example, if you have frequent high gusts, the average is not so useful a number, so you would be better off increasing the capacity of your order.

Here is the reason: The power output is proportional to the velocity cubed. So in the power formula, let's compare the effect of 10 meter per second wind versus 1 meter per second wind. If the relationship were linear, the 10 meter per second wind would carry 10 times as much power. In fact, because the effect is cubed, it carries 10 x 10 x 10 divided by 1 x1 x 1, which is 1000 times as much power! That is why low average winds with high gusts can sometimes be better for wind energy than steady winds without gusts.

In general, if your average is 6 meters per second, you can count on good results from your wind turbine.

What is off grid and what is on grid?

An on-grid system is connected to your local utility's power system.

How do Flower Turbines compare to solar PV?

The key is the resource. In a place with excellent sunlight, we recommend PV. In a place with excellent wind, we recommend wind. Both can be placed nearby. In most cases, a row of our turbines will be more advantageous than putting in several rows, unless the wind speeds are high. That leaves you room for other uses of your roof or land, as for solar.
It all depends on your resource.
Our brochure shows a calculation of the costs and benefits of both in a windy area of New England. There, wind comes out slightly better in terms of return on investment, but a lot better in terms of return on investment per square meter. In other words, our turbines, because of the cluster effect, give the customer a better use of horizontal space.

Can I install it myself without a permit?

In general, an emphatic NO. In most areas of the world, you need a local civil engineer to get you a permit, and to make sure that the base is sufficiently strong…
This is important for your safety.

Is the direction of my wind important?

Yes, it helps us determine the orientation of your cluster. To help you with this, we need a combination of your property map, with the proposed location clearly shown in any unit of distance, and your wind direction data.
If you are purchasing only one turbine, it doesn't matter, since this turbine reacts to wind from any direction.

What is turbine certification and do yours have them?

Wind turbine certification is carried out by companies that specialize in measuring turbine output for a particular wind speed according to international standards. That is the most important part of the certification.

Flower Turbines does not have that yet. We plan on doing it soon. The problem has been a lack of funding to do that.

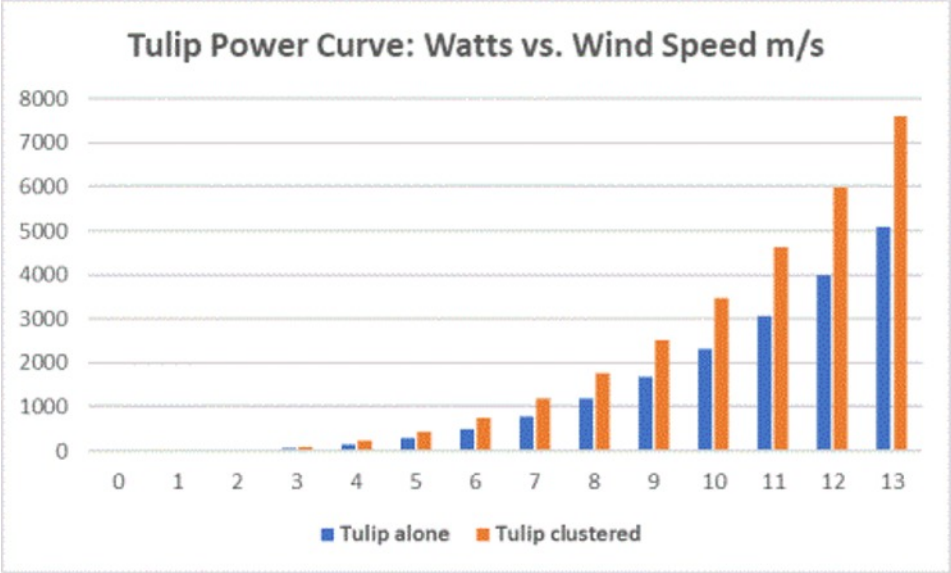
At its best, in any industry, certification is based on the real need to give the consumer or bank lender accurate information. Historically, the small wind industry has been plagued by inaccurate claims. Certification bodies follow recognized international measurement standards. At its worst, in any industry, certification is a weapon used by wealthy vendors of existing technology to protect their turf at the expense of innovation.

We support the idea of certification, but with the improvement of the process to eliminate expensive fees. We would like to see the additional improvement that all turbines are rated at the same speed, for easy comparison, and that each turbine receive a rating for the efficiency at that speed. That would be a benefit for consumers, since a larger size increases the output much more than it affects the efficiency. It would be like going into a store and seeing the signs that show you the amount of product you get per unit price. For example, in CVS pharmacies and Wal-Mart, you can compare a price for a certain volume or weight.

Some wind turbine sites will give useless information for decision making, such as how many tons of carbon you will save, without the more important fundamentals.

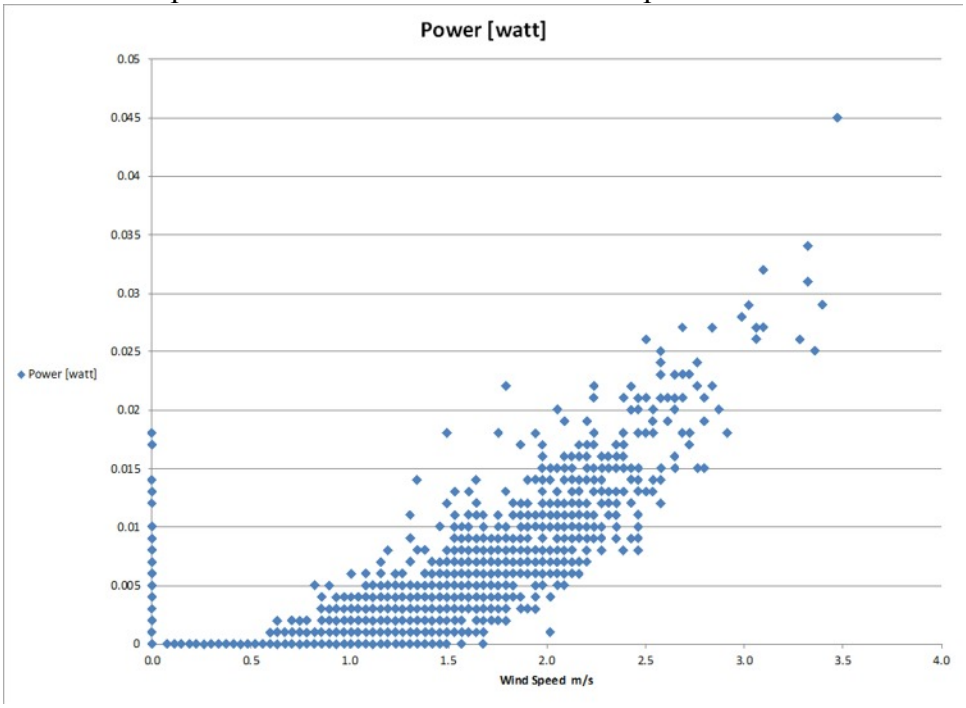
How much energy does the turbine generate?

Here is an expected power curve for the 5.5 high version. The horizontal axis is meters per second and the vertical axis is watts.



Does the turbine perform better than others at low wind speeds? What is the significance of starting at low wind speed?

Most other turbines start spinning at 3 meters per second wind. We collected a lot of data on the 4-meter high turbine at low wind speeds. The graph below is an excerpt from that data. The horizontal axis is wind speed in meters per second. The vertical axis is power in watts. It shows the production of 25 watts at 3 meters per second; the speed at which other turbines are producing zero. We expect our latest 5.5-meter version to be more efficient and produce at least 50 watts at 3 meters per second.



What is the cost of installation?

The cost of installation varies. We assume that it will be around 25% of the cost of a project with 10 turbines. With fewer turbines, the relative cost is higher because you put the crew to work on fewer turbines at one time. With more turbines, the relative cost per turbine becomes lower because of the economies of scale. A good general guide is $25,000 for 10 turbines of height 4 meters and higher. Each 2 meter turbine installation should be much lower. A lot will depend on the condition of the roof or soil where attached.
The more turbines, the merrier.

Can they be mounted on an automobile?

A lot of people think they can mount them on a car and get free electricity. You could only when coasting downhill. Otherwise the resistance that all machines cause would make you use more fuel than you did before.
If you have a mobile home and want to put the turbine on top of your parked vehicle to charge batteries, go ahead. That works.

Haven't I seen this blade design before?

No, you haven't, but you may think you have. Very small differences in shape make a large difference in the field of aerodynamics. There are thousands of patents for slight variations in the shape of airplane wings.
So our 2-bladed "Tulip", as mentioned already, is a variation on the Savonius type of turbine, but the changes we make are significant.

How do you compare these to the large wind turbines?

There is no comparison to the cost-effectiveness of the huge turbines. However, there are limits to the usefulness of the large turbines.
The most relevant one for customers of small turbines is that the price you pay for electricity is much higher than the price the utility pays a wind farm. You pay for transmission and for taxes. Creating your own electricity reduces or eliminates those costs.
Another problem is that transmission systems may not be adequate to bring large amounts of voltage to customers.
Another issue is energy security. Having your own turbines is a hedge against emergencies, brownouts, and inflation.

What are the basic parts of the turbine?

Blades: two overlapping blades in an elegant curvature.
Shaft: the central structure that holds the blades and spins
Flanges: These hold the blades to the shaft.
Bearings: They come with 2 high quality bearings. These align the turbine and protect the parts from wearing out. This is an important reason, in addition to the fact that the turbine is one long axis, that we anticipate a turbine lifetime of 20-40 years with low maintenance.
Brake: This is a manual brake that slows down the turbine. (Some versions may omit the manual brake.) There is also an electronic brake to slow it down, using either the charge controller or the inverter.
Lock: a way to lock the turbine in place.
Gear: This adjusts the rotation of the shaft to the generator. (Some versions may not need this.)
Generator: This produces the electricity from the movement of the shaft. It is still not ready for use, and will need to pass through other electronics, such as a rectifier, charge controller, batteries, and an inverter, according to the use of the system. We use the type of generator called "permanent magnet", which can pick up low amounts of electricity. Sometimes low amounts of electricity are lost in the operation of the inverter. It is easier to make the low amounts useful if the electricity passes to a set of batteries.
Inverter (if included): This enables the electricity to work in an AC grid. EU and North American inverters have different voltage requirements; it is important to specify your location.

What is the warranty?

5 years.

What is the noise?

The noise is extremely low. We have not measured the current version yet, but an earlier version was measured by the Israeli Ministry of the Environment. The conclusion was that at low speeds and a distance of 10 meters there was no difference from the background noise of the wind.

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