

Wind Power

A wind turbine is a device that converts the kinetic energy of wind into electrical energy.

The amount of energy that you will get from the turbine depends mostly on two things: the diameter of the blade rotor, and the exposure to good winds.

The power rating of the alternator in watts actually has very little influence for most of the time, because full rated power is only available in stronger winds. The rest of the time the power output is limited by the wind and by the size of the rotor.

Total days with gales and average wind speed in a year
Belmullet 30 Days average wind speed 6 m/s
Claremorris 5 Days average wind speed 4 m/s

Estimated monthly energy production at different mean wind speeds in meters per second

Turbine diameter mm	1200	1800	2400	3000	3600	4200
Mean wind speed 3 m/s	5 kWh	12 kWh	22 kWh	34 kWh	49 kWh	67 kWh
Mean wind speed 4 m/s	14 kWh	30 kWh	54 kWh	85 kWh	122 kWh	166 kWh
Mean wind speed 5 m/s	23 kWh	53 kWh	93 kWh	146 kWh	210 kWh	286 kWh
Mean wind speed 6 m/s	33 kWh	74 kWh	131 kWh	205 kWh	296 kWh	402 kWh
Mean wind speed 7 m/s	41 kWh	92 kWh	164 kWh	256 kWh	369 kWh	502 kWh



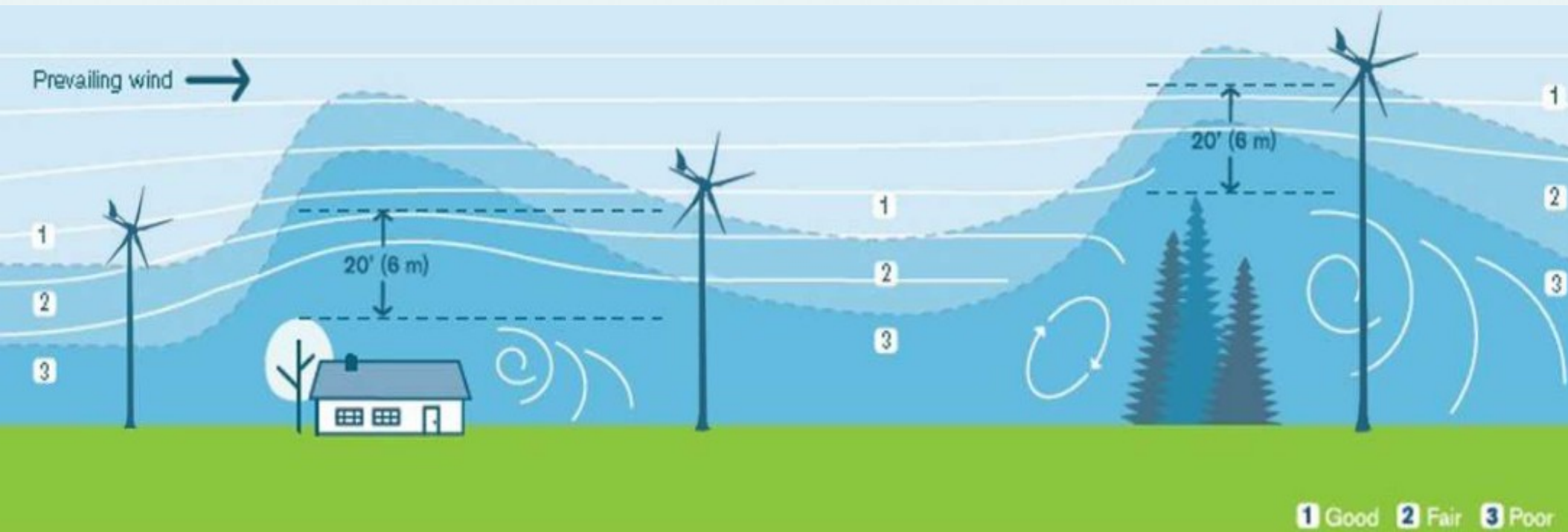
Mounting a Turbine

Small wind turbines are a good way to produce electricity in a windy place.

Wind energy is highly dependent on the wind speed, so it is a good idea to erect a tall tower to reach the best winds.

The turbine needs to be well above surrounding trees and buildings - not just at rooftop level.

If the location is not windier than average, then small wind is probably a waste of effort



5 M Turbine Co Clare



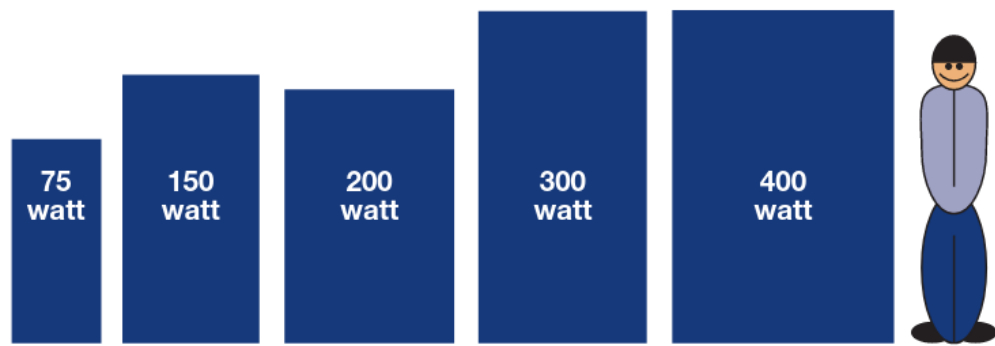
Solar PV

Photovoltaics (PV) is the conversion of light into electricity using semiconducting materials

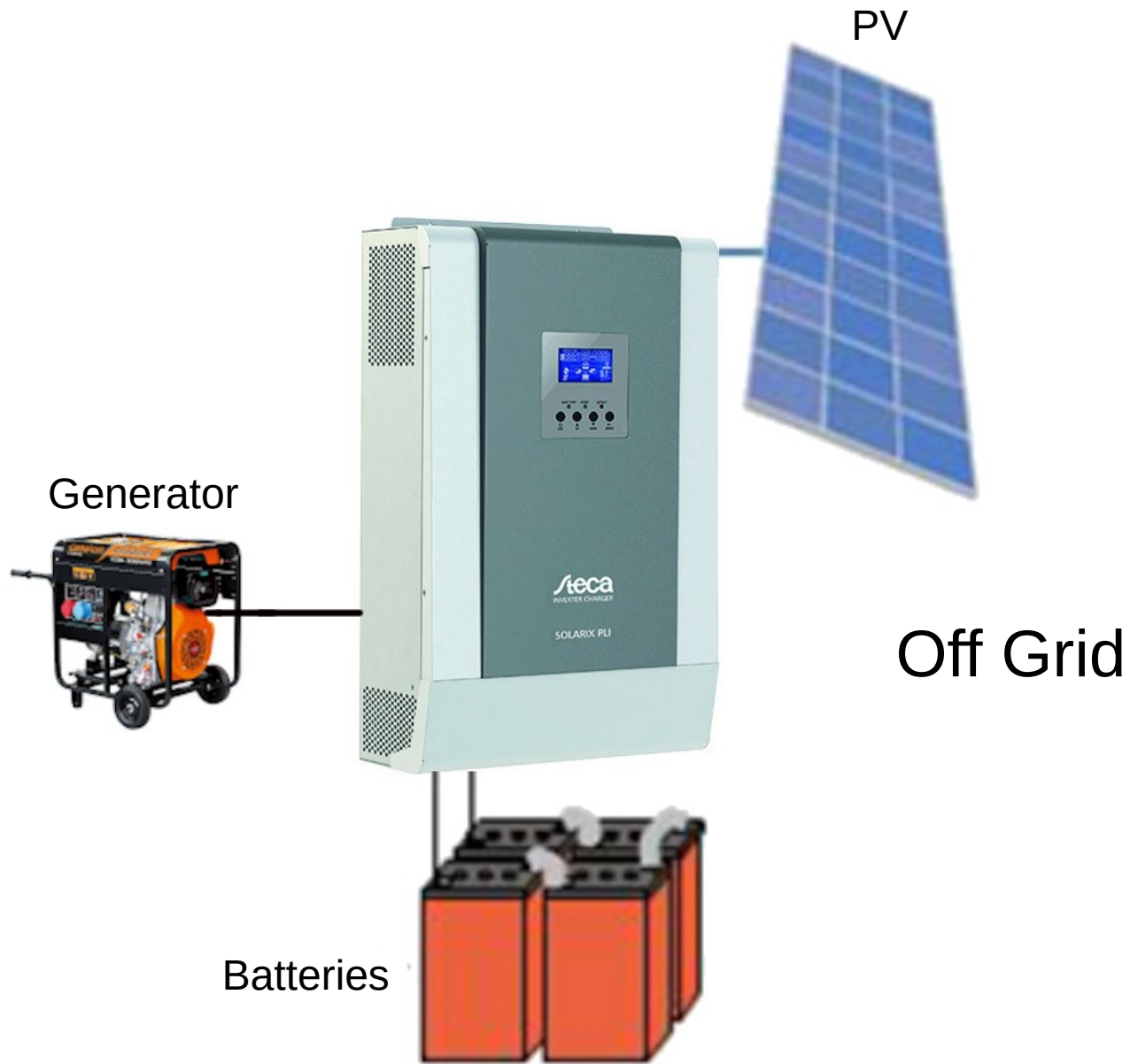
Solar panels capture sunlight as a source of radiant energy, which is converted into electric energy in the form of direct current (DC) electricity

In Ireland you get 800kWh for 1kW of PV per year

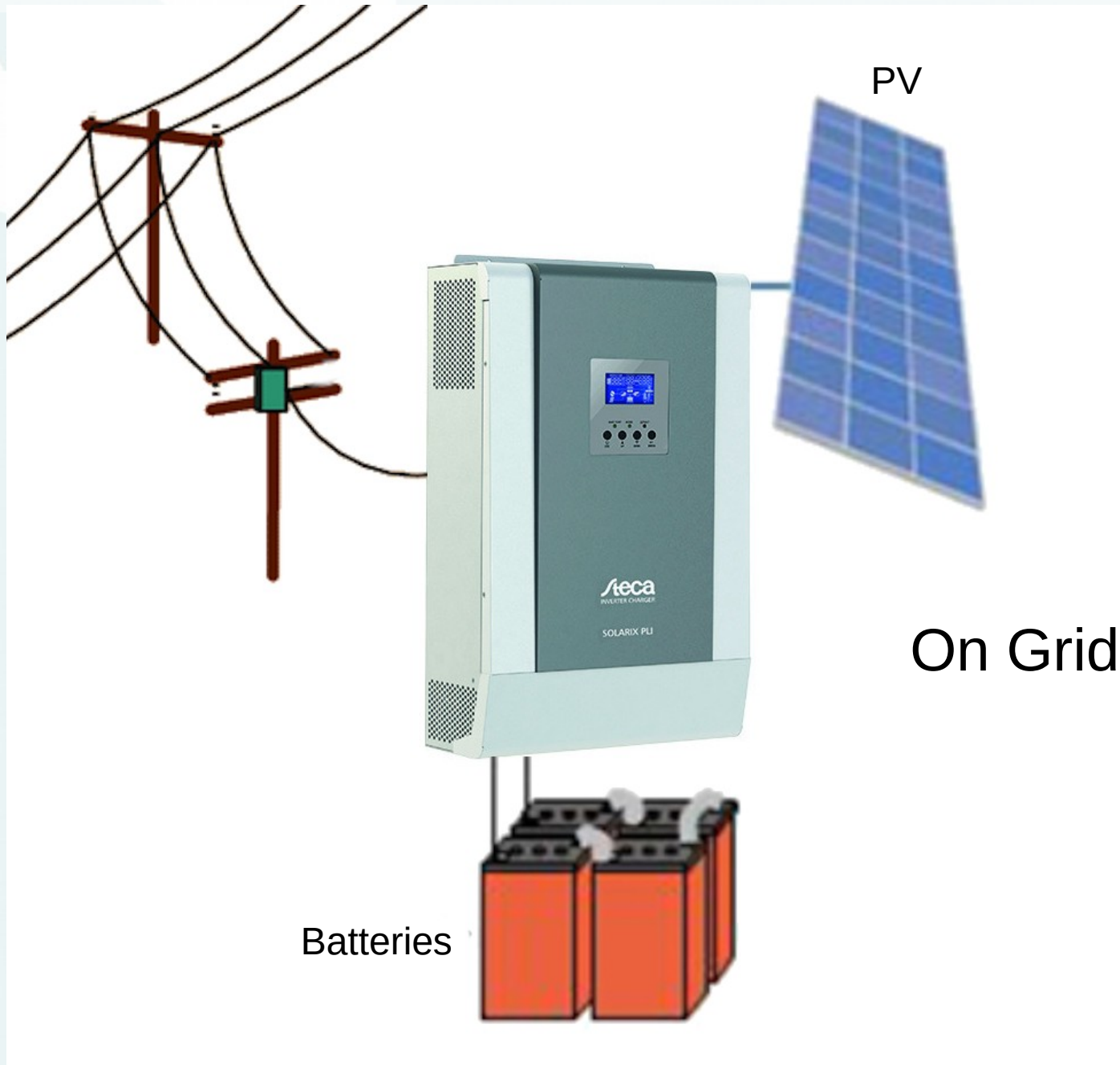
Evolution of Common PV Sizes



Solar Inverter Charger with MPPT Charge Controller



Solar Inverter Charger with MPPT Charge Controller





Hydro power

Hydropower is the use of falling or fast-running water to produce electricity.

This chart shows how much energy you can get from a single turbine, given the available head and the flow.

Estimated Annual production in kWh per year							
	1 l/s	2 l/s	4 l/s	8 l/s	16 l/s	32 l/s	64 l/s
2 m				450		2500	
4 m		200	500	1200	2300	5000	8700
8 m	200	500	1200	2400	5300		
16 m	500	1200	2400	4500	10000		
32 m	1200	2400	5000	8500	15000		
64 m	2400	5000					
128 m	5000	10600					
	Pelton			Turgo		Low Head LH	



Batteries

A deep cycle battery is designed to provide a steady current of power over a longer period of time without being charged or recharged as does a regular engine starting battery.

Depth of Discharge (DoD) is the percentage of your battery's total capacity that you can repeatedly use without permanently damaging the battery's lifespan. The higher the DoD, the more of your battery's capacity you can safely use.

DoD varies greatly depending on battery technology. Lead-acid batteries can only safely be discharged to 50%, while lithium-ion batteries enjoy high DoD rates of 80% (meaning you can use 80% of the battery's total capacity).

Cycle life is the estimated number of times your battery can be charged and discharged before it dies. Again, this also varies depending on technology, anywhere from a few hundred cycles for the cheapest lead-acid battery to a high 10,000 cycles for lithium-iron



EVERY WATT NOT USED IS A WATT THAT DOESN'T HAVE TO BE PRODUCED, PROCESSED, OR STORED

What should drive the design of any energy system are the loads.

Understanding electrical loads and how they are measured is the right first step toward using RE in your home.

To understand loads, some basic electrical terminology literacy is helpful.

“Watt-hours” (Wh) measure electrical energy generation and usage; 1,000 Wh equal 1 kilowatt-hour (kWh), which is the measurement (units) we use in our homes

B	C	D	E	F	G	H	I
Appliance	Amount	Run Watts	Hours/Day	Days/Week	$D \times E \times C \times F \div 7$ Watt-hrs/day		$Total\ Watt-hrs \div 1000$ Total kWh (units)
					706	<i>Total Watt-hrs</i>	0.71
Lights	6	4.5	5	7	135		
Stereo	1	30	4	6	103		
Laptop	2	45	5	7	450		
Food mixer	1	500	0.25	1	18		

$$\text{Watts} = \text{Amps} \times \text{Volts}$$



The average daily load is then used to calculate the battery requirements. The batteries must be able to store the total daily load, in addition to the extra energy lost by inverting from direct current (DC) to alternating current (AC). Dividing the AC average daily load by the inverter efficiency (90% standard), inflates the average daily load that the batteries must store to account for efficiency losses from the inverter.

While inverter manufacturers will commonly list “peak efficiency” (generally ranging from about 92% to 95%), we use a more conservative 90% to account for the fact that the actual operating efficiency depends on the AC load, which is constantly fluctuating. Hence, an inverter will rarely operate at the load level which results in peak efficiency.

The battery bank’s ambient operating temperature is also taken into consideration, since temperature affects a flooded lead-acid battery’s internal resistance and ability to hold a charge. As temperatures fall battery capacity is reduced. A battery temperature multiplier table can be used.

Days of autonomy is also an important design criterion, as it dictates how many days the battery bank will need to sustain the average daily load when there is little or no Renewable energy to recharge it. It’s a compromise between havin energy during overcast spells, how much time the generator will run, and the added cost of a larger battery bank. The more days of autonomy desired, the larger the battery bank. Generally three to five days of autonomy provides a good balance. Keep in mind that the larger the battery bank, the larger the PV array will need to be to recharge the bank sufficiently on a regular basis—or the more the generator will be needed to pick up the slack.

The last major design criterion for sizing batteries is the depth of discharge (DOD). While deep-cycle lead-acid batteries are designed to discharge 80% of their capacity, the deeper they are discharged on a regular basis, the fewer charge/discharge cycles they can provide over their lifetime. When choosing a DOD, strike a balance between longevity, cost, and the significant hassle of replacement. Many system designers will specify a 50% DOD to be used in the worksheet. Because several days of autonomy are accounted for, which increases the battery bank size, the actual depth of discharge during sunny weather will often be less than 20%. The DOD design value can greatly affect the cost of the battery bank.

