Small wind energy

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Small wind turbines, also known as micro wind turbines or urban wind turbines, are wind turbines that generate electricity for small-scale use. These turbines are typically smaller than those found in wind farms. Small wind turbines often have passive yaw systems as opposed to active ones. They use a direct drive generator and use a tail fin to point into the wind, whereas larger turbines have geared powertrains that are actively pointed into the wind.

They usually produce between 500 W and 10 kW, with some as small as 50 W. The Canadian Wind Energy Association considers small wind turbines to be up to 300 kW,[1] while the IEC 61400 standard defines them as having a rotor area smaller than 200 m2 and generating voltage below 1000 Va.c. or 1500 Vd.c.

Small-scale rooftop turbines can be installed on a roof, but may face issues such as vibration and turbulence caused by the roof ledge, which can impact their power generation. These turbines often struggle to generate significant amounts of power, particularly in urban areas.[17]

The generators for small wind turbines are usually three-phase alternating current generators and the trend is to use the induction type, although some models utilize single-phase generators or direct current output.[18][19]

After running the three phase AC wire through a slip ring and down to the receiving end, a three-phase rectifier is used to convert the AC to rectified DC for battery charging, especially in solar hybrid power systems. The rectifier should be mounted to a heat sink for cooling, with the option of adding a computer fan that is activated by a bimetal thermal switch for active cooling.

The DC end of the rectifier is then connected to the batteries. This connection should be as short as possible to avoid power losses, typically with a shunted digital wattmeter in between for monitoring. The batteries are then connected to a power inverter, which converts the power back to AC at a constant frequency for grid connectivity and end use.

Dynamic braking is a technique used to regulate the speed of a turbine by discharging excess energy through a resistive load during high winds to prevent damage. The controller, activated when batteries reach a certain voltage, turns on the load using a solenoid or solid-state relay, the latter of which has the added benefit of "failing open". Proper tuning of the controller is important to prevent parasitic oscillations, which can be achieved through a delay function or using a stock PWM charge controller with a diversion function.

Cable resistant to UV radiation and temperature fluctuations, such as solar cable, should be used in cases where the wiring is exposed to the elements. The wire gauge across the whole system must be appropriate for

the amount of current running through it. The resistance of the wire, which increases linearly with its length, should not create a voltage drop that is more than 2-5% of the total voltage drop.

In July 2012, a new feed-in tariff approved by Japanese Industry Minister Yukio Edano went into effect, promising to boost the country"s production of wind and solar energy production. The country is aiming to increase renewable energy investment in part as a response to the Fukushima radiation crisis in March 2011.[20] The feed-in tariff applies to solar panels and small wind turbines and requires utilities to buy back electricity generated from renewable energy sources at government-established rates.

Small-scale wind power (turbines of less than 20 kW capacity) will be subsidized at least 57.75 JPY (about 0.74 USD per kwh).[21]

Properties in rural or suburban parts of the UK can opt for a wind turbine with inverter to supplement local grid power. The UK"s Microgeneration Certification Scheme (MCS) provides feed-in tariffs to owners of qualified small wind turbines.[22]

In 2008, small wind turbines with capacities of 100 kW or less added a total of 17.3 MW of generating capacity in the US, according to the American Wind Energy Association (AWEA). This growth represented a 78% increase in the domestic market for small wind turbines. AWEA"s "2009 Small Wind Global Market Study" attributed the increase to higher manufacturing volumes, thanks to private investment financing plant expansions, and rising electricity prices and public awareness of wind technologies driving residential sales.