

## Innovative Cross-Axis-Wind-Turbine Design

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**Abstract:** Researchers and inventors have suggested novel wind turbine designs that were claimed to enhance the energy output of the existing vertical axis wind turbines (VAWT). There are many advantages of VAWTs compared with HAWTs. Research has shown that VAWTs are more suitable for turbulent wind flow and urban applications. However, the efficiency and low self-start ability of VAWTs are always the main drawbacks especially for the lift-type VAWTs. Unlike HAWTs, the rotor blades for VAWTs do not always provide positive torque during operation. Various designs have been suggested to increase the performance of VAWTs which includes different blade sections and VAWT configurations. Power augmentation features have been proven as one of the wind turbine performance enhancement methods particularly for vertical axis wind turbines (VAWTs). The augmentation devices can consist of a duct, stator, diffuser, guide vanes, and other devices. Researches showed that with the aid of an augmentation device, the power output of a VAWT can be increased remarkably. The deflected wind flows improve the performance significantly as well as reduce the self-start velocity of the turbine. Furthermore, a new type of wind turbine namely the cross-axis-wind-turbine (CAWT) that is capable to harness wind power from both the horizontal and vertical components of the oncoming wind is presented. The CAWT comprises of 6 horizontal blades and 3 vertical blades arranged in a cross axis orientation. In the initial testing, the wind deflectors were used to guide the oncoming wind towards the upward directions. The result showed that the CAWT have increased power output as well as rotational speed when compared with a conventional straight-bladed VAWT especially when integrated with a 45° deflector which produced a power coefficient about 2.8 times higher than the VAWT. The rotor rotational speed was increased by 70% with a better starting behaviour. The CAWT is a practical wind turbine which has various applications such as in standalone systems, urban and offshore wind farms.

**Keywords:** cross-axis-wind-turbine; efficiency; power augmentation; urban energy system; wind energy; offshore wind turbine