

Analysis of ducted (or diffuser-augmented) wind turbine



Why ducted wind turbines?

With the introduction of the Energy Strategy 2050 and its goal of increasing the quantum of renewable energy production, wind energy is seen to be indispensable to help integrate these technologies.

Wind Energy is fast becoming a significant source of energy throughout the world. This ever-expanding field will potentially reach the limit of availability and practicality with the wind farm sites and size of the turbine itself. Therefore, it is necessary to develop innovative wind capturing devices that can produce energy in the locations where large conventional horizontal axis wind turbines (HAWTs) are too impractical to install and operate. A diffuser-augmented wind turbine (DAWT) is one such innovation.

DAWTs increase the power output of the rotor by increasing the wind speed into the rotor using a duct.

This study aims to analyse the ducted wind turbines for small scale applications and try to "optimise" the converging-diverging duct geometry for maximum power output.

Optimum parameters of DAWT

- Nozzle area ratio: 1.7
- Diffuser area ratio: 5
- Nozzle opening angle: 10
- Diffuser opening angle: 15
- Diffuser length over rotor area: 7

These parameters give the maximum performance coefficient of the nozzle-diffuser wind turbine system of 1.503 and resulting length of 13.48m with rotor diameter of 1.5m. The conventional wind turbine does not perform over the Betz limit of 0.59.

Advantages of the technology

To be able to compare conventional wind turbine and diffuser-augmented wind turbine from an economic point of view, the

same wind speed of 5.56m/s and power output 280W is considered.

Diffuser augmented produces this power output with rotor diameter of 1.5m and costs \$353. On the other hand, conventional wind turbine needs the rotor diameter of 2.4m to produce the same power output and costs \$753. The price of conventional wind turbine to produce the same power output increases twice in comparison to dif-fuser-augmented wind turbine.

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