SkyWindFarm: Design of a Novel Vertical Airborne Wind Turbine Clean Energy Farm

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Airborne Wind Energy systems (AWEs) are an innovative variant of wind energy technology that harness the power of high-altitude winds. However, conventional AWEs face limitations due to tether drag, restricting their operational elevation, performance, and power output. This research introduces a novel ‘tether-free’ vertical airborne wind turbine clean energy farm system – ‘SkyWindFarm,’ with adaptive elevation control, designed to harness the most potent high-altitude winds at previously unattainable altitudes between 5,000 and 30,000 feet. The system demonstrates an unprecedented energy density of up to 5kW per meter squared. SkyWindFarm utilizes a novel approach to harnessing high-altitude wind energy by employing a 5 Blade H-Rotor Darrius Wind turbine, generating lift and power simultaneously. The system’s development has achieved a Technology Readiness Level (TRL) of 3 through proof-of-concept demonstrations utilizing a laboratory-scale prototype, built after multiple iterations using detailed experimentation and state-of-the-art computer modeling tools. Wind tunnel testing and Schlieren imaging have been utilized to optimize various wing profiles to maximize power, and computational fluid dynamics (CFD) simulations have been used to gain a deeper understanding of the experimental observations. The SkyWindFarm system has the potential for significant scalability, capable of producing power in the megawatt range. The study comprehensively addresses all major challenges and corresponding mitigation strategies. The proposed system will be cost-effective to build (initial investment) and operate (running cost). This pioneering approach to high-altitude wind energy harvesting marks a crucial stride toward realizing a sustainable future for all.

Awards Won:
Third Award of $1,000