Solar Updraft Tower-Wind Turbine Hybrid: Maximizing Power Output through Vortex Shedding, Water Droplet Atomization and Arduino Servo Control Feedback Loop

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BACKGROUND: World energy consumption will increase by 28% by 2040 with renewables being the fastest growing energy source. Furthermore, renewables will increasingly replace coal. Solar updraft towers can take full advantage of this reliance on renewables through abundant solar energy. However, they are substantially expensive to build, with about half of the total cost attributed to the solar collector construction. HYPOTHESIS: An optimally designed structure incorporating a solar updraft tower structure and wind turbine with improved solar collector design (via higher surface area & lower volume), water droplet atomization and turbine angle adjustments will improve performance over the previous design as well as traditional solar-thermal energy systems (i.e. solar updraft towers). METHODS and PROCEDURES: The design principles were based on research from subject matter gleaned from expert resources such as the National Renewable Energy Laboratory. Original design concepts were created with hand sketches. Multiple virtual 3D prototype models were analyzed using CFD analysis software. Once the prototype model was complete, a series of tests involving varying solar exposure, wind conditions, turbine angles, and water atomization were evaluated. Data was captured and analyzed for statistically significant improvements. DATA ANALYSIS and CONCLUSION: The new solar updraft wind turbine hybrid design generated statistically more power than the previous design. Atomization of water droplets statistically lowered the performance. The new solar collector design and the servo controlled wind turbine performed statistically better than the previous design, with the exception of wind speed measured at 10.4 KPH.

Awards Won:
Fourth Award of $500