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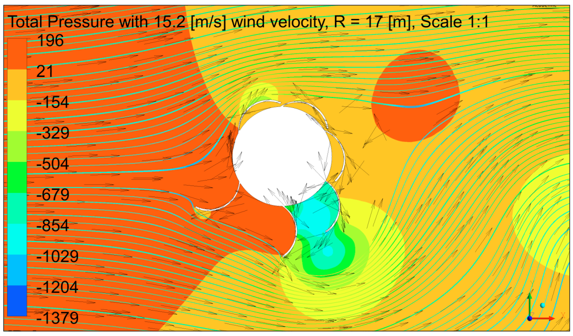
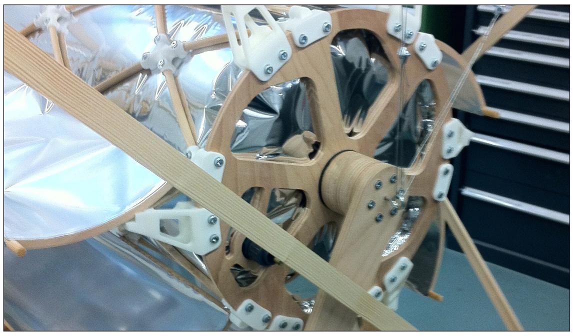
Subject Area	Energie- und Umwelttechnik

Scaled Prototype of a Lighter-Than-Air Airborne Wind Energy System

System Design and Construction



Total pressure and flowlines indicating particle flow. Wind velocity at 15.2 metres per second, wing radius of 17 metres. Scale 1:1



Detail of the prototype during final assembly

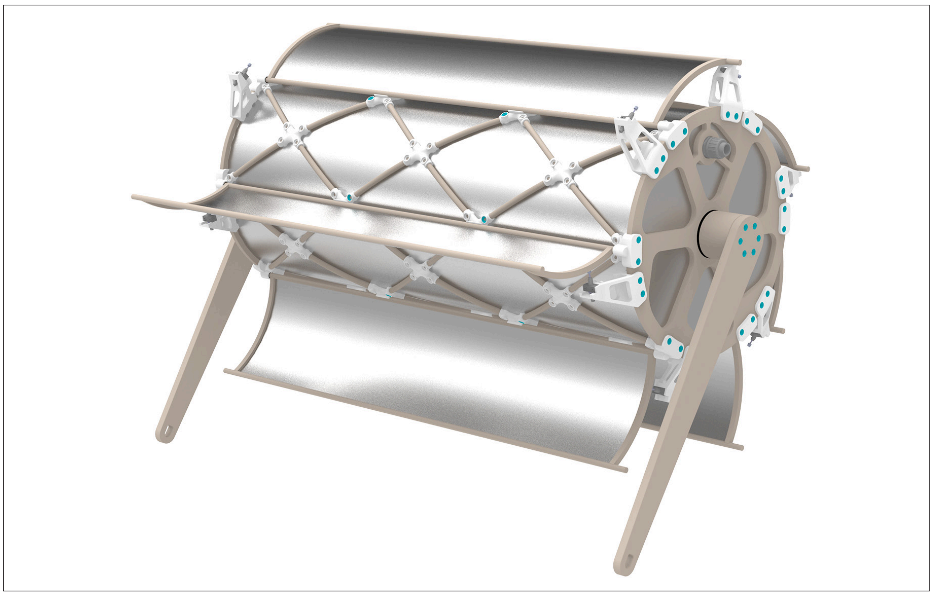
Task: To drastically lower the cost and environmental impact of wind power.

Objective: The objective of this bachelor's thesis is the design and construction of a lighter-than-air wind energy system. The focus is on a design for 6 megawatts, with a scaled prototype built for demonstration purposes. With wind turbines, a higher hub height automatically leads to more wind. But a higher height also has additional benefits:

- less wind turbine shadow (leads to higher acceptance with communities)
- less bird strike (leads to higher acceptance with conservationists)
- more energy being generated (replaces coal or nuclear power plants)

Solution: The proposed design consists of a rotating cylinder, on which the wings (also rotating to decrease drag) are mounted. A generator is placed on each side to balance the weight. The cylinder is filled with hydrogen, providing the lift. Two levers on each side are connected to ropes, which simultaneously hold the system in place, and transmit the generated power to the ground. Through simulation it could be shown that a wing radius of 17 metres has the best ratio of material cost to torque. That means that with this radius, one obtains the most torque with the lowest material costs. Further simulations showed that even with high winds of 25 metres per second, the blow-down angle would not exceed 60 degrees from the vertical. Thus, an airborne wind energy system starting at 300 metres would sink to about 178 metres in high winds, still more than half of the starting altitude. There is further potential for R&D in these areas:

- wind tunnel tests to determine the power coefficient
- development of a membrane which is light, robust and gas-tight
- CFD-simulations to optimize the design



Rendering of the scaled prototype (1:140)