Background & Problem Statement:
The Village of Hope is a school in Haiti sponsored by American missionaries, which also functions as a clinic and a food distributor. Their campus is looking to expand, adding on-site residences and an industrial-size kitchen. Without access to a reliable power grid, the Village of Hope powers its well, lights, medical equipment, amenities and utilities using electricity generated on-site by a 13.5 kW generator running continuously. The administrators are concerned by the heavy financial and environmental costs of this generator, and have decided to explore substitutes and supplements which will make use of the local abundance of wind and sunshine. A small array of solar panels has been installed on the campus, and this team will be assessing whether wind power will be a viable addition to their personal power grid.

Solution Evaluation:
Based on the advantages suggested by the Decision Matrix, The team designed a hybrid turbine that would make use of the relative strengths of two vertical axis turbines, the Darrieus and the Savonius. The Savonius would overcome initial resistance, and the Darrieus permit high maximum speeds. In theory, both rotors would share a shaft, which would be supported by a PVC frame, and connected to an alternator (1800 rpm operating speed) via a 10:1 gear box. Due to testing limitations, The team decided to craft both rotors to fit within a 4ft x 4ft x 6ft space, and test their speeds separately to gain quantitative results. The assembly itself was designed to be manufactured primarily using materials available in Haiti.

The Darrieus airfoils were constructed from a tarp sleeve, pulled taut between a PVC guide and bolting it to the shaft. A metal bar was added to prevent the turbine from sagging under its own weight, and holes were drilled through the back to allow smoother rotation. Qualitative testing was conducted using a box fan generating estimated wind speeds between 10-15 mph (the expected average wind speed at the VoH site falls within this range). The team determined that, while the loaded Savonius rotor was able to generate rotation speeds exceeding 15 rpm while unloaded, the Darrieus rotor, even unloaded was unable to maintain continuous rotation, and would be unable to actuate the alternator and produce electricity.

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The financial cost appears to be dominated by the planetary gear box, which had to be ordered from an online vendor. A v-belt power train with additional supports could allow consistent power transfer, at greatly reduced cost.

Social Impact:
- Unsuccessful at generating electricity with this design, although could provide suggestions for an improved future project, with a slower alternator, stiffer, better shaped airfoils, and a supported V-Belt power train.
- Analytics of campus energy demand can be used to predict future energy supply parameters at Village of Hope
- Analysis suggests that the current energy production (~277 kWh, on average) at the Village of Hope likely vastly exceeds their true energy needs, and that much of their current costs can be saved by more conservative behaviors.