Thesis Project Portfolio

Harnessing the Power of the Seas When Generating Sustainable Wind Power

(Technical Report)

The Need for Federal Legislation to Drive the Transition to Renewable Energy

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

The world is facing an environmental crisis as the effects of climate change become more severe and widespread due to years of generating energy using fossil fuels that have released harmful greenhouse gases into the atmosphere. The United States is the second largest contributor of fossil fuel emissions. It follows that the U.S. must work to quickly and drastically reduce their carbon footprint to help slow climate change.

Utilizing more renewable energy, such as wind, solar, hydropower, and geothermal, will allow the U.S. to significantly decrease its carbon footprint, as these sources of energy produce essentially zero CO_2 emissions. The STS portion of the paper positions U.S. federal legislation as the most effective motivator of a transition away from fossil fuels and towards renewable energies. This portion of the paper argues that this issue must be overseen at the federal level through legislative action to force a faster transition as the climate crisis continues to pose increasingly grave threats to people all over the world.

The technical portion of this paper delves into one such renewable energy source whose potential remains relatively untapped – floating wind turbines. Wind energy offers huge potentials; however, many people oppose the construction of more wind turbines on land because they can be an eyesore, are known to kill flying wildlife, and can damage the environment since their construction requires large areas of land to be cleared, so the wind can flow unobstructed and laminarly. Wind turbines placed in the ocean offer a solution to many of these problems; however, the highest winds occur over very deep waters, and it is expensive, dangerous, and difficult to drill into the ocean floor when it is under 60 meters of water.

Floating wind turbines offer an alternative that does not require working beneath deep waters. They utilize the favorable wind conditions present over deep waters while being easier to construct on land and tow out to sea to be anchored. The goal of this portion of the paper is researching the most effective base design to prevent these turbines from sinking or capsizing in high winds and rough waters. There are multiple different concepts for bases and anchoring mechanisms that will be presented.

Now that my group and I feel we have identified the best base structure of the options we explored, we suggest further research on this design using digital controls to assist in stabilizing the structure during disturbances. Our research only covered the structure's design, and it did not include an analysis using mechatronics.

Finally, I would like to thank the following people for their meaningful contributions to my success: Professor Momot, Professor Ferguson, and my capstone groupmates for their enthusiastic, scholarly, and attentive support throughout the last two semesters of capstone research; Mr. Schultz, who instilled in me a love of math and science; Will for filling each day with love, laughter, and crazy singing; my family for always supporting me and teaching me that I can do anything I put my mind to.