Innovation Project

Identify:

For the innovation project, our team tried to look at and understand various options for alternative energy generation. We looked at Solar, Wind, Nuclear, Geothermal, Tidal, Hydrogen, etc. We primarily focused on Solar and Wind energy since both happen to be quite popular in our great state of Iowa.

As a part of research, we visited a local Solar installation company; 1 Source Solar in Ankeny.

As we learnt more about Solar and Wind, we realized that both have a major limitation in the form of predictability. Power generation from Solar can be very low on cloudy or rainy days. In some places, Solar panels can get covered by dust blown by winds and will need to be cleaned to operate at capacity.

Similarly, for Wind turbines, power generation can suffer on days when there isn’t enough wind blowing.

On our visit to the City of Indianola municipal utilities office, we learnt of how the city purchases and generates power needed for the homes and businesses of Indianola.

We also read about hydrogen fuel cells and got to meet with Dr Alexandr Simonov of Monash University, Australia who talked to us about his latest project for producing green ammonia.

One thing that stood out for us is when they explained, that on days when the renewable supply of electricity from the vendors is not enough for their needs the city then must make up the shortfall by firing up its diesel generators. This obviously isn’t the most eco-friendly way to generate electricity.

This led us to our problem of trying to figure out what would be an eco-friendly yet predictable way for energy generation.

On further research, our team zeroed in on Tidal energy. Because humankind has been predicting the Tidal cycles of sea with great accuracy since the ancient times, we felt that this is a perfect solution for predictability and consistency issues that we see when dealing with Wind or Solar.

Design:

For further research into Tidal energy, we read through various sources which have been identified in the glossary at the end of this document.

There are 3 main ways in which Tidal energy can be harnessed,

1. Tidal barrages: A tidal barrage is a dam like structure. When the tide comes in, the sluice gates open and water comes into the reservoir and when the tide goes low, the gates let the water out of the reservoir. In both cases, the moving water spins the blades of a turbine or turbines to generate electricity.
2. Tidal fences: Tidal fences are basically small underwater turbines in a straight line like a fence which rotate with the tides to generate electricity.
3. Tidal Turbines: These are individual turbines placed anywhere there is a strong tidal force. The tides spin the turbine which spins a generator. There are 2 types of tidal turbines, floating and underwater.

We read further on each of the above methods and found out that,

1. Tidal barrages are the most expensive option of all the three and are also harmful to marine ecology. Also, like normal dams, they have a considerable amount of maintenance.
2. Tidal fences are the 2nd most expensive option, since it involves setting up multiple small turbines. Also, they can be difficult to maintain repair.
3. Floating tidal turbines or tidal platforms are the most economical and sustainable of all the three options. They are normally installed near to the shore and thus can be easier to maintain and repair.

Based on the above information, our team decided to focus our further research and debate on floating Tidal turbines or Tidal platforms.

We were fortunate to get to meet with Professor Brian Polagaye, Director, Pacific Marine Energy Center at the University of Washington and Abigale Snortland, Graduate Research Assistant at University of Washington, who gave us a lot of ideas and information about Tidal energy.

Create:

After learning about Tidal energy, we wanted to figure out ways to improve upon the currently used methods and ideas. After a lot of brain storming sessions, we identified the following innovations that can improve energy generation from Tidal waves.

Diagram

Description automatically generated

1. Currently available Tidal solutions are very heavy and need to use various complex ways for buoyancy. Our solution uses carbon nano tubes for the main body which keeps the weight low.
2. Our solution covers the main body with solar panels which will generate power to operate the on-board electronics of the platform. There will be a backup power supply as a backup to the solar panels.

To be able to visualize and explain our solution, we made a 3D printed model of our concept. We had to learn how to use a free 3D modeling software called Tinkercad and we used a vendor on Etsy who 3D printed it for us. But then we felt it was too small and delicate.

So, we also ended up making a much bigger cardboard model of the same. This was interesting since we got to understand basic box making and use a hot glue gun.

Iterate:

We showed our model to Abigale, and she gave us the feedback about the ability of our concept for handling bad weather events on the sea.

Normal tidal turbine solutions use steel for their body. This makes the whole structure very strong and can easily withstand severe weather conditions. Since we are using carbon nano tubes instead of steel, we save a lot of money & it makes our structure lightweight. But this also makes it more vulnerable to damage from bad weather.

Based on Abigale’s feedback, we modified our tidal platform to have a mechanism of ballasts and motors for retracting the whole platform below the surface of the water and then bringing it back up again after the bad weather event has passed.

Communicate:

We tried various methods of presenting our innovation. We initially thought of making a Microsoft PowerPoint presentation. But we realized that we might not have access to a computer and a large screen during the judging session.

We then just tried to talk about our innovation by taking turns, but that did not feel very interesting or engaging.

Finally, with the help of our coaches, we prepared a script for a short skit which we thought was the best way of presenting.