**Written Description**

After performing a site analysis, our group came to the conclusion that the most abundant renewable resource available was wave energy. This resource was chosen over the others because of its availability in terms of occurring during both the day and the night, as opposed to other renewable resources like the sun which is only available during the day. Wind was not chosen because of its unreliability, meaning that it was not constantly available and is susceptible to inconsistences. Large amounts of wave activity occur at the breakwater beyond the pier, making it an appropriate place to incorporate wave energy generation technologies.

The type of wave energy that we became interested in and decided was most appropriate was a buoy that would capture the movement of the waves in both the horizontal and vertical direction. By doing this, we were able to design a system that could pump captured water through a series of underwater pipes in order to spin a turbine that would power a generator to create clean energy. In order to capture the maximum amount of wave movement available so that we were able to pump large amounts of water back to the turbine, we designed the anchor point to be able to rotate in any direction in order to capture wave energy from all directions. The base of the buoys would be hinged to the anchor point in order to be able to sway freely with the passing waves. In addition to capturing the horizontal movement of the waves, we also wanted to capture the vertical movement of the tides in order to aid in pumping the water from the buoy to the turbine.

As the buoys move in a horizontal direction, they are being pulled away from the base which allows water to be pulled in through a one way check valve, similar to a syringe. As the buoys come back to a vertical position, they are pushed back towards the base, forcing water through another one way check valve. The water is then pumped to spin a turbine which powers a generator that creates electricity. Some of the electricity is used to power the lighting component of the project while the rest of it is sent to the grid.

We were able to ﬁnd a precedent that used a similar concept in which buoys were used to capture wave energy and pump water to a turbine located off site. The precedent that we found used buoys that were approximately 30 feet wide and our buoys were roughly half of that, approximately 15 feet wide. Because of this, we took the numbers that were provided from our precedent and divided them in half in order to come up with a number for the amount of energy that our buoys could produce. A single precedent buoy was able to produce 80 kW or 1,920 kWh. We made the claim that because our buoys were half the diameter of the precedent buoys, that they could produce 40 kW or 960 kWh each. We then multiplied that by the number of buoys that we were able to ﬁt on the site, approximately 222 buoys, to get 213,120 kWh each day. Finally, we divided that number by the average Santa Monica household use of electricity which was approximately 19 kWh to conclude that our entire array of buoys could power about 11,215 houses each day.

**Environmental Impact**

The shape of our buoys and the reason that we chose to use this type of technology derived from the idea of kelp and the current issue of kelp deforestation in Santa Monica. Problems with overﬁshing and stormwater runoff have led to a steady decline in kelp population as of recent years. Overﬁshing leads to a loss of biodiversity within the marine ecosystem, making it difﬁcult for kelp to thrive. Stormwater runoff not only pollutes the water, it also prevents oxygen from being absorbed into the water, disallowing both plants and animals from being able to breathe.

Because we wanted to encourage biodiversity and kelp growth, it was important that we came up with a way to generate energy from waves without disrupting the marine ecosystem. Existing ways of generating wave energy include exposed turbines that can pose harm to living organisms. Because of this, we decided to use a buoy system that pumped water to an enclosed turbine at a different location in order to generate clean energy. We designed our buoy as a hybrid between the characteristics that deﬁne kelp and existing buoy technologies to create a buoy that protrudes out of the water in order to help the public to understand that this type of technology can not only generate clean energy, but also live harmoniously with the marine ecosystem.

Kelp is anchored to the ocean ﬂoor through a root system similar to the way our buoy is attached to the ocean ﬂoor through its base. The stem that makes up the piston of the buoy is derived from the long stem of the kelp that acts as its structure. The buoys themselves are derived from the buoyant pods that keep kelp aﬂoat. Our project was designed to be seen both during the day and at night. During the day, people can interact with the installation by walking on the ﬂoating dock and seeing the buoys up close. At night, the light that the buoys emit can be seen from a distance and become an artistic installation that allows the public to understand that the buoys that they were exposed to during the day are the reason that the light installation exists at night.