**Concept**

When looking at the island of Refshaleøen one can see its relationship with the water defined by the many piers that protrude into the strait, like fingers reaching out to grasp at its surroundings. This intertwining of land and sea is emphasized by the fact that Refshaleøen was at one point a shipyard. The idea behind Oscillating Platforms is to bring back the connection that the island had with its surrounding environment and history as well as allow visitors to recognize their relationship with the island and the water itself.

This is done by excavating a section of Sønder Hoved Pier below the level of the adjacent strait to create a flood plain, in essence inviting the surrounding waterway to enter the site. This flooded area would then be populated with the core art pieces of the project, a series of freeform floating platforms which are anchored to the site. These platforms, reminiscent of inverse ship hauls, have masts and sails integrated into the design making it possible for them to catch the prevailing winds coming from the west. In addition they are meant to be habitable surfaces which visitors can use as viewing platforms out onto the water. With the iconic Little Mermaid Statue just across the strait these platforms would be great for lounging and enjoying the surrounding environment around Sønder Hoved Pier. The variable sizes of the platforms provide visitors with a wide range of possible experiences and sight lines across the area. One may choose to have a more intimate experience on the small platforms to rest and dip their feet into the water, or decide to ascend onto the larger mounds with better views of the water and more room for larger group activities.

When the instillation is completed artists and local vendors will also be invited to design graphics for the sails. These graphics which can be changed depending on the season or event, emphasizing the idea that this installation is an art piece as well as a renewable energy source. One can imagine the atmosphere of the space during events such as the FIFA World Cup when the sails are flying the colours of all the competing countries or during Christmas when they are decorated with more festive images. There is also the opportunity of having annual art exhibits centered around designs for the sails, where famous artists or local vendors can showcase their talents. The possibilities are endless.

Aside from its pleasing aesthetics and connection with the history of the site, the platforms also act as oscillating water columns which harness the tidal energy of the flood plain into electricity. The undulation of the platforms caused by the activity on its surface and the movement from the wind allows the water columns to generate energy anytime of the day all year round. Aside from the obvious positive environmental impacts that this installation will have by providing clean, renewable electricity, its other purpose is to make visitors aware of the myriad of possibilities for sustainable energy which nature can provide, and connect users with the elemental forces around them. As one stands on these mounds they can feel both the wind and waves pushing on the structures causing the platforms to oscillate. The natural forces being transformed right under their feet becomes something that can now be experienced. It reminds people of the natural environment constantly around them and promotes the idea of living harmoniously with nature.

The design of the Oscillating Platforms is meant to be playful as well as functional. Its versatility in use and experience allows it to interact with people of all ages at any time of the year. With a large variety of businesses and recreational venues in the area one can imagine this installation transforming into a gathering place for both visitors and locals alike, becoming a cultural landmark as well as a beacon for sustainable energy.

**Technology**

The technology being utilized in Oscillating Platforms is a modified version of an oscillating water column. This technology allows for wave or tidal energy to be transformed into usable, renewable energy. The device consists of a pressurized air chamber otherwise known as the water column which is partially submerged in the water. As waves come in and push the level of the water upwards, the air within this pressurized air chamber is also forced up, powering a turbine located at the top of the column as the air rushes out of the device. The inverse is true as the water level descends, drawing in air from the exterior top of the water column powering the turbine. Most oscillating water columns use a Wells Turbine which rotates in one direction no matter the direction of airflow, allowing the device to generate electricity in both instances, as it releases and intakes air. In the case of Oscillating Platforms the energy of the waves used to generate electricity is further supported by the motion of the platform itself caused by the force of the wind harnessed via the attached sails as well as the activity and weight of the occupants on top of the platforms. The motion of the turbines is used to power a generator attached to it, and the electricity is transferred via power lines to storage units at the anchors of each platform where the power can then be stored or fed back into the grid. The anchors themselves provides the platforms a hinge point in which they can pivot as the wind pushes the back end into the water, allowing more of the kinetic energy from the waves, wind, and live loads to be transferred into electricity.

**Materials/ Dimensions**

The dimensions of the platforms can be separated in 4 sizes:

Platform A: 795 m² height: 60m

Platform B: 193 m² height: 30m

Platform C: 53 m² height: 15m

Platform D: 13 m² height: 1.2m

The total dimensions of the installation spans 92.5m in width 245m in length and covers an area of 22,662.5 m².

The platforms will be constructed out of locally sourced lumber, since it is a rapidly renewing resource that also has the aesthetic value of tying the project to the history of the site. The masts will use a recycled carbon fibre composite being developed in universities in the UK which have both cost saving and environmental benefits. This allows the masts to be more durable and perform better in the long run. The sails can incorporate a recycled carbon fibre composite as well. Although it’s not as environmentally friendly as organic based fabrics the recycled carbon fibre composite weaves have the advantage of durability, water resistance and efficiency, allowing the installation to perform better and last longer.

**Energy Output**

The estimations of energy output for this installation are based off of data from an existing oscillating water column called LIMPET located on Islay which was constructed by a company known as WAVEGEN. This existing OWC which is approximated to be the same dimensions as the largest generator in Oscillating Platforms produces 500kW of energy, which translates to 4,380,000 kWh annually. Based on this data one can estimate the annual output of energy for each type of unit size in Oscillating Platforms. For the purposes of this calculation the 4 sizes of the platforms in this installation will be assigned letters A-D from largest to smallest, with each descending size to be half the volume of the previous platform.

Platform A:

500kW x 8760 (hours/year) = 4,380,000 kWh

Number of units 4

4,380,000 kWh x 4 = 17,520,000 kWh

Platform B:

22.4kW x 8760 (hours/year) = 196,224 kWh

Number of units 19

196,224 kWh x 19 = 3,728,256 kWh

Platform C:

4.7kW x 8760 (hours/year) = 41,172 kWh

Number of units 60

41,172 kWh x 60 = 2,470,320 kWh

Platform D:

2.2kW x 8760 (hours/year) = 19,272 kWh

Number of units 558

19,272 kWh x 558 = 10,753,776 kWh

Total Energy Output: 34,472,352 kWh annually

**Environmental Impact**

It was estimated in 2007 that on average a citizen in Copenhagen uses 22,400 kWh of energy annually meaning that Oscillating Platforms has the potential to offset the energy use of approximately 1539 people per year. The only negative impact is the initial excavation of the site. To offset this, the project will use most of the excavated material as infill required to weigh down the platforms. The technology itself is environmentally friendly. Since the platforms use a hybrid of wave and wind energy it does not produce noise pollution which is a concern for current wind farms. Also the turbines in the oscillating water columns do not dip below the water level, meaning there are no moving parts in the water, making it safe for any wildlife in the area. With its potential to be scaled and adapted to other locations Oscillating Platforms has the ability to inform the future considerations of how to incorporate sustainable energy generation in a functional and aesthetically pleasing public context.

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