IN/Ex-Hale

Introduction

After being entertained by lively music, rides, and variety of snacks from food vendors, you walk toward the end of the pier to be closer to the ocean. Passing through the merry crowd, you encounter an infrastructure gracefully undulating in front of you. Rising and falling gently, you see multiple elastic semi-transparent coverings constantly reacting to the movement of the waves. It seems as if they are inhaling and exhaling, they seem to be *breathing.*

Intrigued by its form and wondering what's causing the coverings to move, you find a pathway that leads to the infrastructure and proceed. You continue on the wavy platform, where the warm sun rays envelop your body, the salty breeze gently touches your cheeks, and the splashing waves whisper into your ears. As you head toward the largest membrane of the infrastructure, you see an array of poles attached to the layer, mimicking the never-tiring waves. Taking a closer look at the system that causes the movement, you see that the poles are attached to massive energy-generating wave attenuators, leisurely floating on the ocean's skin.

The ocean has never stopped working. Similar to the human respiratory system, the ocean has been filtering out contaminants, dutifully providing resources, leisure,and inspiration. With graceful ups and downs of *In/Ex-Hale* behind you, you realize that the ocean is breathing and alive, just like humans, and therefore should be respected and cherished.

Form

The form of In/Ex-Hale was inspired by the powerful yet peaceful movement of the ocean. A movement that is being created by the constant force of wind, transferring its energy to the ocean's surface. In/Ex-Hale is an analogy of the human respiratory system and is composed of four main parts: lungs, bronchioles, diaphragm and ribs.

Similar to the respiratory system, In/Ex-Hale has " lungs" of its own which are the pieces of perforated spacer fabric found sitting just above the platform. These " lungs" inflate and deflate with the movement of the waves in the same way that real lungs inflate and deflate when air is breathed in and out. Surrounding In/Ex-Hale's "lungs" are wooden pathways which are seen as the "bronchioles" of the structure. These "bronchioles" work by allowing people to navigate through the many pathways and nooks in the structure in a similar way that bronchioles navigate air to the alveoli in the respiratory system. Just below the wooden "bronchioles" pathways, sitting on top of the water are the Pelamis wave energy attenuators, with 20m high clear PP poles attached to them. The attenuators and the poles act as the "diaphragm" of the structure by contracting and expanding according to the up and down movement of waves, in the same way that a diaphragm would contract and expand when air is breathed in and out. The final piece and what holds everything together are the "ribs" of the structure which are the concrete beams and foundations located underneath the pier. The "ribs" are what keep the whole structure stable and in place.

Technology

In/Ex- Hale is powered by three main technologies; Pelamis wave energy attenuators, photovoltaic panels and Seabins. The first and most powerful source of energy in In/Ex- Hale are the Pelamis wave attenuators. These powerful hydraulic energy systems made up of carbon steel are what create the movement of the canopy through the movement of waves. The second most powerful energy generating technology that is incorporated into In/Ex-Hale are the clear, thin film photovoltaic panels, located in some of the circular perforations of the canopy. The solar photovoltaic panels are incorporated in the perforations on the platform as well. The third and final system located along the edges of the structure are the Seabins, which do not generate energy but rather filtrate and clean the ocean.

Multifunctionality

Although In/Ex hale's main purpose is to generate renewable energy and clean the water, it has other multifunctional uses as well. One of the main functions for In/Ex-Hale is to provide habitat for marine species such as California sea lions and sea otters. The reason for choosing these two species was due to their habitats. Both species are known to interact well in human-like habitats such as marinas, boat docks, jetties, piers and buoys. The sea otters are a keystone specie as well, which means that without them there is no kelp and without kelp the ocean cannot clean itself from all the pollution and CO2. To accommodate these species, In/Ex-Hale provides additional platforms located right underneath the main pathway which animals can use as resting areas in the same way that they use boat docks and buoys. This way people visiting the site can see the animals through the clear photovoltaic windows, but would not be able to get close enough to touch them or interrupt their habitat.

Another function that In/Ex-Hale would provide is education. Many people have the misconception that renewable energy systems are just big, ugly machines that make a lot of noise, take up a lot of room and interrupt the aesthetic look of cities. The goal of In/Ex-Hale is to educate people about renewable energy systems that can help heal the planet, while providing aesthetic appeal to places such as Santa Monica. The whole site was designed for people to be able to see these renewable energy systems as an art form and learn about how natural forces such as wave power can produce large amounts of energy to power our cities.

To further support the statement that renewable energy can be aesthetically appealing, one of the main functions of *In/Ex-Hale* will be to provide an interactive art piece for the city of Santa Monica. During the day, people will be able to walk through the many pathways that the site provides, view animals peacefully resting on the bottom platform or simply just relax while watching the graceful movements of the perforated canopy. As they day turns to night, the PP clear plastic poles attached to the attenuators will light up creating a light show that can be viewed from close up or far away. The lights would be motion activated LED lights that react to the movement of the ocean, so the higher the wave goes the higher the light goes making a spectacle out the movement of waves, reminding people that renewable energy can be both beautiful and functional.

Environmental Impact

The purpose of In/Ex-Hale was to create an environmentally friendly art installation that captured as much energy as possible. By using the least harmful, non-toxic materials such as Polypropylene (PP) plastic and carbon steel, In/Ex-Hale is to serve as an extra set of " lungs" to the ocean and our environment. The technology chosen to make In/Ex-Hales serves two purposes, to capture energy and to clean the ocean.

The first technology used are the Pelamis wave attenuators. One Pelamis attenuator is made up of four segments and three hydraulic joints. Each hydraulic joint can generate up to 250kW, powering up to 330 homes. This enables one pelamis to produce up to 750 kW, generating power for at least 1000 homes. In/Ex-Hale would consist of two different sizes of Pelamis attenuators; 15 made up of two segments and one hydraulic joint and 11 made up of three segments and two hydraulic joints. In total the pelamis attenuators in In/Ex-Hale will produce 9.25 MW, powering up to 12,500 homes!

The second technology used in In/Ex-Hale are the clear photovoltaic panels located in some of the perforations of the canopy. These clear PV panels will be able to produce up to 1.2 MW.

The third and final technology in In/Ex-Hale are the Seabins, which clean the ocean. As the ocean water flows into the bins, any rubbish floating in the ocean goes into the bin as well. While the captured trash could be emptied later, just like regular trash bins, the water goes out the bottom of the bin, then goes through filtration process that cleans the water and releases it back into the ocean.

In/Ex-Hale's goal is to help our environment in as many ways as possible. All the materials and technologies used in this design are eco-friendly, non-toxic, have no harm to wildlife or humans and have no run-offs or emissions.

List of Technologies and Manufacturers

1) Pelamis Attenuator
- Manufacturer: Pelamis Wave Power

2) PV panels
- Manufacturer: has multiple manufacturers

3) Seabins
- Manufacturer: Seabin project