**UNWIND**

***Reciprocity and Playfulness:***

A means of energy production that can be aesthetically pleasing and sustainable is the challenge of the present. Fossil fuels are on the decline, therefore sustainable power in close proximity to our everyday lives is a must. But how to breach the status quo; to turn the mundane into the exciting while maintaining energy production?

Our answer is to use Kites. Since the 5th century BC, kite flying has been a time-honored tradition. Kites have emerged in many facets of history, region, nation, and storytelling. In its essence, a kite is a symbol of playfulness, they can metaphorically and literally symbolize connections. Connections between parent and child, ground and sky, and best of all wind energy and rotational energy.

St. Kilda Australia is a place of playfulness. Surrounding the St. Kilda triangle is the Palais Theater, the Luna Amusement Park, and the Port Phillip Bay. This is where people come to watch plays, experience rides, and kitesurf in the bay. UNWIND has the ability to create and everlasting landscape of kites and programable illuminated spheres that convert the winds energy into rotational, electric energy. This landscape captures the playful tradition of the past and present of kite flying while simultaneously bringing energy right to the hands of the people who occupy the space. Both day and night UNWIND will give visitors the space to relax, interact, and play with the landscape of frames and spheres that inhabit the ground, while the kites fly above.

***Operation:***

Each unit in UNWIND operates on a system of two kites that cycle in a yo-yo style. While one kite flies up in a figure eight pattern, the second kite is retracted back in. Once the first kite reaches its max height and is positioned to be retracted, the second kite begins its ascent. Inside the spheres are two spools connected to ratcheted gears. The ratcheted gears engage the momentum flywheel when in the traction phase. The momentum flywheel regulates the sporadic speed of the unspooling kites into a consistent output speed. This output rotational energy is connected to the generator that produces the electricity. A small motor is connected to both spools to retract the kites. Each Kite has a KCU (kite control unit) which houses GPS monitors and servo motors attached to the bridles of the kites. The KCU can communicate to the sphere and its partner kite its position through GPS. This positional information is used to direct the kite through its figure eight pattern.

During maintenance or severe weather, the kites can be retracted all the way to the frames that are positioned around each sphere. These frames are not only functional, as the design was inspired by the architecture of Indigenous Australian huts. When the time comes to deploy the kites, the KCU unreels the kites from the frame to gain enough lift. With sufficient lift the sphere can then further unspool the kites safely into altitudes for power production. The spheres and the frames can rotate to position the kites into the prevailing wind direction.

***Power Output:***

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sphere Diameter | Kite Width | Max Altitude | Power Generator | # of Sets | kwh | kwh/year |
| 3.5m | 6m | 200m | 80kw | 2 | 80kwh | 700,800kwh/y |
| 3m | 5m | 35m | 25kw | 4 | 50kwh | 438,000kwh/y |
| 2.5m | 4m | 30m | 20kw | 5 | 50kwh | 438,000kwh/y |
| 2m | 3m | 25m | 10kw | 5 | 25kwh | 219,000kwh/y |
| 1.5m | 2m | 20m | 5kw | 5 | 12.5kwh | 109,500kwh/y |

UNWIND contains five different sizes of spheres, frames, and kites. Each sphere has two kites. The graph breaks down the power output for each set.

**UNWIND can produce up to 1,905,300kwh a year**

Power was calculated using estimates from experiments done on kite energy. The convention is that a 100kw system that uses a 20-meter-wide kite, at altitudes of 70-450 meters, can produce 450Mwh a year.[[1]](#endnote-1) UNWIND uses smaller kites, at lower altitudes, so a single set produces less energy, however there are more sets, so the power is multiplied in that regard. The equations used are as follows.

*kw generator \* .5 hour = kwh kwh \* 24 hours = kwh/d*

*kwh \* 8,760 hours = kwh/y*

***Construction:***

The kite’s fabric is made out of the same fabric used on kite surfing kites[[2]](#endnote-2). The bowed frames of the kites are made out of carbon fiber tube. All the tethers and bridles are made from Dyneema® rope[[3]](#endnote-3). The main tethers have fiber optics included for lighting at night.[[4]](#endnote-4) For the spheres, the internal frames are constructed out of welded segments of galvanized steel tube. Surrounding the internal frame is a two-part fiberglass shell that gives the spheres their clean look. Underneath the shell is a LED mesh that can be programmed to produce colors, shapes, and text. This allows the spheres to change color for special events, present information such as weather and time, and display art.

The external frames that extend over the spheres are made of steel that are painted white to match with the spheres. The foundations for the spheres and frames would be of poured concrete. The intention is that the foundations would be poured on site, while all the other components would be built offsite and transported when complete.

***Environmental Impact:***

Unwind was designed to have little to no negative environmental impact on the site. The current parking lot site contributes to rainwater runoff, so the design is intended to be incorporated with the permeable grass surface of the masterplan. Having the major components manufactured offsite lessens the environmental impact to the local area. Using kites for wind energy also does not pose a significant threat to birds compared to conventional wind turbines.

**Sources:**

1. “Tech,” Kitepower tm, accessed March 26, 2018. <https://kitepower.nl/tech/> [↑](#endnote-ref-1)
2. “Fly with Challenge” DLE tm Innovative Kitesurf, accessed April 12, 2018. <http://www.challengesailcloth.com/kite-windsurf/> [↑](#endnote-ref-2)
3. “Renewable Energy” Dyneema@ Products, accessed April 12, 2018. <http://www.dsm.com/products/dyneema/en_GB/industries/renewable-energy.html> [↑](#endnote-ref-3)
4. “Windvogel” studioroosegaarde, accessed March 8, 2018. <https://www.studioroosegaarde.net/project/windvogel> [↑](#endnote-ref-4)