

LAND ART GENERATOR PROJECT NARRATIVE:

"To move, to breathe, to fly, to float; to gain all while you give; to roam the roads of lands remote; to travel is to live" ~

Hans Christian Andersen

Refshaleøen Windmark is a minimal surface; a rolling wave that emerges from the tidal water which surrounds, and shimmers with reflections of the currents and wind energy it encounters. The object unites with the water – a new horizon line for the city of Copenhagen – an uplift of power that harnesses the strong prevailing winds that travels and stirs up the water it crosses.

At its highest point, this 84 metre tall sculpture is one that astonishes from afar, whilst simultaneously enticing visitors into its mesmerising and perplexing interior. Purposefully designed, like the wind to be drawn into its epicentre.

In our design approach, it has been key to develop a scenario that sparks a yearn; a must filled desire to make a journey to Refshaleøen Windmark, as if to boat (quite literally) across a Great Lake to then enter a cave full of mysterious promise, adventure and life lasting memories.

There are four possible entries into this immersive environment, with each grand entrance tapering along a length of 50 metres to a concentrated point, allowing prevailing winds to activate a 15 metre diameter turbine that has been calculated to generate enough electricity to power 1200kwh.

Wind power is a form of sustainable energy shrouded in controversy. Horizontal axis wind turbines (HAWT) are massive, bladed towers that have greatly increased in size and height in recent years, but their fundamental design hasn't changed much in decades.

With the centre piece of the LAGI Copenhagen we were determined to incorporate innovations in wind technology into something that could be viewed not as a controversial bladed tower, but as a thing of beauty.

Engaging with some of the wind industries leading innovators and support from one of Europe's leading manufacturers allowed us to critically review and develop basic principles.

The Venturi Effect dictates that the velocity of a gas or fluid increases as the cross sectional area decreases, along with the static pressure. Turbines of this type have been tested extensively in the past and have never overcome the inefficiencies introduced by vortices and other turbulence created by the funnels.

Computational Fluid Dynamic simulation (CFD) has proven that the shape developed by our team, with its huge inlets, dynamically formulated curves and unique dimensions based upon principles developed by leading innovators over the past few years is successful in increasing wind velocities and as such the cut in point of our turbine, allowing the rotor blades opportunity to rotate and maintain an output power of 100kW in the ideal prevailing wind, even at wind velocities of less than 10m/s (Average wind velocity in Copenhagen of 10.4m/s).

The reduction of pressure across our inlet became a key consideration once we had begun to select our turbine. The pressure differential across our selected turbine is key to efficient performance and reduce turbulence.

Ogin of the United States have developed a compact turbine that provided a solution to our problem. Utilising a shroud system not dissimilar to a jet engine the Ogin wind turbine offered us some benefit over more traditional rotors in that it allowed us to reduce the size of our inlet tube in the centre of the

artwork and have more confidence in tackling turbulence issues that have been a hindrance to Venturi Effect turbine development in the past. The mixer shroud, surrounding the rotor plane, creates vortices of slower and faster airflow that mix out turbulence and reduce turbine backpressure. Exit air passes from the mixer into the larger ejector shroud that in turn reduces turbulence and the wake.

The site offers no shortage of opportunity for incorporating innovative sustainable technology.

Another product key to our strategy for making the site an attractive location to visit for the locals and tourists is Pavegen's innovative kinetic floor tile. The use of water throughout the site limits circulation routes to all but the main performance space, water taxi and visitor centre. All circulation routes are designed to house these innovative low-carbon alternatives to traditional paving. The technology offers an opportunity for visitors to engage with renewable energy generation and power the site's external lighting. As well as generating electricity the tiles provide valuable data regarding the footfall and popularity of the landscaped site. Communications with Pavegen have made us very confident that these tiles are a tried and tested product for the challenging external conditions on this particular site and Pavegen are ready to engage in further development of our concept.

With both technologies combined the efficiency of the installation is wholly left in the hands of the visitors to the installation and the prevailing winds of Mother Nature herself.

On a busy day with average prevailing winds in an effective direction it is anticipated the 100kW turbine can produce enough electricity to keep the site and surrounding street lighting powered for a whole month and your average Copenhagen household supplied for up to half a year.

'Bioluminescent' – when stimulated organic material lights up the dark waters they inhabit – is a natural phenomenon that tends to spark the imagination. We are interested in the land art generator genuinely performing as an artform; one that stimulates its environment and all who encounter it. The design not only practically activates the water's edge by lighting the dark area of Refshaleøen, it also connects the life of Copenhagen's city centre with Refshaleøen; and allows our imagination to wander and take delight in something complex and somewhat otherworldly.

Quite dramatically, much areas of the site have been flooded to visually integrate this land art generator into the river front. Our concept enables water taxis to populate in and around the structure to allow for unique visitor experience whilst becoming viewing platforms in of themselves.

This locally sensitive ecological approach of enhancing the natural habitat provides a counter balance to the large scale manmade intervention of the land art generator. The landscape creates a rugged parkland that produces clean water and air to breathe and brings human habitation closer to the rich diversity of nature always so possible by a water's edge.

The flooding strategy has a twofold vision: one it provides a visual logic; and two it has a number of environmental benefits. The site has opportunity to demonstrate sustainable urban drainage systems such as engineering beautiful detention basins that naturally help to mitigate flash floods and heavy precipitation, whilst increasing local biodiversity with rich ecosystems. Furthermore, there is opportunity to create dams and exploit hydropower within this strategy.

Around the northern and eastern edges, the areas are built up with earth grading to accommodate visitors coming by foot or bike. These landforms are not only fun to walk around and explore but they provide a broader biodiversity and as they are vegetated, they slowly navigate rainfall into the various wet ditches and attenuation ponds; which is slowly released in the river body. Wetland systems such as are highly beneficial to the environment, helping to naturally cleanse water and

A combined Visitor and educational centre sits almost invisibly on the site, encased in earth mounding that utilises the excess material gained from cutting the site. This design encourages user activity for climbing the sloped embankment around the centre, providing enjoyable physical interaction with the

site and a special amphitheatre for looking outwards; over and through the landmark with increased vantage points.

Sustainability has been key to our design process. Our team proposes that the existing soil is naturally treated through bioremediation utilising organic matter/ dredging's from the water works north of the area. Likewise, the idea of cutting the site to allow for flooding and then using the excavated material further within the design is a very sustainable approach.

In conducting the Environmental Impact Assessment (EIA), a combination of Product environmental Life cycle Analysis (LCA) and Genetically Modified Plants (GMP) methods were used to understand the product impact and ecological values of the proposed design for Refshaleøen.

The intended methods for construction is tensile to ensure a low impact development for this large scale proposal. Material is stretched over a mesh a structure.

The establishment of a flood mitigation strategy by the way of attenuating water on site and slowly releasing it back into the river body, will enhance the GMP results. The use of bioremediation techniques to clean the existing contaminated soil will reduce cost and embodied carbon compared to bringing in new soil onto the site.

In the creation of earth grading, dykes and dams would be well placed to utilise the tidal waves as a further source for renewable energy.

Our team consisting of artists, architects, engineers and landscape architects have thoroughly enjoyed developing a design concept for the Refshaleøen site and would like to thank you for organising such a meaningful competition.