**Head in the Clouds**

*After our afternoon picnic in the St. Kilda Triangle, we laid in the grass for hours, watching clouds pass by under the translucent airy canopy. As the sky cleared, the sun finally peaked out behind the clouds, warming our faces. While the sun slowly revealed itself to us, the poles that held up the structure grew taller, stretching the canopy above us into a billowing space as if trying to capture all the heat and light it could hold. We realized we were shaded from the hot Melbourne sun as it transformed into a blazing afternoon heat. As we reflected on our culture of burning fossil fuels and destroying the Earth for its resources, we gazed at the blue, sparking ocean stretching out for infinity in front of us. We thought about its coral reefs, and looked towards a future predicated on the principles exemplified by the canopy above us–that renewable energy can be beautiful.*

Melbourne’s St. Kilda Triangle is currently planned for redevelopment to influence future growth in the area. Head in the Clouds presents itself as a public art piece that considers both sustainability and context, hand in hand. The interwoven design is derived from the ubiquitous roof solar panel, a common renewable energy element popularly used and known, as well as the various contextual narratives of the site, ranging from the characteristic entertainment district to the prominent use of the landscape for sunbathing.

Head in the Clouds converges on these points as a series of clouds, challenging the notion of standardized sustainable solutions while being inspired by the nearby Luna Park’s carnival-esque atmosphere and the vast amount of sunbathers on site. The structures lay on various areas of site’s new masterplan, giving stronger identity to each region: the primary site of the ‘Lawn’ adjacent to Palais Theatre, and the secondary sites of the St. Kilda Festival Park, and the beach. Parking and cultural facilities in the masterplan are maintained, with *Head in the Clouds* proposing an additional layer of interest on the plan.The ephemeral structure maintains views from the Esplanade while providing lightweight shelter for the exposed, open areas of the site.

Head in the Clouds hopes to provide the unhurried and tranquil experience of bathing and basking in a sunlit environment, while inviting visitors to participate in the sustainability. Through a submersive cloud structure that embraces those who interact with it, the art piece welcomes an optimistic view of sustainability quite literally with heads in the clouds.

**Energy Generation and Technology**

Head in the Cloudsfocuses on generating electricity by harnessing solar energy. Every day, solar radiation provides 5000 times more energy than the needed amount for all activities on Earth1. Therefore, Head in the Cloudsaims to maximize the usage of this energy source, which is the most freely available and abundant source.

In context, Melbourne receives considerable amount of sunlight to use solar energy as the primary form of renewable energy collected. The optimal angle for collecting solar energy in Melbourne is 30 degrees North. Learning from this efficiency in design, a translucent tensile fabric embedded with Spheral solar cells is used to transform a typical flat roof canopy into a billowing cloud-like structure, creating rolling peaks that orient towards the North to collect maximum sunlight, ensuring maximum efficiency. The innovative Spheral solar cell is woven into the fabric of the structure and generates twice as much energy as typical flat solar panels and solar fabrics due to its spherical shape, which enables it to capture solar energy from all angles as opposed to the restrictive one dimensional surface of flat solar cells2.

These Spheral solar cells are ultimately unique creations which the cloud structure forms its concept around: while the cells ensure the most optimal amount of solar energy output, their unitary spherical nature also allows for a customized flexible curved surface and translucency due to the cell’s own special transparent character3. This ultimately informed the design by providing the possibility of creating a light-feeling structure that is still able to capture solar energy. Combining this idea with the traditional method of maximizing solar energy gain by orienting panels at 30 degrees North gave way to envisioning the ethereal and undulating cloud structures which were conceived in the end.

The cloud structure and form furthermore changes and responds to the amount of daylighting, educating visitors about renewable energy while allowing them to directly engage with the moving structure. Openings within the structure regulate the amount of daylight that directly penetrates it. During hot sunny days while the fabric is mostly exposed to the strong North sun, the openings are oriented South allowing a diffuse light to enter below, while keeping most of the covered space shaded. During cloudier days, the openings face towards the sky, welcoming in any daylight that remains. Collected solar energy is transferred to the electrical grid. The varying and changing height of the cloud structures allow for different programmatic functions and events such as performances, markets, picnics, and sunbathing.

In addition to collecting solar power, wind energy is collected by Windbelts embedded within the skeletal steel structure’s telescoping columns, producing enough energy to operate the up-down movement of the structure that creates the billowing effect of the cloud fabric. The energy produced is stored in a battery for future use.

*Calculations:*

Sphelar Power Production3

0.1 kW/sqm/hour4 \* 4563 sqm \* 6 hours/day \* 365 days = 999297 kWh/an = **~1000 MWh/an**

Formula: E \* A \* D \* 365 = EST

E = Sphelar solar cells’ average energy output per square metre per hour

A = Area of Sphelar solar cells

D = Average daylight hours in Melbourne

EST = Total Sphelar solar cell’s energy output per year

Windbelt Energy Production5

0.2 kWh/m/day6 \* 510m \* 365 days = 37230 kWh/an = **~37 MWh/an**

Formula: W \* L \* 365 = EWT

W = Windbelt output per linear metre per day

L = Total linear metres of Windbelts

EWT = Total wind energy output per year

**Environmental Impact Summary**

The St. Kilda Triangle of greater Melbourne is located on a site that embodies the transition of city core and urban beach, spanning the intersection of city and nature. Head in the Clouds is a land art piece that responds to the environmental, cultural, and social qualities of this site.  
   
St. Kilda Triangle has heritage values that reach beyond the public realm of history and culture to the regional habitat of the beach and shoreline. Little Penguins and Rakali inhabit local vegetation, making up the ecology of the Foreshore. These species harmoniously coexist with daily visitors of the Triangle, making it a prime location to showcase the environment’s importance to all inhabitants via public interaction with sustainable energy harvesting technologies. In a world dependent on extractions, Head in the Clouds at The St. Kilda Triangle is an example of a sustainable future.  
   
Aligning with community and government goals on all levels, Head in the Clouds supports Melbourne’s 2020 net-zero target, conforms to City of Port Phillip’s Greenhouse Plans towards a low carbon city, and contributes to The Renewable Energy Action Plan from the Province of Victoria. This is achieved with zero emissions and renewable energy production. Head in the Clouds generates 1000MWh of solar energy annually to contribute to the grid and sustains its own operation by generating 37MWh of wind energy annually. It utilizes two technologies that are integrated into the weightless aesthetic of the art piece–Spheral solar cells embedded in the fabric canopy and Windbelts in the steel columns holding up the billowing, cloud-like structure.

Alongside generating energy, Head in the Clouds conveys sustainability beautifully, inviting visitors on site to interact with the structure itself. Through a scalable configuration of three different sizes, the piece hosts various public activities while advancing awareness of the environmental issues challenged.

1. Di Nuzzo, Daniele, et al. “Polymer solar cells: ‘see’ what is going on inside.” Technische Universiteit Eindhoven. TU/e, 31 March 2018. Web. Accessed 1 May 2018. <https://www.tue.nl/en/university/departments/applied-physics/education/applied-physics-graduate-program/phd-program-applied-physics/research-groups/molecular-materials-and-nanosystems-m2n/research/polymer-solar-cells-see-what-is-going-on-inside/>
2. “Spherical Silicon Cells.” RCI Energies. RCI Energies Ltd., 26 June 2017. Web. Accessed 1 May 2018. <http://www.rcienergies.com/spherical-silicon-cells/>
3. “Sphelar BIPV.” Sphelar Power. Sphelar Power Corporation, 20 September 2012. Web. Accessed 1 May 2018. <http://sphelarpower.com/product/sphelar_bipv.html>
4. “Sphelar Cells Save on Silicon, Capture Light From All Paths.“ JEI. Dempa Publications, Inc., 26 February 2007. PDF. Accessed 1 May 2018. <http://sphelarpower.com/technology/pdf/03_JEI_200702.pdf>
5. “Technology Wind Belt.” Humdingerwind. Humdingerwind, 12 October 2007. Web. Accessed 1 May 2018. <https://www.humdingerwind.com/>
6. Windbelt - Reinventing wind power.” Physics.org. IOP Institute of Physics, 25 June 2010. Web. Accessed 1 May 2018. <http://www.physics.org/featuredetail.asp?id=47>