# SOLAR ORBS

**Description**

There is a unique yet formal relationship between land and sea, where the sweeping curve of the water’s edge and tight curve of the cliff’s edge touch. It is here where the built environment and the wilderness begin to blend together under the omnipresent sky.

We have seen the world as human dominated for so long that our perception of the relationship between land and sea has become somewhat skewed. If we looked at the world upside down for just a second, we would see just how the ubiquitous sky blends together the human world and the natural world, giving man-made forms a natural sense of identity. Solar Orb’s concept inspiration stems from figure 3 on

page 10 of the urban design framework document supplied by the competition (see figure 1). We were drawn to this figure because it embodies the environmental culture and values held by the people of St. Kilda. Solar Orbs reflects this concept and engages the public in both daylight and

starlight. Figure 1. (Figure 3, Urban Design Framework Document)

Our design proposal seeks to stretch the secondary boundary 24m further southeast down Jacka Boulevard to accommodate the pedestrian bridge. The proposed bridge links pedestrians safely to the St Kilda Triangle and the various attractions like The Stokehouse, the St Kilda Life Saving Center, and Donovan’s. The southwest threshold would exist as an elevator, while the northwest would exist as stairs. The elevator allows greater access and safety for handicapped users.

# Technology

The design of Solar Orbs utilizes spherical solar concentrators to focus sunlight onto a photovoltaic thermal (PV+T) solar cell. By concentrating the sunlight through a sphere, the solar radiation per square meter is increased, allowing the solar orbs to generate the same amount of power using a smaller photovoltaic cell as compared to a larger solar panel. These panels are 25% the size of conventional commercial solar panels but have the same efficiency.²

Solar Orbs can absorb diffused rays of solar energy to harness solar energy during low light conditions such as early morning hours, overcast days, late evenings, and even moonlight.1, 2 Using principles of spherical geometry Solar Orbs enhance efficiency, decrease solar cell surface, absorb diffused sun rays, and contribute to an aesthetic suitable to an urban environment. Unlike conventional solar panels that are fixed in place and only able to harvest energy for part of the day, Solar Orbs can track the sun as it moves across the sky each day.2 Each solar panel is mounted on a dual access tracking system, maximizing the potential power generated.1, 2 By utilizing PV+T solar panels Solar Orbs can not only generate electricity but

also capture heat and use it on site in heating buildings or water.2, 3 Collecting heat from the panels performs another benefit in that it keeps the panels from overheating, thus optimizing production. This optimization of both solar efficiency and heat collection allows Solar Orbs to be four times more productive than conventional systems.4, 5

# Energy Production

To calculate the power generated, we used the following equation:

P = [nameplate capacity] x [time] x [capacity factor]

**Electrical generation nameplate capacity**: 220W/m2 (5) **Heat generation nameplate capacity:** is 350 W/m2 (5) **Capacity factor:** .25

Because the sunlight is focused through the orbs onto the photovoltaic cells, the area of light being collected is a circle within the diameter of the orb. The equation for the area of a circle is as follows: A = πr2

In this intervention there is **one large solar orb** that is 16 m in diameter and **94 small orbs** that are 1.8 m in diameter. The effective area for the 16 m diameter orb is 201.06 m2, and the effective area for each 1.8 m orb is 2.55 m2.

# Electrical power generation for the large orb per year:

Pe1 = 220 W/m2 x 201.06 m2 x 8,760 h/yr x .25 Pe1 = 96,870.71 kWh/yr

# Electrical power generation for the 94 small orbs per year:

Pe2 = 94 x (220 W/m2 x 2.55 m2 x 8,760 h/yr x .25) Pe2 = 115,487.46 kWh/yr

# Total electrical power generated per year:

Petotal = 96,870.71 kWh/yr + 115,487.46 kWh/yr Petotal = 212,358 kWh/yr

# Thermal power generation for the large orb per year:

Ph1 = 350 W/m2 x 201.06 m2 x 8,760 h/yr x .25 Ph1 = 154,112.49 kWh/yr

# Thermal power generation for the 94 small orbs per year:

Ph2 = 94 x (350 W/m2 x 2.55 m2 x 8,760 h/yr x .25) Ph2 = 183,730.05 kWh/yr

# Total thermal power generated per year:

Phtotal = 154,112.49 kWh/yr + 183,730.05 kWh/yr Phtotal = 337,842.54 kWh/yr

\*Energy storage proposed to exist within proposed Cultural Center

# Materiality + Dimensions

Each orb is made of a clear acrylic sphere, filled with water. The orbs are supported by stainless steel structural components. The structural widths vary based on the arrangement and height of the structure. There is a total of 20 stainless steel structures with orbs; 14 of them are 10.65m tall, while 6 of them are 8.56m. The large orb has a diameter of 16m while the small orbs have a diameter of 1.8m. Each orb has an 18” PV+T panel.

# Environmental Impact Summary

Today we are challenged with the issue of global warming – the 2020 Vision for Melbourne begins to confront this issue head on. Our proposal will contribute to the Net Zero 2020 Initiative, giving users a chance to interact with green energy, seeing how it can be beautiful and artful, yet functional. Our design stems from the formal relationship of the natural and built environments – proposing a union between the two to creating a powerful impact on how people perceive our environment and how the built and natural environments can function simultaneously as one.

The Solar Orbs while positively contributing to the Net Zero 2020 Initiative, will also contribute to Melbourne’s light pollution. These lights can potentially have a negative impact on marine life, specifically, changing the composition of marine invertebrate communities, a negative impact of all night-time coastal light pollution. 6 The proposed lights are white LED that illuminate the transparent orb, using less energy and having a longer life span. The Solar Orb structure is also filled with water, but they only need to be filled once.

The solar panel on the dual axis tracking arm is ¼ the size of an average solar panel, but has the same efficiency – utilizing less material, and being easier to replace in the future.

# References

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