**Sol Tower**

Imagine a peek into the near future. It’s a sunny day on the coastal shore of St Kilda on the outskirts of Melbourne. This is the new St Kilda Triangle - a major hub for fun seekers, locals, and tourists. People are strolling the Esplanade, gazing at the bay from the Terrace, or just wetting their feet at the beach. The sea breeze plays across the Triangle as the crowds enjoy their afternoon. The view from the Esplanade stretches far out to the horizon, where sunrays glimmer on the blue waters.

The horizon is punctuated with popular destinations like the Palais Theatre, the rolling grounds, and the welcoming gates of Luna Park. A graceful walkover bridge rises gently from the grounds close to the Terrace, spanning over Jacka Boulevard and landing at the Bay Trail between Donovans and the St Kilda Life Saving Club.

Atop the bridge, you see an installation rising. In keeping with the spirit of Luna Park, the new Sol Tower features a vertical drop ride where fun seekers cheer as they drop down through the 36-meter-high shaft overlooking the vista of St Kilda. You will be pleasantly surprised to discover that the Sol Tower and the bridge aren’t just tourist spots; they combine to form a true powerhouse that feeds a large portion of energy back into the grid! The Sol Tower embodies the idea of art with a purpose, harvesting energy from natural, renewable sources with a net-zero effect.

**Design Concept:**

The St Kilda Triangle, developed through a masterplan collaboratively designed by the city council, the community, and stakeholders, will become a vital part of the Melbourne community. The proposed bridge and ride tower concept is our contribution to this thoughtful masterplan, with the aim of advancing leisure opportunities, promoting renewable energy, and enhancing the overall appeal of the Triangle. The bridge will create a walkable pedestrian link over Jacka Boulevard, connecting bayside attractions with the Palais and Luna Park, and offering a stunning view high above the Triangle.

The Triangle has a compelling history of urban transformation. As times and priorities changed, landmarks like the Palais and Luna Park have reinvented themselves into their present-day attractions. Today, St Kilda demands a different kind of transformation. We must lessen our dependence on carbon-based fossil fuels and develop self-sustained cities with a balanced ecosystem.

The team’s approach would generate energy using:

* Solar Updraft Tower
* Bladeless Wind Oscillators
* Thin-Film Photovoltaic Cells

The Sol Tower will be a fun and lively symbol for the city of Melbourne’s advanced sustainability goals. In harmony with St Kilda’s history and the Triangle’s masterplan, our design uses renewable technologies to create art on the shores of St Kilda.

**Engineering Design:**

The design incorporates three renewable energy technologies which contribute varying amounts of power to the overall system:

1. The primary element of the design is the solar updraft tower, which leverages solar thermal heat principles to generate air flow;
2. Bladeless wind oscillators sit atop the tower to capture power from the vortices created by the air movement around the structure; and
3. Thin-film photovoltaic cells cover fins protruding from the bridge’s surface to optimize the solar collector area and increase power generating capability.

Power generation by a solar updraft tower depends on several factors, including solar irradiance (W/m2), tower height, tower diameter, collector area, and obtainable differential temperatures. Based on engineering theory and data gathered from the real-world, small scale prototype installation in Manzanares, Spain, researchers have developed technical parameters that can be used to gauge power generation capacity, as well as annualized energy production. The Manzanares prototype has a height of 194.6 m, a tower radius of 5.08 m, and a collector area of 46,760 m2. It produced a nominal power output of 50 kW.

The team’s proposed design is a scaled down version with a height of 44.5 m, a tower radius of 3.12 m, and a collector area of 1,860 m2. Thermal storage is provided in water-filled black tubes laid down on the radiation absorbing surface under the collector. The use of water thermal storage nominalizes the release of solar heat into the updraft tower and enables the plant to run during the night. The Melbourne site receives an annual average horizontal solar insolation (W/m2) of approximately 162 W/m2. This equates to a peak power of approximately 0.4 kW, or an estimated energy generation of approximately 2.0 MWh/year.

Bladeless wind oscillators developed by Vortex Technology are designed with a 13 m tall vertical pole-shaped generator that oscillates to produce electrical power. The devices has no moving parts, ensuring that they avoid long-term fatigue and wear. Installing these wind oscillators 40 m above ground at the proposed site accommodates average wind speeds approaching 10 m/s. Based on the manufacturer’s reported data, the 13 m tall model is estimated to produce 4 kW of renewable power. Assuming a 20% capacity factor, this equals approximately 7 MWh/year. Placing five of these devices around the circumference of the updraft tower, with an allowance of derating due to vortex interference, may generate a total of approximately 20 MWh per year.

Finally, thin-film solar cells are installed on the protruding fins covering an area of 1,200 m2. Assuming a photovoltaic efficiency of 20% for thin-film and an effective rate of 0.7, the estimated average energy generation is 645 kWh/day, or 236 MWh/year.

The collective renewable power generation of the design is estimated to be approximately 260 MWh per year and will feed into the utility grid. The annual energy produced by the tower and bridge structure is able to produce the annual energy consumption required by the vertical drop ride.

**Environmental Impact Statement:**

One of the core values of this project is to minimize disruption to the existing environment, including coastal ecosystems and wildlife, as well as the surrounding buildings and structures. With an integrated solar updraft tower, bladeless wind oscillators, and photovoltaic thin-film cells, the tower and bridge combination connects St Kilda attractions without diminishing the look and feel of the coastal atmosphere or impeding existing traffic.

From a power generation perspective, the project integrates several types of renewable energy based on primarily passive design. No environmental pollution is produced at the project site. The updraft tower turbine is the only rapidly moving part in the installation and is hidden from public view and protected from wildlife with wire mesh screens. Crowning the tower with bladeless and rotor-less wind energy generation devices ensures that coastal aviary species are not at risk, while extracting renewable energy from the air and sky.

Although this design includes some energy consumption devices, the project will be net-positive generator of electrical energy. On an annual basis, the energy generated by the project will feed significantly more into the utility grid than it draws.

**Conclusion:**

The Bay Trail boardwalk that links Stokehouse, the St Kilda Life Saving Club, and Donovans, will be connected to the St Kilda Triangle at the Terrace Plaza around Palais Theatre by the Sol Tower and Bridge. **The Sol Tower and Bridge would be a striking beacon for St Kilda, helping to unite the buildings, plaza, park, and seashore, while promoting the power of renewable energy.**