RADIANCE RIBBON

A playful canopy winds down from the Esplanade at St. Kilda Triangle, colorful sawtooth peaks guiding your way to Port Phillip Bay. Sunlight filters through the canopy, scattering multi-colored light across the walkway; looking more closely, you realize that the festive stripes are actually translucent solar panels.

The pathway is filled with St. Kilda neighbors and tourists, exchanging the daily gossip and buying veggies from a bustling farmer’s market. Beach goers are buying food for a picnic lunch in the shade beneath a section of canopy reaching out onto the lawn. Families relax after a thrilling morning at Luna Park. A whimsical reminder of the classic beach cabana, you wander through the fluttering ribbons and out across the beach.

Later that evening, retiring from a concert at the Palais Theater, you join your fellow music enthusiasts for a glass of wine from a pop-up bar, then go to relax under the soft glow of the canopy lights. Others gather at the ribbon trail’s dance floor outside the Terrace. Their movements are illuminated by a dynamically lit section of the trailing roofline. Their cheering and dancing increases as more join the floor and the lights grow brighter.

*Radiance Ribbon* transforms the St. Kilda Triangle into a programmatically vibrant bridge;activating the gap from between the Esplanade and the beach, while transforming it into an exciting, interactive node that greets a bright and sustainable future.The walkway embraces St. Kilda’s coastal identity, celebrating the area’s vernacular architecture of leisure and festivity. *Radiance Ribbon* is an invitation: to air, sunlight, and St. Kilda!

CONCEPT

* **Modular** form allows phased construction, the installation can be expanded as elements of the St. Kilda master plan are actualized and as resources are available.
  + Instead of investing heavily in custom tech that may quickly become obsolete, this system can be upgraded to use more efficient solar PV and wind capture systems.
* Opportunity for experimenting with **emerging technologies**
  + Basic structure is equipped with standard mounting elements, so the energy harvesting skin can be adjusted or replaced easily.
  + Can be used as a testing ground for emerging PV technologies, installing multiple kinds of PV systems at once.
* Engage and **augment new master** plan buildings
  + The canopy distorts and adapts to form entrance canopies to new pavilions (restaurants, museums, pavilions, etc).
  + *Radiance Ribbon* unites new buildings with a common design language
* **Interactive elements** educate and provide feedback to St. Kilda visitors
  + Installation light elements dim and brighten according to the amount of energy generated on-site
  + Real-time feedback: lights in the dance floor area (*Radiance Ribbon*’s tribute to the Palais de Danse that was destroyed) react with color, brightness and movement to visitors moving on smart, power-generating pavers

PROGRAM

* Beach **cabanas**: vernacular structure, cultural recognition, atmosphere of celebration and relaxation
* **Marketplace**: an integral festivity of St. Kilda, and a proven functional corridor created by double-loaded market stalls
  + Enhances the existing markets already active around St. Kilda and on the site, and offers the opportunity to expand
  + The growth of sustainable and fresh food markets would engage local residents as well as expand dining and entertainment attractions for tourists
  + Potential partnerships with nearby community gardens like St. Kilda Community Garden and Veg Out Farmers Market

ENERGY

Dye-sensitized solar cells (DSSC) recently reached a record of 15.4% efficiency.1 Though they are not as efficient as some synthetic photovoltaic (PV) cells, they are cost-effective, translucent and may be produced in many different colors. *Radiance Ribbon* can support up to 2,863 of these panels.

Varying the pitch of each module’s roof creates different panel dimensions, but the average area of a single DSSC panel is about 0.28m2. Under typical sun irradiance of 1000W/m2, this would yield an average of 34W per panel at a conservative 12% efficiency.

Given that Melbourne receives an average annual 46 sunny and 139 partly sunny days, *Radiance Ribbon* could provide an annual 269MW hours of energy.2 This assumes panels operate at 6% efficiency (DSSC perform better than most other PVs in lower light) for the 139 partly sunny days.

Windbelts form *Radiance Ribbon*’s vertical ribbons. As shown, there are a total of 713 Windbelts, though the installation has the capacity to support additional units if needed. Windbelt area is proportional to its energy output, and shares a cubic relationship with wind speed.3 With an average area of 2.8m2, and an average windspeed of about 10.6km per hour in Melbourne, this would indicate about 45.4W of energy per ribbon.4 For a full year, this could yield roughly 284Mwh of energy.

The last active feature, the dance floor tiled with the Pavegen V3, generates 5W of energy with continuous engagement.5 A 2016 report on St. Kilda triangle tourism determined about 1.9 million domestic and international visitors visited events in St. Kilda from September 2014 to 2015.6 Clearly, there are plenty of tourists and citizens of St. Kilda to occupy the floor, but energy output is still difficult to predict, as studies indicate weight and activity type (walking, jumping, etc) vary the output. Therefore, a best estimate might be floor area: The dance floor is 374m2. Proposing that for one hour, once a day for every day of the year, there is a single person for every square meter (374 people) dancing or walking continuously, this could produce 16MW hours of energy annually. This activity would likely be more concentrated during events or seasonal activities.

In total, *Radiance Ribbon* could potentially generate up to 569Mwh annually. These systems power *Radiance Ribbon*’s oscillating LED roof line (at 4.8W/m) and still store about 528MW. As an additional attraction to the dance floor, activity there will be reflected in the local LEDs’ brightness, color and movement--- creating a dialogue with the movement and profile of the historic Luna Park roller-coaster.

ENVIRONMENTAL IMPACT STATEMENT

*Radiance Ribbon* supports the St. Kilda Triangle masterplan by complimenting the proposed landscapes and programs with a minimal footprint and up to 569Mwh of annual, clean energy. The installation landscape scheme supports use of native, non-irrigated plantings and passive rain water mitigation.

Additionally, *Radiance Ribbon* contributes to St. Kilda’s public well-being and healthy living environment. By augmenting the existing outdoor recreational space, the installation promotes physical activity, especially around the interactive dance floor, and encourages local eating and agriculture by offering greater access to locally grown food, through the marketplace.

With the exception of recycled steel framing, almost all other materials used in the installation are provisioned specifically for the production of sustainable power. In addition to this tangible resource, *Radiance Ribbon* inspires and educates visitors about emerging forms of renewable energy technology. By wandering the path and experiencing its different systems at work, tourists and St. Kilda natives alike can come to understand how energy generating technology can contribute to the beauty and function of public space.

DIMENSIONS

* Project spans about 400m in length
* The basic cabana module is 3.5m wide by 1.75m deep
* The average height of this module is 4m

MATERIALS

* Dye-sensitized solar cells (DSSC)
* Windbelt (Humdinger Wind Energy)
* Pavegen V3
* Other: recycled steel structure

SOURCES

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2 "Average Sunshine a Year in Australia's Cities." Current Results: Weather and Science Facts. Accessed May 05, 2018. <https://www.currentresults.com/Weather/Australia/Cities/sunshine-annual-average.php>.

3 Balaguru, P., Dr., B. Vignesh Raj, and B. E. Vignesh. "Low Cost Energy Production Using Wind Belt Technology." *International Journal of Engineering and Innovative Technology*2, no. 9 (March 2013): 252-55. Accessed May 5, 2018. http://www.ijeit.com/vol 2/Issue 9/IJEIT1412201303\_48.pdf.

4 "Average Annual Wind Speed at Australian Cities." Current Results: Weather and Science Facts. Accessed May 05, 2018. <https://www.currentresults.com/Weather/Australia/Cities/wind-annual-average.php>.

5 "Product." Pavegen - The Next Step. Accessed May 05, 2018. <http://www.pavegen.com/product>.

6 *St Kilda Triangle Comparative Analysis for Cultural Tourism Attractors*. Technical paper. Essential Economics Pty Ltd. February 2016. http://stkildatriangle.com/ESSENTIAL\_ECONOMICS\_FINAL\_REPORT\_-\_Cultural\_Attractors.PDF.