**The Kilda Collection**

NUMBERS

Total annual production: 50,000 kWh

June 21st: 55 kWh

Dec 21st: 222 kWh

Annual Production of 1 panel: 100 kWh

Annual Consumption of 1 bench (LED lighting of battery and pole during night + 2 daily phone charges): 34 kWh

Storage: 11,000 kWh

Storage in Bench Type A: 12v (2.6kWh)

Storage in Bench Type B: 24v (6.4kWh)

Storage in Stage: 20,000v (10,000kWh)

THEME OF COLLECTING ENERGIES

SOLAR ENERGY

As the Victorian sun bathes the site, solar canopies capture and transmit electricity into the battery benches beneath. The harvested electricity is stored within the benches and is made available to visitors, vendors, and performers.

SOCIAL ENERGY

Connecting people and place is the theme underlying the site’s design. Stitching the esplanade to the foreshore, residents and visitors have direct and indirect paths to experience the Kilda Collection as they access the waterfront, Luna Park, and other nearby attractions.

CULTURAL ENERGY

A new plaza, a multi-purpose stage, and improvements to the Palais will reinforce the Triangle’s position as an epicenter of cultural energy. These spaces will host events, such as markets and festivals, that already draw visitors to St.Kilda.

Throughout the site, benches vary in seating capacity and panel angle. Varying angles allow the site to effectively capture sunlight at all times of the year while educating visitors about the factors that determine solar panel output. These angles also produce dynamic shading to provide protection from the elements on summer days.

ESSAY

Energy is all around us. Capturing and harnessing it for future use is key to a the clean energy transition. The Kilda Collection shines a light on the solar plus storage, as an accessible and reliable alternative to fossil fuels. The Kilda Collection artistically features innovative solar and battery technologies, while enhancing the public realm. Renewable energy from the sun is overlaid with Port Phillip’s renewable social vitality and the continued movement of people within and through the site. The Kilda Collection invites visitors to see the St. Kilda Triangle as a hub of the Port Phillip community.

The photovoltaic array on the St. Kilda site is the most apparent energy overlay on the site. The array is composed of solar panels elevated above the site’s social spaces and movement corridors. The array appears as a singular art form from above and as individuated forms from ground-level. At both scales, the visitor can witness the potential of solar energy and intuitively connect the solar panels with their ability to meet the site’s energy demand.

While standing on the Esplanade at the northeast corner of the site, a visitor will notice the uneven surface of the array. Each of the 279 panels is oriented toward the north of the site to face the sun, but angled differently. The ideal angle for solar production varies in relation to the position of the sun in the sky. The various angles of the panels result in different levels of production based on the time of the year. The panels are arranged at angles ranging from 53 degrees (the optimal angle for production in June) to 23 degrees (the optimal angle for production in December). The total Array is estimated to produce approximately 50,000 kWh per year.

While walking underneath the array, a visitor will notice that each panel is elevated above a bench. The benches are arranged along the circulation paths at varying densities and each contain a gel battery. The benches are illuminated at dusk to reveal the level of the battery’s charge. The level of the light in the bench will correspond to its charge level: a bench will be fully lit up when the battery is fully charged and dark if it is empty. Visitors will notice that the battery levels vary in a pattern across the site: the panels that are closer to the optimal angle for that time of year will have more charge than the others.

Visitors will have the opportunity to engage directly with the storage in the benches by charging their phones with the stored energy. Each bench will be equipped with two USB charging ports. Each panel is estimated to produce 100 kWh per year and the benches are estimated to consume 34 kWh per year. The batteries within each bench will allow the lights and phone charge ports to remain solar-powered throughout the year, even on cloudy days, at night, or in the darker winter months when productivity is lower. On particularly sunny days, some of the panels above the benches will produce more than the battery can hold. In these cases, the excess power will flow through underground conduit to the central battery on the site: the battery underneath the stage. This distribution of power will be made visible through embedded lighting that highlights the grid that informed the site design.

The visitor will notice that the array also extends above the outdoor performance space. These panels, along with the excess power from the benches, fill a commercial-scale gel battery underneath the stage. The gel battery product was selected to maximize safety of the design. Ventilation will still be included in the walls of the stage as a precautionary measure. This battery is sized to hold 10,000kWh of electricity, one fifth of the total annual production. This battery has the capacity to power one outdoor concert. The stage will also be illuminated to show the level of the battery, so that visitors can witness the impact of electricity usage (during a show) on the battery level.

The Kilda Collection will be connected to the Port Phillip electric grid, allowing for managers of the site to monetize the benefits of battery storage, if desired, by allowing grid electricity to be stored there when it is in excess and affordable and then used during peak demand times.

The Collection intentionally features technology that is already on the market and that can be applied in a residential or commercial setting, so that visitors can imagine taking part themselves in the transition to clean energy. Visitors may be inspired to join the over 1 million Australians who are already powering their homes with solar energy, paving the way for the state of Victoria to meet its climate goals.

The next overlay on the site is social energy, which is oriented around connections: by cultivating connections between people on the site and by increasing accessibility to the site. The Kilda Collection is designed to make the site an appealing space for socializing. The Kilda Array is physically interconnected with benches that are interspersed throughout the site. The benches are designed to stimulate conversation between visitors. The range of designs allows for a range of activities, all under the pleasant shade of the array during the daytime. By retaining the Slopes and adding new lawn areas, the Kilda Collection provides diverse spaces for conversation or play. The Kilda Collection protects the key view corridors, with respect to *St. Kilda Triangle 2012*. At night, the Collection is illuminated, allowing visitors to use the sight at all hours. This art form invites visitors to linger and mingle in the site when passing between Port Phillip and the Foreshore.

The Kilda Collection proposal includes features that will make the site more accessible for visitors, by providing safe access points and underground parking. The Kilda Collection adds a pedestrian bridge across Jacka Boulevard to ease access to the Foreshore. The pathways through the site are transit-oriented in that they intersect directly with the two nearest tram stops on the Esplanade and the bike share locations.

The final overlay highlights the cultural legacy of the St. Kilda Triangle site. The Array evokes the theme of entertainment that has defined the Foreshore, respects the form of the Palais Theatre, and allows for anticipated expansion of the Theatre building, as projected in *St. Kilda Triangle 2012*. The Array also brings the Palais Theatre programming out into the open with the outdoor stage. The stage is situated so that visitors can sit on the Slopes, with views of the performance and the Foreshore on a summer evening. This stage is imagined as a new central performance site for events such as the St. Kilda Festival.

The Kilda Collection also responds to the weekly Esplanade Market, by adding benches along the western Esplanade but not disrupting the space directly to the north of the site, so that it can continue to be used to stimulate the local economy through this lively event.

The intersections of the social and cultural energies on the site are deeply embedded in the design of the Kilda Collection. The site is designed as expressions of a linear pattern, drawing on the connections created by the site. These lines appear in the terrain as paving and lawn, and act as a guiding framework for the location of the benches and consequently the array itself.

The Kilda Collection overlays the social and cultural legacy of the St. Kilda Triangle with the clean energy being generated and stored on the site. The site makes visible the invisible by visually depicting the collection and distribution of solar energy through responsive lighting. Visitors will be encouraged to linger, mingle, and learn as they travel through the St. Kilda Triangle from the bustling Port Phillip community to the beautiful Foreshore.

ENVIRONMENTAL IMPACT SUMMARY

The Kilda Collection is designed to minimize environmental impacts.The Kilda Collection prioritizes materials that are manufactured in Australia, including Gelion batteries and Clearvue panels in order to minimize the embodied energy used to transport them to the site.

A life cycle analysis of the products used to develop the Kilda Collection reveals some unavoidable environmental impacts. The embodied energy in the concrete production and the manufacturing of the solar panels and batteries is likely powered by fossil fuels, given the current mix of the Australian electric grid. The City of Port Phillip could choose to buy renewable energy credits to offset this demand, in order to ensure that the development of the St. Kilda Triangle remains truly carbon neutral. Looking forward, there may be challenges with recycling the batteries and photovoltaics. Research should be directed toward recycling options for these specific technologies.

The site design itself may also have an impact on the local urban ecosystem of Port Phillip. The LED lighting could contribute to light pollution, creating a distraction for wildlife. The lighting design should shield lighting downward when possible. The paved paths and lawn spaces, though an improvement from the current paved surface, will continue to contribute to stormwater runoff, if mitigative steps are not taken. The paving material should be pervious and plantings should be strategically situated to collect stormwater during storm events.

The site is designed to encourage environmentally friendly behaviors, but must accommodate the expected behavior of its users. The site is made accessible by transit, bike, or foot. However, to respond to expected demand, it does incorporate 200 car parking spaces. A pricing regime could be designed for the parking garage to encourage visitors to consider alternative forms of transportation.

TECHNOLOGY

The technology used on the site was selected in order to optimize the user experience and prioritize Australia-made products.

* + Photovoltaic Panels

The 48kW of solar arrayed across the site is estimated to produce 47,123 kWh of electricity per year (PVwatts 2018). This estimate assumes a production of 50 watts per square meter, which is about one-third of the average photovoltaic panel’s production, due to the semi-transparent nature of this design. The Kilda Collection team proposes contracting with Clearvue for the manufacturing of these panels. Clearvue is a leading Australian start-up that specializes in transparent photovoltaic panels.

Each of the 300 panels across the site is equipped with a micro-inverter, to keep costs manageable while allowing for AC electricity load at each bench.

* + Gel Batteries

The central innovation of the site design is the visible usage of storage, in the form of gel batteries. The gel batteries provide a safer alternative to the more typical lead acid batteries. The base of each bench contains a small battery that is 6 volts or 12 volts, depending on the specific bench’s design. The largest concentration of storage on the site is positioned in the base of the stage. This use will provide an opportunity to collaborate with another leading Australian clean energy firm- Gelion. Gelion was started to commercialize technology that was developed at the University of Sydney and is prepared to begin implementation of their innovation on gel batteries, which maximizes efficiency and safety. The Gelion product is designed to be built into the walls of buildings, so the base of the stage will be an ideal pilot site. The 20,000 volt battery in the stage will have the capacity to hold 10,000 kWh of electricity and will be able to power the outdoor concerts held on site.

* + LED Lighting

The Kilda Collection proposes the use of LED lighting on the site to maximize visibility and efficiency. This lighting will be used to illuminate the base of the benches, in order to show the level of each battery’s charge, and to highlight the conduit lines, in order to show the distribution of electricity across the site. LED strip lighting will be used to illuminate the poles supporting the panels to provide ambient light at a pedestrian scale. The Australian-company LED Lighting Solutions could be a strong domestic supplier for these materials.

MATERIALS

» dimensions and list of the primary materials used in your design

Energy Production and Storage

* + Semi-transparent photovoltaic panels (263 sized 2mx3m and 16 sized 5mx5m)
	+ 263 Microinverters
	+ Electrical conduit to run from the panel to the battery
	+ Electrical conduit to carry overflow from the bench batteries to the stage and through a point of interconnection to the grid
	+ Gel batteries (150 6v batteries with 3kWh capacity, 68 12v batteries with 6.4kWh capacity and 1 commercial-scale battery with 10MWh capacity)

Bench structure

* + Lightweight Concrete as border and support pole for panel
	+ LED strip lighting to illuminate the distribution of electricity across the site (100 5m rolls)
	+ LED strip lighting to illuminate the benches and poles (218 5m rolls)
	+ Semi-Transparent Acrylic (2,000 sq ft)
	+ Wood for backs of benches

Pedestrian bridge

* + Ductal Ultra High Performance Concrete