**THE SOLARSHELTER**

**FLY RANCH WICKIUP**

The Fly Ranch, the ancestral and sacred lands that belonged to some Native Americans ethnic groups, can give us certain clues to the social and cultural lifestyle they developed, where the hostile or radical environmental circumstances in which they lived and forged their way of life. Being mostly nomad societies, living from hunting and gathering, they built communities in complete harmony and respect with the environment.

With a nomadic lifestyle, they had to be able to adapt and change according to the natural rhythm of seasons, harvests and animal migration patterns.  In order to survive the inclement seasons and climate, they developed hunting, manufacturing and shelter techniques, using materials provided by nature.

They developed a unique shelter typology, the Wickiup, a sort of oval-shaped hut, built with natural elements such as branches of shrubs, earth and other plants that allowed them to protect themselves from the night cold and the inclement sun, a structure that was easily constructed, which was given temporary or permanent use.  Demonstrating the resilience and adaptation of their communities, solidarity with the animal and vegetable world that Paiutes have always cultivated, in the hope of being able to weave a stable and lasting bond with the essential elements of our existence.

The Paiute people were characterized by living in independent groups of three or five households, where social relations were based primarily on meetings to forge close relationships between them and where gender roles were shared, whether narrating stories or making decisions for the future, following the warnings and advice of their leader.

Perhaps this is the major legacy of the Paiute tribes, from which we should learn. Listening to those stories and myths that shamans sang in the heat of the faint flame of fire; the legends told during the nights about the origin of the world, the deep sense of existence, and the intrinsic character of any feeling of love.

**THE SOLARSHELTER**

The Solarshelter is a self-supporting structure that seeks to reflect the spirit inherited from the Paiute culture, shaped like a dome, like the vernacular Native American architecture, we designed an infrastructure that formally resembles the old Paiute Wickiup.

Fundamentally, this structure is intended as a portable and resilient installation, like the Paiute Indians, that used to migrate according to their immediate needs. The Solarshelter is intended to serve as a shelter for the various tasks that are planned to be done in the territory of Fly Ranch and as a collector of solar energy.

The Paiutes gave great importance to the transmission of their traditions and culture from one generation to another, so we imagined the territory of Fly Ranch as a place to transmit, share and live human culture. To do so, we need infrastructure to support us in these activities.

**FUNCTIONS**

The Solarshelter aims to function as the infrastructural support for this: to develop any type of cultural event, such as **conventions, festivals, retreats, experimental fields**, we need a place that provides us with certain basic elements. The Solarshelter provides the shelter to protect us from the sun and cold, and electric power from a battery charged during the daytime by means of solar cells.

As the traditional Paiutes did in their social dealings, the Solarshelter becomes that circular space that invites us to meet, to share debate ideas and gives us its energy, in harmony and respect with the environment, a place of self-sufficiency, self-expression and community spirit.

**THE STRUCTURE**

The Solarshelter is a structure that is designed to be flexible. To do this we thought of a light and movable structure that is supported on the ground, to be able to cover different areas of space according to the requirement of use at the time.

Basically we start from two modes of use:

Open-Shelter: For this we devised a zero-emission system, used to lift each of the petals/layers that makes up the dome, to end up forming a flower-shaped cover, which mainly works as a facility for multiple cultural events, for work or leisure activities in the Fly Ranch area, and even as support to the activities of the Burning Man festival.

The lifting system will be based on a traditional pulley system, which allows to lift each of the petals autonomously. This system will be operated by the user manually. Each of the petals has its own independent lifting system, which allows for multiple opening possibilities.

Closed-Shelter: The versatility lies in its adaptability. With the pulley system, we can control the opening angle of the petals and, in this way, have a shelter completely or semi-closed to protect against inclement weather and night temperature changes.

**THE PETAL UNIT**

Structurally the design is based on a basic unit (the petal) which is repeated around to form the Wickiup dome. Although it seems complex, we seek to develop a simple assembly and disassembly system to be able to move the structure whenever necessary.

This Petal Unit will be composed of a system of cells that will carry integrated plates of ORGANIC SOLAR CELLS, a technology that for its flexibility and adaptability can fit perfectly with the design. These cells are attached to a blind system that allows the petals to perfectly fit when opening and closing.

Each petal is covered in the inside by a thermal fabric, which allows to maintain the interior heat during the nights, reminiscent of the old Paiute habitat and their weaving techniques.

**TECHNOLOGY**

CHEMICAL BATTERY ENERGY STORAGE

Energy storage is essential to provide power to the different events that run on Fly Ranch, both for visitors and inhabitants of this special place. The Solarshelter becomes an essential element of electrical power for connecting devices, computers and artificial light.

ORGANIC SOLAR CELLS (ORGANIC PHOTOVOLTAIC)

Organic solar cells have shown efficiencies exceeding about 11 percent (although some recent experiments have pushed that number several percentage points higher in controlled situations).

The main difference between silicon solar cells and organic solar cells is the semiconductor material used.  Silicon solar cells use crystalline silicon, while organic cells use carbon-based organic compounds applied in a thin layer to the synthetic backing.  Organic cells are manufactured using an ink-based application, making it possible to build flexible solar panels.

Each Petal Unit of The Solarshelter is structured by 144 organic solar cells "Power Plastic Series 40 (16w)" built by the Konarka company, resulting in a total of 1,728 cells.

Each "Power Plastic Series 40 (16w)" cell has an area of 0.18 m2, (Dimensions 67.6 cm x 27.3 cm), for a total production area per Petal Unit of 25.9 m2 and a total per Solarshelter of 310.8 m2.

**PRODUCTION**

Cell model: Power Plastic 40 Series Konarka Power: 16w

Dimensions: 676 mm x 273 mm (customizable)

Number of cells: 1,728

Total Area: 310.8m2

Capacity Power: 27.6267Kw

Annual Capacity: 27.6267kw x 3,650 hours per year (Ave. 10 sun hours per day) x12% (capacity factor) = 12,100.4946 KWh

Total Annual Capacity= 12.1005 Mwh by Solarshelter

Total of 8 Solarshelter structures x 12.1005Mwh = 96.804Mwh Annual capacity

On average, this will produce enough energy per unit to meet the basic needs of an American home per year. With this amount of energy, it is possible to cover more than the basic needs of the visitors to Fly Ranch. Konarka’s solar technology is effective in situations of indirect light, so it adapts effectively when the Petal Unit are closed. In addition to its flexibility, this cell is available in different formats of color and transparency, it is only 5 mm thick and weights less than 1 kg per square meter.

**MATERIALS**

The structure is formed by 12 Petal Units which shape the Wickiup dome of about 22 m in diameter and a height of 6 m. Each Petal Unit has dimensions of 5 x 5.6 m and a height of 6 m, formed by 12 beams of recycled wood to which the 144 organic solar cells are anchored. Each wooden beam is fitted with 12 organic solar cells. These wooden beams have dimensions of 5 x 0.5 m, in a (type blind) folding form structure.

To join these wooden beams, a system of steel cables is used, which allows the opening and closing of each device by activating the system of pulleys, located in the main self-supporting structure, which is the main load shaft for the entire structure. This central axis has a diameter of 2.7 m and a height of 5 m and a base of 7.5 m in diameter that works as a counterweight to maintain the total stability of the structure (like an umbrella). This shaft is formed by a system of 24 metal tubular structural cranes, which work as a support for the pulleys that allow the opening of the Petal Units. These cranes have a dimension of 10 m and a height of 8 m. Each crane carries a double pulley system to facilitate the manual opening of the Petal Units, so it is necessary to make the cover as light as possible through by using light materials.

For the construction of this prototype, we propose to use recycled materials. The main structure of the pulleys is based on a tubular system (48 mm galvanized tube, scaffolding type) that can be mounted and disassembled easily at a reduced cost.

This requires the use of local materials to reduce transportation costs and their environmental impact.

Square timber beam structural LVL wooden 288$/cubic meter x 20m3 = **5760$**

SteelTek 1-1/4-in x 10-ft Galvanized Steel Structural Pipe 35$/unit x 340 units= **11,900$**

Stainless Steel Cable 25 meters 103$ x 24 units= **2472$**

508mm stringing sheave nylon pulley block 75$/unit x 120 units= 9,000$

Konarka Power Plastic Series 40 Solar Cells (16w) estimate 45$/unit x 1,728 units= **77,280$**

PowerOak PS3420 energy storage system 5100$/unit x 2 units= 10,200$

Another Supplies = **5000$**

Total Budget estimated = **121,612$** per Solarshelter

**PROTOTYPE ON SITE**

For the application on site we proposed to developed a Petal Unit prototype that can be implemented on an original or smaller scale. This means to build on site one of the petals of The Solarshelter. This represents 1/12 fraction of the total project (approximately 10,134$ budget), but it would help us to foresee and test the partial functionality of this design. A functional and operational Unit of this project, which has been successfully tested, would be the starting point for developing the full Solarshelter structure.

One Petal Unit has 144 Organic solar cells, which represents a reduced portion of the total number proposed, allowing to develop a budget adjusted to the reality and needs of this contest.

**ENVIRONMENTAL IMPACT**

We take into consideration that the environmental impact of this infrastructure has to be equal or almost zero. To do this, the entire structure is designed to be built with renewable and recycled materials, which can be found in the intervention area nearby. Everything will be assembled on the site and designed to be a clean construction and disassembly system. The entire facility will not produce waste or emissions.

The use of organic photovoltaic cells has the advantage that they are made of biodegradable materials and their transport and installation is made simple due to their characteristics, so no heavy construction machinery is needed. In addition, the manufacture of these cells is more sustainable than conventional silicon, they can even be developed by means of 3d printers.

At the moment that this installation is no longer used, it is designed in a way that its parts can be reused, mainly the components that have a lower level of biodegradation. This makes the Solarshelter design a fully sustainable alternative infrastructure for Fly Ranch, as well as providing clean energy and a space of congregation for the recreation of human culture.