**Solar Oasis**

LAGI 2019 Submission

As cities develop it is important to embrace new technologies and be environmentally responsible but it is equally important to acknowledge the past and maintain the culture and identity of a people. Large public art projects are one of the best ways to express culture and it is in this context that the Solar Oasis is presented. At the center of the design is a modern reinterpretation of the traditional Bedouin tent. Its striking form inspires the imagination and its solar fabric generates electricity that is fed back to the grid.

To populate the rest of the park solar palms were developed. Their shape has a reassuring familiarity and is quite suitable for the application. The palm design allows the solar panels to be elevated out of the space humans normally occupy in a park providing solar power without consuming valuable park real estate. As a bonus shade is provided with interesting shadows adding to the character of the park. The palm leaves are presented in two layers each of which are independently articulated as is the entire palm head. This allows full tracking of the sun for optimal solar energy production. The movement makes for a dynamic park, always different, almost giving the illusion of being alive.

The palm trunk will of course be a hollow metal tube which lends itself to another ancient technology of the region, the windcatcher. The design consists of a cutaway dome that is able to rotate at any angle. Temperature sensors at the top of the palm and at the base allow a microprocessor controller to determine if it is beneficial to direct the wind at the palm top to the base for cooling. While this in itself does not add to the energy generation it provides cooling and an improved park experience that would otherwise require significant energy to achieve.

**Power Generation**

The sail is intended to fabricated from solar fabric based on organic photovoltaics but of course there are several technologies competing in this space that may be more applicable at the time of construction. The efficiency is taken at 10% for the purpose of calculations. Being extremely conservative only 10 productive hours are considered per day.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sail** |  |  |  |
|  | Area (flattened) | 2,170 | m2 |
|  | Efficiency | 10 | % |
|  | Solar radiation level | 1000 | W/m2 |
|  | Number of hours of sun considered | 10 | hours |
|  | **Production by sail** | **2170** | **kWh/day** |
|  |  | **217** | **kW** |
|  |  | **792** | **MWh/year** |

The palms are based on flexible monocrystaline silicon panels similar to those supplied by SunPower. While this manufacturer claims 22 to 25% efficiency panel values seem to be closer to 18% when the actual panel sizes are used. Erring on the side of caution the calculations utilise 18%

|  |  |  |  |
| --- | --- | --- | --- |
| **Palm** |  |  |  |
|  | Single leaf | 0.95 | m2 |
|  | Each palm has 8 leaves | 7.57 | m2 |
|  | Efficiency | 18 | % |
|  | Solar radiation level | 1000 | W/m2 |
|  | Number of hours of sun considered | 10 | hours |
|  | Power per Palm | **14** | **kWh/day** |
|  |  | **1362** | **W** |
|  | No. of Palms | 217 |  |
|  | Area of all palms combined | 1642 | m2 |
|  | **Production from Palms / day** | **2956** | **kWh/day** |
|  |  | **296** | **kW** |
|  |  | **1079** | **MWh/year** |

The total production and total area covered by solar technology is provided below.

|  |  |  |
| --- | --- | --- |
| Total Power Production | **5126** | **kWh/day** |
|  | **513** | **kW** |
| Production for 1 year | **1871** | **MWh/year** |
| Total Area covered with solar technology | 3,812 | m2 |

**Cost of construction**

Construction cost vary with jurisdiction and is even more challenging when a design is at conceptual level. To estimate the cost of construction in UAE reference was made to Turner and Townsend International Construction Market Survey 2017. Simplified conservative cost estimates are provided below. Based on the competitions limit of USD$20 per watt the budget of Solar Oasis is over USD$10 millon. Construction estimates put the cost of the project at USD$1.6 million which is significantly lower and allows some leeway for any estimation inaccuracies. It is duly noted that the estimates are for the artistic elements alone as listed below and make no allocations for the park itself including landscaping.

|  |  |  |  |
| --- | --- | --- | --- |
| **Bridge** | Concrete Structure | $180,000 |  |
|  | Railings | $60,000 |  |
|  | Finishing | $30,000 |  |
|  | **Total for Bridge** |  | **$270,000** |
| **Sail** |  |  |  |
|  | Cloth & tensile | $300,000 |  |
|  | Poles | $100,000 |  |
|  | Installation | $250,000 |  |
|  | **Total for Sail** |  | **$650,000** |
| **Palms** |  |  |  |
|  | Per Palm - Base, electrical, infrastructure | $450 |  |
|  | Per Palm - Actual palm tree | $2,350 |  |
|  | Per Palm - Installation | $250 |  |
|  | Per Palm cost | $3,050 |  |
|  | Number of palms | 217 |  |
|  | **Total for Palms** |  | **$661,850** |
|  |  |  |  |
| **Total Installation Cost** | | | **$1,581,850** |
|  |  |  |  |
|  | Total power production | 513 | kW |
|  | **Budget @ USD$20 per Watt** |  | **$10,260,000** |

**Materials**

Solar Oasis material list is as follows:

* concrete and tarmac for the bridge and pathways
* glass for the bridge rails
* stainless steel for the bridge rails and sail supports
* solar fabric for the sail
* galvanised steel for the palm trunks
* Steel, aluminium, plastic and composites for the palm core and leaf supports
* flexible monocrystaline silicon panels covering the palm leaves

**Environmental Impact**

Solar Oasis has no negative environmental impact. The construction is consistent with the development in Masdar City. Materials used are standard and are by no means different from the surrounding construction. The palm trees are expected to be prefabricated in China and assembled on site. The extent of the site works would include the structural plinths and power cabling.

The sail is a tensile structure and once properly installed would not create any significant noise pollution. Since no wind generation is proposed no low frequency noise is expected.

In addition to the solar palms some amount of vegetation is proposed. This would have a very small positive impact generating a micro ecosystem.