**Starlit Stratus**

*Project Description*

What kind of art should be built for the rapidly changing and developing desert city? The main concept lies in the idea that the art in Masdar city needs a unique installation with the unprecedented characters and functions more than merely utilize the cutting edge technologies?

Geologically, Abu Dhabi is in the ‘Sunbelt region’ in which solar irradiation levels are very high. A solar panel in the UAE can potentially produce double the electrical energy compared to a country with relatively lower irradiation levels such as any countries in Europe. So the first aim is to use the solar energy to experience new micro climates that cannot be experienced in the desert. At the same time with providing a surreal place in the desert, we propose a piece of art like dynamic organs that accumulate energy and consume it for self-sustainability. The art responds to sunlight and can also be directed according to the activities of program, providing a pleasant shade and mist during the day and a light at night. The art designed to form a civic park which is accessible all year round day or night to provide a continuous activation of the site including events, festivals and annual activities. Due to the characteristic of creating new surreal environment in desert, this art can be called “**Starlit Stratus**.”

Even though the site is built as a park, it is not a comfortable place to take diverse activities for visitors or residents because of the large amount of solar heat gain. But, the columns spread at 15-meter intervals for flexible site design are designed to respond to the sun and create shade while folding or unfolding like an umbrella. The form of the canopy is inspired by the identity of the site, Abu Dhabi and desert, providing an iconic public brand. It spreads broadly during the day, but at night it folds and changes into lighting, as it looks like flowers are rare in desert. When it accumulates enough energy to return to use the lights at night, extra excess accumulated energy will spend to collect moisture in the air and be stored as water. The stored water is transparent in the cylinder at the eye level so that not only the day’s record of the sun energy can be watched, but also it is used for educational purposes. In addition to the cylinder showing the degree to how much water is stored around the columns, we can also integrate the street furniture on site. It can be a bench or a planter box, or can be integrated with a information kiosk or bending machine by adjusting the height as needed.

Unlike a typical folding methodology, the pattern took from one of Ron Resch’s patterns to make it feasible to act a light fixture at night. Certain triangular geometries are made of a conventional rigid PV panel (50% Hydropanel), so that it collects solar energy. The remaining geometries are made of fabric so that it easily can be fold and unfold. At night the light passes through these fabric geometries shaped like stars.

The art can be used permanently without additional operating costs because the PV panels collect energy and consumes the energy it stored during the day for light at night. A pipe with a smaller diameter was inserted into the hollow steel pipe column to adjust the height. The height can be adjusted to the program of the entire site, sometimes to be elevated as a gate for festivals, or to provide an optimal shading area, thus creating a dynamic space and having a constantly changing identity. To reduce wind load, the canopy height can be adjusted when the wind storm happens.

There is no doubt that the Starlit Stratus will enable new surreal space experiencing, just as unexpected meeting a mirage in the desert.

*Technologies in Starlit Stratus*

Solar-powered and infrastructure-free drinking water solution with PV panels.

Ambient air is drawn and water vapor in the air adsorbs onto advanced hygroscopic materials. That creates condensation. Then it is collected in a water tank. The entire process is powered by solar panels, therefore it is a totally self-sustainable technology.

Hydro PV panels works like 3D Solar Cell, so the all cells can response for the best result of the sun energy production. The assumption of the energy producing efficiency could reach to +40% instead of 20% conventional PV panels.

When it accumulates enough energy to return to use the lights at night, extra excess accumulated energy will spend to collect moisture in the air and be stored as water. The water primarily serves to provide fog on a hot day, yet secondarily to allow drinking water to be provided in the park if the technology (Currently applied in market with high initial cost) permits it to accumulate enough in the potable water. In UAE, municipal tap water is not suitable for drinking, so that providing potable water should be considered one of the most significant resources than any others.

*Nameplate Capacity in kWp*

* Surface PV Area of One Canopy: **78.5 m2** 🡪  **78,500 watt**
* x 40% Efficiency Assumed Based On LAGI Field Guide Document, 3D Solar Cell 🡪  **31,400 W(p)**
* On site, **99 Canopies** Are Distributed: 31,400 W(p) x 99 (Ea) = 3,108,600 W(p)
* After conversion to KW(p) is **3,108.6 kW(p)**
* Total KW(p) = **1,554.3 kW(p)**
\* Only 50% PV is conventional PV, another 50% PV is Hydropanel for potable water collection

$20 Estimated cost per watt = **$31,086,000**

*Annual kWh (Kilowatt-hours) of Energy Expected*

One Day kWh : **3,885 m2** (50% Conventional PV Panel Area) x **0.40** (Efficiency) x **5.84** (Peak Sun Hours) x **0.75** (Effective Output % After Deducting Losses) = **6,808 kWh/day**

Annual kWh = 6,808 kWh/day x **365** = **2,484,859 kWh/year** = **2,484 mWh/year**

\* Ladybug Outcome = 2,110,150 kWh/year

*Environmental Impact Summary*

The structure is composed of renewable materials and recycled wherever can be found in local areas with low transit impact. The structure steel and prefab concrete (can be replaced to steel foundation if possible for easy construction) is composed of recycled steel manufactured in factory and assembling on site and is designed for clean construction and de-construction. All materials, steel, prefab concrete, steel cable, PV panel (1.2m x 1.2m 127 Triangles per canopy), light, mist nozzles can be manufactured or transported from local areas. The art does not generate any physical or airborne waste products. To minimize the impact of future development on site, art's height can be adjusted accordingly.

Collecting potable water technology from air is already applied in UAE, so it can be applied with higher efficiency in 5 years. The reason for consideration harvesting potable water is that there are plenty of excess energy produced yearly through the responsive 50% Hyrdo PV panels and it reduces the necessity on site and adjacent neighbors including laboratories and residents. If the technology is not ready to apply in 5 years, excess energy can be fed to keep as electrical energy for serving local infrastructures.

Optional urban street furniture such as bench, high table, kiosk, cage of emergency water storage or vending machine can be attached with the future development. It can be harmonized with landscape planters and serve as a part of the art.

*Primary Materials*

1. Canopy (15 M x 15M Rectangular Shape):
	1. 50% Hydro PV + 50% Conventional PV: 1.2m x 1.2m x 147 (Ea)
		1. Surfaces Area: 78.5 m2
			1. 50% Conventional PV: $4250
			2. 50% Hydro PV: $18,000
	2. Membrane Fabric (146.5m2): $700
	3. Tension Cable for Origami System (x 147 Ea): $10
2. HHS Pipe (25m Height, 0.15 tons): $280
	1. Mist Nozzles (0.15mm Small standard nozzle orifice, extremely low flow with small droplet size and minimal moisture): $100
	2. LED Light (Common 65-95 Color Rendering Index Level RGB LED lights, +50 Luminous Efficacy (Lumens / Watt), 100,000+ hours Lifespan expected): $100
3. Steel or Prefab Concrete Pile Foundation System (1-2 m Diameter, 10 m deep, 0.32 tons, TBD after site survey) + Extra Civil Work TBD: $1,500
4. Additional Streetscape Features (Bench, Planter, Information Kiosk, Vending Machine, Etc): $500
5. Labor Cost for Millwork & Assembly: $5,000

\* Cost can be varied depends on local conditions

**Total Estimated Construction Cost**: **$30,500**x 99 Ea = **$3,019,500**