**RENEWABLE OASIS**

*Renewable Oasis* proposes a forest of solar and wind energy harvesting spherical canopies that provides shaded spaces for current and future Masdar inhabitants and visitors to take a breath, meet and discover the beauty of renewable energy and its impact on the planet.

Its delicate structure is inspired by Arabic geometrical patterns and supports the energy harvesting skin, which filters the sunlight. The movement of the solar leaves caused by the slightest breeze offers the visitor the experience of a choreographed shower of light and shadow that together with the landscape creates an oasis and a gathering place for Masdar’s innovative community.

PROJECT SUMMARY

*Renewable Oasis* is inspired by the leaf trembling of certain tree species such as aspen (lat. populus tremula). This movement caused by the slightest breeze, modulates sunlight penetration and optimizes the plant’s photosynthetic capacity.

The concept comprises a forest of solar and wind energy harvesting trees with an oasis underneath it, featuring native plants. The tree canopy geometry is derived from delicate Arabic geometrical patterns. The density of the structure in combination with the movement of the solar leaves creates a subtle and ever-changing shadow pattern that provides a vibrant space.

The landscape consists of tiles arranged in a geometrical pattern that follows the principle of the canopy structures. The floor build up is designed to be able to accommodate future installation of electromagnetic generators that produce electricity from the visitors’ footsteps.

The overall energy (solar + wind) harvested is stored or fed back to the power grid. A percentage of it is used to power LED lights mounted in the gaps between the floor tiles, enhancing visually the paving pattern and the visitor experience at night. The intensity of the light is gradient and corresponds to the amount of power generated at each tree structure, depending on the local exposure to climatic conditions. This creates an ambient light environment that mitigates the need for pole lights, contributing to less light pollution.

CONCEPTUAL COST ESTIMATE

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| --- | --- | --- | --- |
| Skin | Quantity | Price/Unit | Costs in $ |
| - DSSC PV modules laminated on ETFE sheets  | 6,000m2 | 300$/m2 | 1,800,000 |
| - Piezoelectric vibration sensors | 17,300pcs | 5$ | 86,500 |
| **Installed Material Cost Subtotal** | **1,886,500** |

|  |  |  |  |
| --- | --- | --- | --- |
| Structure | Quantity | Price/Unit | Costs in $  |
| - Stainless steel tension wires with ferrules  | 105,650m | 0.5$/m | 52,825 |
| - Steel plate framing | 527t | 2500$/t | 1,317,500 |
| - Steel columns (AESS 2)  | 103t | 2500$/t | 257,500  |
| - Metallic finish powder coating  | 6,720m2 | 10$/m2 | 67,200 |
| **Material & Construction Cost Subtotal** | **1,695,025** |

|  |  |  |  |
| --- | --- | --- | --- |
| Site | Quantity | Price/Unit | Costs in $ |
| - Composite tiles | 3,700m2 | 50$/m2 | 555,000 |
| - Linear LED fixtures with electrical infrastructure | 1,400m | 160$/m | 224,000 |
| - Native vegetation | 1,000m2 | 180$/m2 | 180,000 |
| - Concrete slab with foundation | 2,700m3 | 185$/m3  | 499,500 |
| - PV electrical infrastructure | 5,500m2 | 70$/m2 | 385,000 |
| **Installed Material Cost Subtotal** |  |  | **1,843,500** |

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Cost Estimate**  |  |  | **5,425,025** |

TECHNICAL DESCRIPTION

Height: varies, maximum 28.5m

Site dimensions: 62 x 118m and 32 x 107m

Sphere diameter: 15m

**Skin**

- Custom shape Dye Sensitized Solar Cell (DSSC) laminated on clear ETFE sheets

- ‘Stalk' with piezoelectric vibration sensor

- Stainless steel tension wires

**Secondary Structure**

-‘Floret tessellation’ with powder coated steel plates and welded joints. Bolted splices facilitate transportation and assembly.

- The size and depth of the frame is optimized for light penetration, so that the outlines of the shadows are blurry similarly to the tree shadows. The idea is to create a shower of light choreographed by the wind and the movement of the solar leaves.

**Primary Structure**

- Powder coated steel column

- Electrical services

- Planter

- Concrete foundation pile

**Site Paving**

- LED fixture

- Anti-slip composite tile in high Solar Reflectance Index (SRI>80) white finish

- Electromagnetic generators (currently excluded from cost estimate) allowing 5-10mm vertical displacement for future installation, once technology becomes cost competitive to standard paving. By then the paving will be working as a standard raised access flooring solution allowing services to be placed below it where needed.

- Electrical infrastructure below grade accessible by removing tiles

**Custom solar leaf**

- Each solar leaf features a piezoelectric sensor that produces electricity out of the trembling caused by the wind. The expected energy generated by that is very low, however the low cost of the piezoelectric sensor in combination with the aesthetic value of the movement of the leaves in the breeze, adds overall to the project as an art piece and sends a positive message about renewable energy.

- Total number of solar leaves/piezoelectric sensors: **17,300pcs**

- Total area of solar leaves: **6,000m2**

- Peak output of custom DSSC cell: **45W/m2**

- Peak output of piezoelectric sensor: **500μW/pc** assuming 13km/h wind speed
(can be increased due to venturi effect)

OUTPUT ESTIMATE

**Peak Solar Power**

6,000m2 x 45W/m2 **= 270kW**

**Peak Power generated by aeroelastic vibration**

17,300pcs x 500μW **= 9.5W**

**Total Peak Power Estimate: 270kW**

**Total Cost Estimate / Peak Power Estimate**

$5,425,025 / 270,000W = **20$/W (Target Value)**

**Cost per Watt: 20$/W (Target Value)**

**Annual Solar Energy Estimate**

270kW x 8,760h x 18% = **425.7kWh**

\* Example: **425.7kWh** can power **130** LED lights (10W each) for 5 hours a day, over the course of an entire year.

ENVIRONMENTAL IMPACT STATEMENT

*Renewable Oasis* aims at conveying a positive message about the use of renewable energy and its impact on the planet. Its delicate lightweight structures create a space focused on human experience, reinforcing the sense of community of current and future inhabitants of Masdar and embracing innovative modes of transportation.

The geometry, ‘lightweightness' and materiality of the structures offer reduced material waste, improved material supply logistics, more efficient assembly, and allow for easier deconstruction. The exclusion of the energy generating surface area from the heat island effect calculation in combination with high solar reflectance (SRI) finishes complies with international standards to curtail global warming.

The permeability of the structures in combination with the biophilic design, that features native plant species, provides human comfort while minimizing the need for irrigation. The ambient lighting powered by the PVs reduces the need for street pole lights, minimizing light pollution, a threat for migrating birds.