**INTERWOVEN**

**Concept**

Al Sadu is an ancient tribal weaving craft that artistically portrays Arabian nomadic peoples’ rich cultural heritage and instinctive expression of natural beauty. Woven geometric and figurative patterns and symbols reflect the traditional tribal lifestyle, the desert environment and the weavers’ creative self-expression.This design proposes to install a vibrant art structure that mimics a colourful carpet created from Al Sadu - the traditional weaving technique. The structure integrates essence from this traditional art with technologies, which generates new energy from solar power, wind power and visitor’s interaction. The energy harvested will be stored and feed back to shape the future community. It is intended to achieve full potential for people to meet, gather, play, learn, share and laugh. The design consists two levels of weaving, the upper level is the weaving of the colour, light and shadow. The ground level is the weaving of people coming together for a variety of social programs. The goal is to build a lively and dynamic community hub that attracts more people to come and live in, shaping a people city - a true sustainable city.

**Technology**

The overall shading structure is comprised of 50m wide, 200m long and 18m tall, state-of-art thin film photovoltaic canopy spreading over the given site. While providing comfortable shades and elegant dappled sunshine through its form, the structure strategically aims to capture solar and wind energy during the daytime for neighborhoods and transformed the clean energy into luminous led lights during night. In addition, the human power driven by spindle evokes engagement from local residents as well as welcomes participation from international visitors, leading the site to become a unique and innovative landmark of Masdar City and a symbol of clean energy in the future.

***Structure***

The posts of the shading structure are inspired by one of the major weaving tools used in Al Sadu - The Spindle Whorl. In our proposal, The peripheral Spindles are major structural components of the structural posts. It also provides seating or shading functions on its whorl disk. The internal ones are more playful. They could be rotated by people. The rotation of the Spindles resembles the process of spinning yarn and leads the carpet to wave, harnessing the power from the vibration of the piezoelectric cable network. The Spindles also provide a variety of interactive opportunities between the structure itself and people in order to create a more engaging experience for people to stay and explore.

***Solar Power***

The canopy is made of Copper Indium Gallium DiSelenide (CIGS). The CIGS is a flexible and lightweight thin film photovoltaic products produced by using state-of-the- art, controlled co-evaporation and the thinnest stainless steel substrate. The product comes with various colour options. The pattern is inspired by the four distinctive landscape typologies across UAE: gulf with island, oasis, desert and mountains. Each diamond module made by CIGS is 1m by 3m. These colourful PV films are strategically arranged to create a typical Al Sadu patterned canopy that absorbs solar energy and generates considerable electricity.

The area is wealthy in solar radiation. On average, the total solar radiation is nearly 2.0 kWh/m2/day. The artwork with a film photovoltaic area of 8,532 m2 and solar systems having efficiency of 20%, will be able to produce an estimated amount of clean energy equal to 6228 mWh as calculated below.

* Solar panel power output: 0.2 kW/m2 (20% efficiency panel)
* Solar panel energy production per diamond module (calculate 10 hours a day):

0.2 x 10 = 2.0 kWh / day

* The area of solar panel each diamond module: 1.5 m2
* Total solar panel area (5,688 modules): 5,688 x 1.5 = 8,532 m2
* Total energy output per day: 8,532 x 2.0 = 17,064 kWh / day
* Total energy output per year: 17,064 x 365 = 6,228 mWh / year

***Wind Power***

The CIGS is also lightweight and flexible enough so it can catch the wind flow and facilitate the movement of the air. By catching the wind and facilitating the air movement, the air flow can be magnified significantly from one end of the canopy to another. This process also helps generate more electrical energy as calculated below.

* Wind power output: 0.2 kW/m/day (per linear meter per day)
* Total linear metres of piezoelectric cable structure: 32,000 m
* Total energy output per day: 0.2 x 32,000 = 6,400 kWh / day
* Total energy output per year: 6,400 x 365 = 2,336 mWh / year

***Motion Power***

The spindles have a variety of sizes and heights, which can engage people in different ways, such as seating, spinning, shading, and staging. There are pressure transducers on these spindles. Therefore, the more people use or play with each spindle, the more dramatic the post for each spindle will rise up, recline, or vibrate. This would help facilitate the air movement underneath the canopy and generate additional energy as calculated below.

* Power output: 0.5 kW
* Power output per spindle (calculate 8 hours a day): 4 kWh / day
* Total energy output per day (48 spindles): 192 kWh / day
* Total energy output per year: 192 x 365 = 70 mWh / Year

**Total Energy output per day: 23.656 mWh / day**

**Energy output per year: 8,634 mWh / year**

The total cost (supply and install) estimated for this proposal is summarized below:

* Concrete Foundation: 256 cu.m.
* Structural Steel: 96.8 tonne
* PV Film: 8,532 sq.m.
* Sheet Metal: 4,000 sq.m.
* Electrical Conduit: 5,000 li.m.
* Pressure Transducer: 480 NO.

Based on the above estimated material quantity, the estimated total construction cost (supply and installation) is around 5.5 million USD, less than $20 per watt.

**Application**

The art structure creates a lively open space for all kinds of applications night and day. On a day to day basis, it provides opportunities for people living nearby to refresh themselves and have a conversation in the cool air. When a special event is coming up, the place can be decorated to attract social media and the public.

With all the electricity generated from the solar energy and wind power during the day time, this system can support the power needed for all kinds of nightlife events such as traditional dance performance, weddings, worships, fashion shows, dinner parties, awards ceremonies and exhibitions etc.

**Conclusion**

Sustainability is the process of maintaining change in a balanced environment, in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. we believe that humans should be part of the big picture as well and more attention should be given to the local residents, who are the primary users of this space. A sustainable city should never deviate from human needs and aspirations.

We believe to solve the basic needs of the residents and create a multi-use open space is the goal for this project. With the proposed shading structure, this place will become one of the centre of Masdar City, to link the community together and celebrate Abu Dhabi's rich cultural and history.

**Environmental Impact Summary**

The project seeks to have the minimal environmental impact. Aligning with master plan and government goals on all levels, ‘Interwoven’ supports Masdar’s sustainable development and the goals for decarbonization and contributes to the renewable energy. The project generates 6,228 mWh of energy annually to contribute to the grid and 2,336 mWh of wind energy annually and additional 70 mWh of human energy annually. The overall energy production associated with the installation is produced through renewable source including solar power, wind power and human power, which greatly minimizes the carbon footprint of a traditional energy production through fossil fuel consumption.

The overall structure is thin film photovoltaic canopy spreading over the given site along with the Spindle Whorl. The Spindle Whorl shaped posts are made of stainless steel with different modular components. It also provides different kinds of activities on its whorl disk. The rotation of the Spindles resembles the process of spinning yarn and leads the carpet to wave, harnessing the power from the vibration of the piezoelectric cable network. Through different scales of Spindle Whorl, the structure hosts various public activities as well as raises awareness of the environmental issues.

The structure features excellent solar access and substantial local wind source specific to the site. Spreading over the site, the canopy is intended to maximize the exposure to the sun and wind energy. With the spindle and people’s involvement, the installation helps stabilize the soil and regulate the salinity of the coastal environment, as well as bringing potential for spontaneous vegetation along the existing surrounding parks. In addition, the unique arrangements of spindles not only enables the long and extending floating carpet spans but also inherents site’s linear feature, allowing for maximum space for public activities and minimum impacts to the ground.