**Pearl Drops**

We, the humankind is blessed with an amazing world that reveals to us beauty defined with perfection. It is present in the soupcons of things that Mother Nature provides us with. Its flawless charm inspires our heart and the alluring beauty touches our soul. Probably Einstein had got it figured when he said, “Look deep into the nature and you will understand everything better”.

This work of art is inspired by one such delight in nature. Drops of bliss that greet us every morning...dew drops. The ‘Drops of Pearl’ as Shakespeare calls it, is indeed a manifestation of our marvellous Nature.

This design proposal, ‘Pearl Drops’ is inspired by the morning dew, showcasing art installations designed with flower-shaped structures featuring small droplets of dew. This flower-shaped structure is added with functionality when it acts as canopies for the seating area beneath to be enjoyed by the public. This design is further enhanced with large globular structures that are styled with a crescent shaped add-on, taking inspiration from the beauty and calmness of the moon that is a prominent part of the Islamic Culture. Both the dew drops and the globular structures act as separately sized, sun-tracking, solar energy-generating spheres, which is the crux of this project.

**Technology:**

The technology proposed in this project, employs ‘The Spherical Sun Power Generator’, which is a solar energy capture device that was designed by German Architect [Andre Broessel](https://rawlemon.com/). The spherical solar generators concentrate the diffused sunlight to a hybrid collector (Photo voltaic and thermal solar cells). The system is equipped with a duel axis tracking system that tracks the passage of the sun throughout the day, thus maximizing energy capture compared to fixed panel systems. The geometry and the optical properties of the spheres act like magnifying glasses to generate power, thereby reducing the silicon cell area to 25% with an the equivalent power output compared to conventional PV panels. It can reach an efficiency level of 57%in hybrid mode. The spherical lens can also function during the night, utilising the light from the moon to generate power. At night time, the spherical lens transforms into a high-power lamp to illuminate the site, by using a few LEDs.

**Power Generation:**

Manufacturer Technical Data:

Electrical Generation nameplate capacity – 180W/m2

Heat generation nameplate capacity- 450W/m2

Capacity factor – 0.25

The area receiving light is considered as a circle with the same diameter as the sphere. The project has 11 flowers with 10 petals each. Each petal has 3 dew drops (solar concentrators) with diameters 1m, 1.2m and 1.85m respectively. The 5 large spheres are of diameter 20m each.

P = Name plate capacity x time x capacity factor

Assuming the solar spheres function for an average of 18 hours per day,

Time = 18 hrs/day x 365 = 6570 hrs/year

Electrical Power Generated:

Pe1 = (180 x 3.14 x 0.5 x 0.5 x 6570 x 0.25 x 110) = 25529377 Wh/year = **25.53 MWh/year**

Pe2 = (180 x 3.14 x 0.6 x 0.6 x 6570 x 0.25 x 110) = 36749295 Wh/year = **36.75 MWh/year**

Pe3 = (180 x 3.14 x 0.925 x 0.925 x 6570 x 0.25 x 110) = 87374294 Wh/year = **87.37 MWh/year**

Pe4 = (180 x 3.14 x 10 x 10 x 6570 x 0.25 x 5) = 464170500 Wh/year = **464.17 MWh/year**

**Total Electrical Power generated = Pe1 + Pe2 + Pe3 + Pe4 = 613 MWh/year**

Thermal Power Generated:

Pt1 = (450 x 3.14 x 0.5 x 0.5 x 6570 x 0.25 x 110) = 63823443.75 Wh/year = **63.82 MWh/year**

Pt2 = (450 x 3.14 x 0.6 x 0.6 x 6570 x 0.25 x 110) = 91905759 Wh/year = **91.90 MWh/year**

Pt3 = (450 x 3.14 x 0.925 x 0.925 x 6570 x 0.25 x 110) = 218432736.2 Wh/year = **218.43 MWh/year**

Pt4 = (450 x 3.14 x 10 x 10 x 6570 x 0.25 x 5) = 1160426250 Wh/year = **1160.42 MWh/year**

**Total Thermal Power generated = Pt1 + Pt2 + Pt3 + Pt4 = 1534.57 MWh/year**

**Total Power generated from the art installation = 613 MWh/year + 1534.57 MWh/year**

 **= 2147.57 MWh/year**

**Name plate capacity** = **1.3 MW**

**Cost Calculation:**

Spherical solar concentrators:

Cost of sphere with 1 m diameter = $ 6000

Cost for S1 = $6000 x 1 x 110 = $660000

Cost for S2 = $6000 x 1.2 x 110 = $792000

Cost for S3 = $6000 x 1.85 x 110 = $1221000

Cost for S4 = $6000 x 20 x 5= $600000

Flower petals:

Each petal area = 30 Sqm

Material – Fibre Reinforced Polymer (FRP)

Qty = 3300Sqm @ $300/Sqm

**Cost = $990000**

Flower Piping:

Length for each petal = 25 Rmt

Material – Metal

Qty = 2750 Rmt @ $600/Rmt

**Cost = $1650000**

Support system for the larger spheres:

Diameter of larger ring supporting each sphere = 25m

Diameter of smaller ring support from the ground = 15 m each

Material – Metal

Qty = 900 Rmt @ $600/Rmt

**Cost = $540000**

Length of crescent frame = 82 Rmt

Material – Metal

Qty = 410 Rmt @ $500/Rmt

**Cost = $213200**

Area of geometric pattern screen = 122 Sqm

Material – Metal

Qty = 610 Rmt @ $150/Rmt

**Cost = $91500**

**Total cost = $11181500**

**Cost/Watt = $18/W**

**Environmental Impact Summary:**

The everyday demand for electricity is continuing to grow at a fast pace due to a rise in population, an expanding economy and climatic change. At the same time the concept of sustainability and renewable energy technologies is also gaining a lot of significance. The proposal of Pearl Drops is yet another attempt to showcase that power generation from renewable sources can be functional and aesthetically pleasing as well. The proposal uses energy from the sun, which is the most abundant energy source on earth. The Solar spheres used in the proposal are filled with water which is a renewable source. The LEDs used to light up the spheres at night requires very less energy which can be generated on site. The technology is integrated with a hybrid collector which can harvest thermal and solar energy simultaneously. The geometry and the optical properties of the spheres act like magnifying glasses to generate power, thus reducing the silicon cell area to 25%. The small size of the solar panel collectors reduces the amount of space needed for deployment and also the cost. Conventional moveable solar panel systems require a lot of moving mechanical parts to both support the panels and move them throughout the day. They are susceptible to high winds which can often damage PV installations. The technology used in this design only need to move a very small PV panel around the outside of the transparent sphere. This is not only efficient but also significantly reduces maintenance costs as well. Integrating this efficient technology with the design, this proposal is a cost effective attempt to contribute to the clean energy future of Masdar City.