



Hour Glass

timeless beauty for timeless COPENHAGEN

DESIGN GESTURE AND SKIN BEHAVIOR



Collaborative Technology

VAWT
INTEGRATED
darreius type enhanced
by fish scoop effect

total 2285820 kWh
enough to run 650 homes

PV CELL
TECHNOLOGY
rawlemon integrated

total 373275 kWh
enough to run 110 homes

SOLAR
DESALINATION
fresnel lens combined with 8m dia furnace
system

total 517776 gallons of Hot Water per day
enough to run 4000 homes per day

RAIN WATER
HARVESTING
man made tank system
on the site

total 20100 sqm
surface area tank
20m deep tank can store
340 Tons of excess water

ART + TECHNOLOGY:
But our sculptural design is just not a passive form sitting idly in the urban-scape. It's fundamentally an active device which harnesses clean energy for a cleaner ecosystem. It is worth mentioning that problems and conditions in nature and on site is developed from collaborative effects of multiple causes, so the solution to such deep diverse problems should also come from collaborative approach and henceforth in this project we have enabled multiple green energy technology, which collaborates together to significantly enhances each other's impact in terms of optimized efficiency in energy generation. After studying the local weather conditions the strengths of our site in terms of clean energy generation was established as a proper source of wind (average wind speed 6m/s), adequate sunshine hours annually (10 hours' average) and more than plenty source of rain water.

VAWT, Fish Scoop Effect Tech:
In terms of constitution each hour glass houses a Vertical axis Wind turbine(VAWT, Darrieus type).These vawt turbines can generate electricity from the wind energy from site, which is on average 6m/s , high enough to generate 2285820 kWh from 8 turbines annually, enough to run 650 homes. Based on research vawt has significant advantages from horizontal axis turbines, like they are more compact, cheaper and easy to install. Also they have less cut in speed to get started. They are less efficient than horizontal axis wind turbines, but our design and technology is based on the latest research by a team of CALTECH scientist. Based on their research findings vawt when placed in a group perform with much higher power output, thanks to the fish scoop effect. Fish scoop effect is exhibited by swarm of fishes in lake, which says the vortices formed by one fish's movement assists in the velocity and streaming of neighboring fish. In similar process, vawt when rotates in a different direction to its neighboring vawt, performance is enhanced and enriched significantly adding to power full gains. A recent study by The Caltech Field Laboratory for Optimized Wind Energy (FLOWE) found that because VAWTs can be placed closer together, they're capable of generating ten times as much energy per square meter than HAWTs. The study also found that having each VAWT spin in the opposite direction of its neighbor allowed them to spin faster because the opposing spins reduced the drag on each turbine, which upped their efficiency even more. By observing the movement of schools of fish, it was established that if the shape of small vertical-axis wind turbine blades resembles fish fins, when placed close to each other, they will complement each other and harness wind energy much more efficiently. Similar to the movement of school of fish, instead of reducing the power coefficient, these wind turbines actually feed off each other, resulting in higher efficiency.
Power Generation Formula Used:
Power in the wind = 1/2 * ρ * A * W³
ρ = Density of air = 1.2 Kg/m³
A = Area of turbine = 450 m²
W = Wind speed in m/s

SOLAR DESALINATION, solar furnace:
Adding to the above in each of the hour glass there's a modified solar furnace installed on the bottom part of the form. The sinuous curvy form of refined hour glass design is extremely conducive to such arrangement of two parts and installing two separate technology into them. Unlike conventional solar furnace systems, we use a recycled plastic (much lower embodied energy) Fresnel lens 7m in diameter at 30m height from ground to boil water in the base. The Fresnel lens reduces the amount of material required compared to a conventional lens by dividing the lens into a set of concentric annular sections. There's a compact hot water tank, where the sun rays when concentrated at a point via the Fresnel lens, can reach temperature at the scale of 700c within minutes. The hot water volume tank is 7m in diameter and 10m deep. We use Fresnel lens instead of a conventional magnifying lens as it's much cheaper and can track sun location more precisely. The hot water when reached a certain temperature is extracted out via pipes into bigger hot water reservoir from where it can be supplied to homes for use. Since the water is highly boiled by Fresnel lens, its already desalinated and all residual bacteria's are killed, and henceforth the water so obtained is readily usable for home use. This is a very potential reuse of excess rain and grey water on site. We calculated and found on a sunny day with average sunshine hours of 8 hrs, we can get enough hot water from 8 hour glasses to feed 4000 homes per day. Moreover, the continuous steam generated from the solar furnace is transferred vertically to the vawt windmill on top, which aids significantly in adding to the base wind speed of 6m/s. This is a strong add-on to enhance the efficiency of the regular vawt system.

PANASONIC DEVELOPED THERMOELECTRIC METAL ROD:
Panasonic's new thermoelectric material can suck 2.5 watts of electricity out of hot water running through a 10 centimeter section of pipe. It can generate 1.3 W of electricity by running hot water of 90 °C inside, and cold water of 10 °C outside the tube. The power density corresponds to as high as 10 kW with only 1 cubic meter of volume. The tube can produce electricity from hot water by creating temperature differences between the different thermoelectric materials with low and high thermal conductivity. By generating electricity from the temperature difference between the inner and outer parts of the tube, it achieves capacity of more than 400W/m³.

PV CELL TECHNOLOGY integrated with Rawlemon Sphere's:
From research, it looks like Copenhagen has great potential of PV Cell technology. But since our sculptural art form is resonating with each other's form in the group, especially the orientation of the top of the hour glass is angled at different degrees for each system, they do not allow enough leverage to harness efficient solar radiation. We researched further and the technology we adopt to access substantial PV Cell energy is by adding a Rawlemon sphere, 6m in diameter on top. This is a glass sphere with sun tracker devised by German Architect Andre Broessel, which allows sun energy from any orientation to be concentrated over the PV Cell Array placed right below. Since this comes with a solar tracker, orientation is not a problem anymore to harness solar energy. It aids to increase the solar pv cell by over 70% while conventional PV only works at efficiency level of 25% max. Our calculation suggests PV Cell array area over one glass is 64 sqm. Total energy stored is 373275 kWh, enough to run 106 homes annually.
Formula to calculate PV energy:
 $E = A * r * H * PR$
E = Energy (kWh)
A = Total solar panel Area (m²)
r = solar panel yield (%)
H = Annual average solar radiation on tilted panels (shadings not included)
PR = Performance ratio, coefficient for losses (range between 0.5 and 0.9, default value = 0.75)