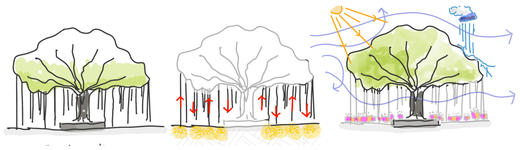
SUSTAINABILITY AND ENVIRONMENTAL DESIGN



CONCEPT

The concept for the module is inspired from ‘a village tree’. This community tree offers the people a perfect weather protected canopy and at the same time, exchanges resources with the ground to become a self-supporting ecosystem.

The module is made of key components: a base support structure and a changing outer skin on top. The skin or the bubble on the top expands or contracts as a direction function of what it needs to do, how much energy it needs to capture, how much water it needs to filtrate, how much shade it needs to provide to the people below, etc.

CLIMATE

AVERAGE MONTHLY TEMPERATURE

AVERAGE MONTHLY SOLAR IRRADIANCE

Gerlach is one of the coolest places in Nevada. It experiences cool comfortable temperatures for 4 months of the year, from June to September, with average high between 70 - 85°F. December has coldest night time temperatures with an average of 17.8°F. This is colder than most places in Nevada.

In Gerlach, there are only 13.2 days annually when the high temperature is over 90°F while there are 193.3 days when the night time low temperature falls below freezing. An annual snowfall of 79.4 inches means that it is one of the snowiest places in Nevada.
There are 275 sunny days and only 72 overcast days in the year. Therefore solar radiation is very high and it is an ideal location for harnessing solar energy (through solar PV or solar thermal).

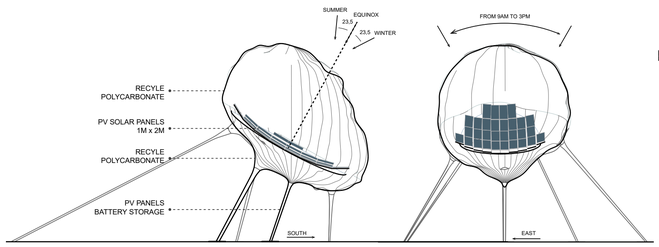
SOLAR ENERGY HARVESTER
The module is oriented towards South and perpendicular to the Equinox’s solar position, placing it inclined to the ground plane. The solar position shifts 23.5° either way for summer (towards zenith) and winter (toward horizon). This position ensures maximum annual solar gains to the outer shell.

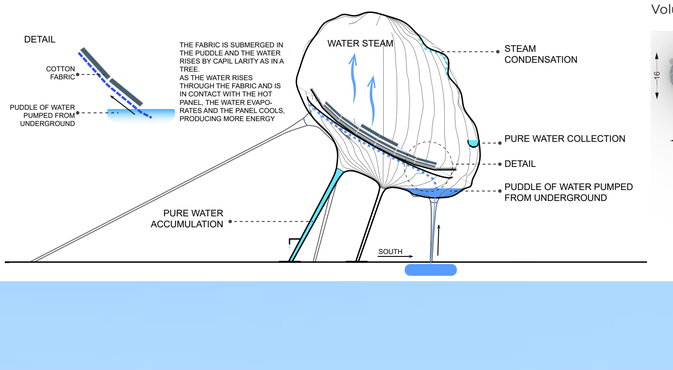
90% of the incident solar radiation passes through the shell (made of recycle polycarbonate) to reach the inclined photovoltaic surfaces, almost perpendicular to the direction of solar rays. This ensures maximum energy production from the solar panels.
Elevated temperatures within the skin could cause solar PV panels to overheat. But a carefully designed evaporative cooling system that double up to provide water filtration, ensures maximum efficiency throughout the year.

WATER CIRCUIT
To avoid overheating of solar PV, an underlying fabric is introduced that remains wet as it draws water from a small water puddle within the shell. The heated internal air in the module results in evaporation (from underneath the solar panels), thereby both cooling the panels and resulting in water droplets collecting on the module’s top inner skin. These droplets find their way to collection gutters and become source of pure drinkable water. It is a similar process followed by small boats at sea to create fresh potable water from sea water.
The legs of the module work as capillary tubes to draw underground or surface water as it maintains the puddle in the module, sometimes with our without assistance from a pump.
The extracted water is considered potable as it has been heated and pasteurized (when it exceeds 66°C). This distilled water is used for drinking and could also be diverted to summer evaporative cooling installations (like micro-sprinklers, etc.).

An estimate on drinking water production
0.8 gal / m2.day

The distilled water would require mixing with fresh water to achieve the required levels of saline content. Depending on the level of salts in the original water, it is currently estimated that this mix could be 50% distilled water and 50% of the fresh puddle water.





ENERGY CYCLE

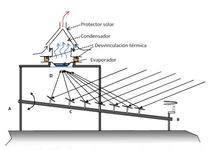
ENERGY DEMAND
The module is designed to be a generator than a consumer of energy. But as functions would be introduced underneath the module, a rough estimate for energy consumption has been created. Energy may be required for water circulation pumps, lights, sound systems, local climate control devices (fans, heating and cooling units). The following table indicates typical daily power consumption:

EQUIPMENT	POWER (KW)	TIME (H)	WINTER CONSUMPTION (KWH/DAY)	SUMMER CONSUMPTION (KWH/DAY)
WATER EXTRACTION PUMP	5	4	20	20
4 WATER MICROSPERSORS PUMPS	2	4	----	32
LIGHTS	5	4	20	20
FANS	6	4	----	24
ELECTRIC HEATERS	20	4	80	---
OTHERS: CEL PHONE CHARGERS, SOUND EQUIPMENT, ETC.	10	4	40	40
TOTAL			160	136

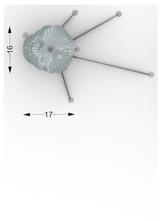
ENERGY PRODUCTION
The daily monthly average solar radiation is 5.85 kWh / m2.
Efficiency of the photovoltaic panel: 15%
Photovoltaic Energy production: 0.877 kWh / m2

BALLON	SOLAR COLLECTOR SURFACE (M2)	MAXIMUM ENERGY SUPPLY (KWH/DAY)	MAXIMUM DRINKING WATER PRODUCTION (GAL/DAY)
SIZE 1	300	210	240
SIZE2	676	480	540
SIZE3	1521	1070	1200

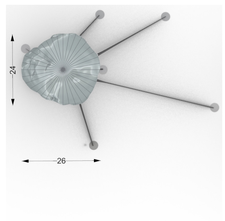
REFERENCES SIMILAR SYSTEMS



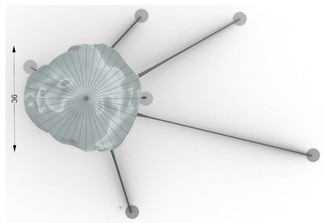
Size 1
Volume 2,245 m³



Size 2
Volume 7,578 m³

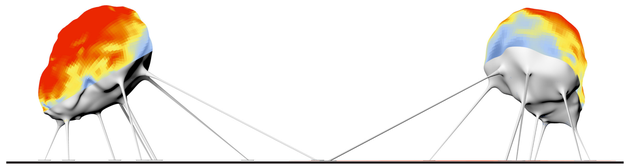


Size 3
Volume 25,576 m³

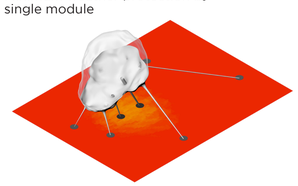


ENVIRONMENTAL ANALYSIS

Higher solar exposure towards south lowered Minimum exposure toward north. Increased structure provides protection to people below Height.



Minimum weather protection by single module



A cluster offers significant weather protection and creates micro climate.