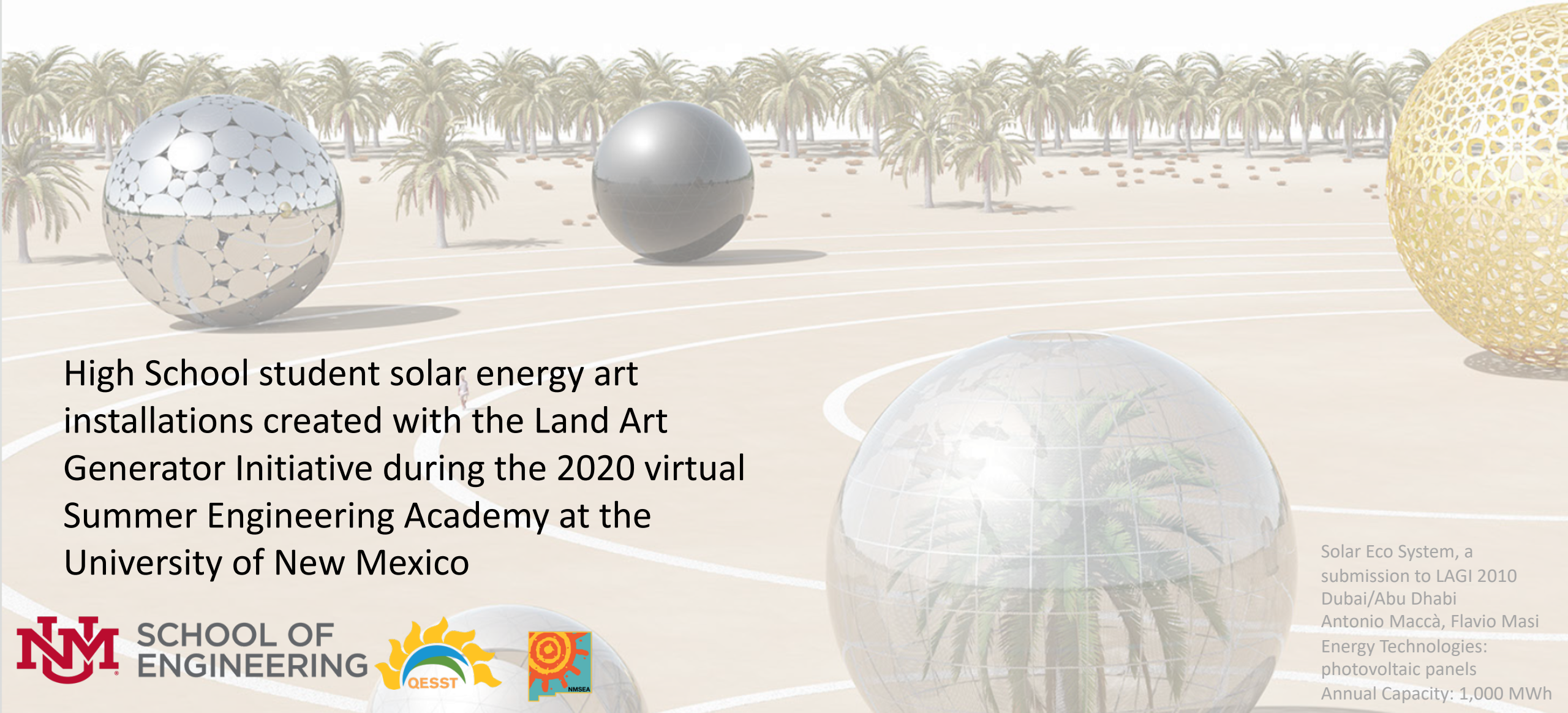
Designing Their Energy Future



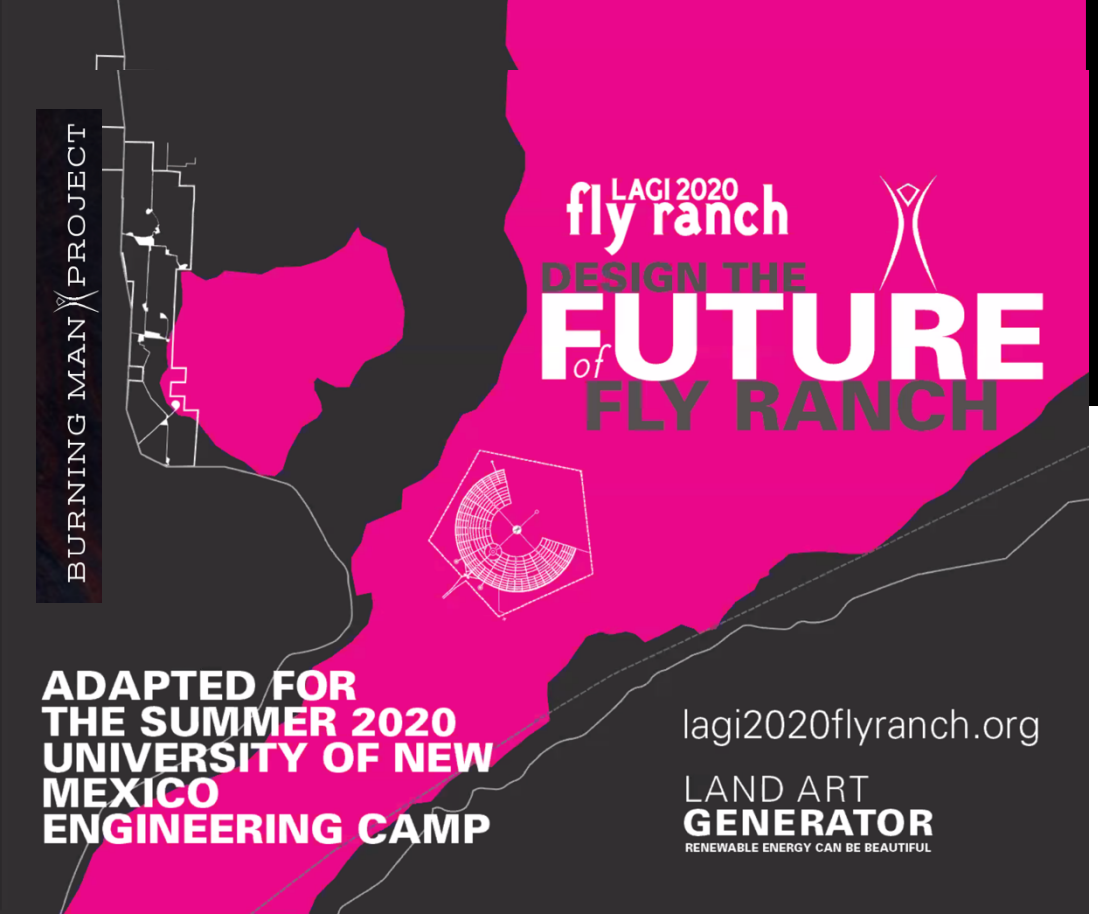
High School student solar energy art installations created with the Land Art Generator Initiative during the 2020 virtual Summer Engineering Academy at the University of New Mexico

SCHOOL OF ENGINEERING

QESST

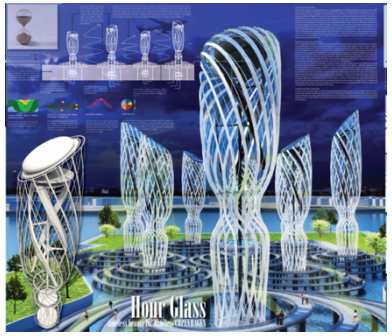
NMSEA

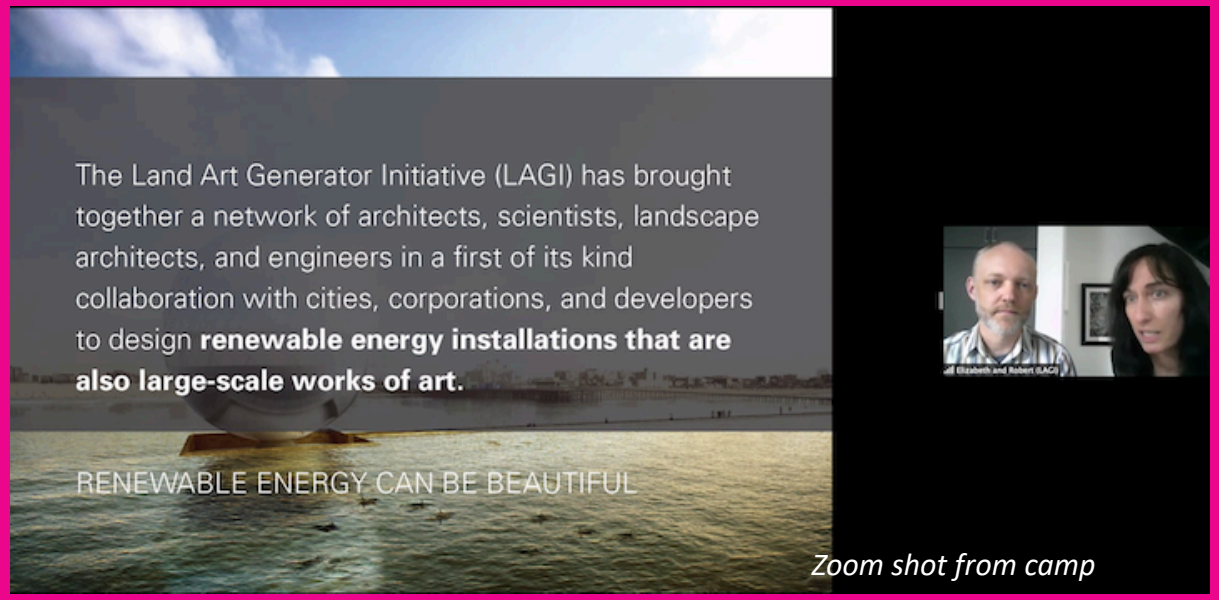
Solar Eco System, a submission to LAGI 2010 Dubai/Abu Dhabi
Antonio Maccà, Flavio Masi
Energy Technologies: photovoltaic panels
Annual Capacity: 1,000 MWh



Elizabeth Monoian and Robert Ferry, cofounders of the Land Art Generator Initiative, have hosted renewable energy art competitions all over the world. In Summer 2020 they worked with 10 high school teams in the Virtual Engineering Summer Academy at the University of New Mexico, inviting them to submit their designs to their current contest at Fly Ranch, owned by the Burning Man Project in Nevada.

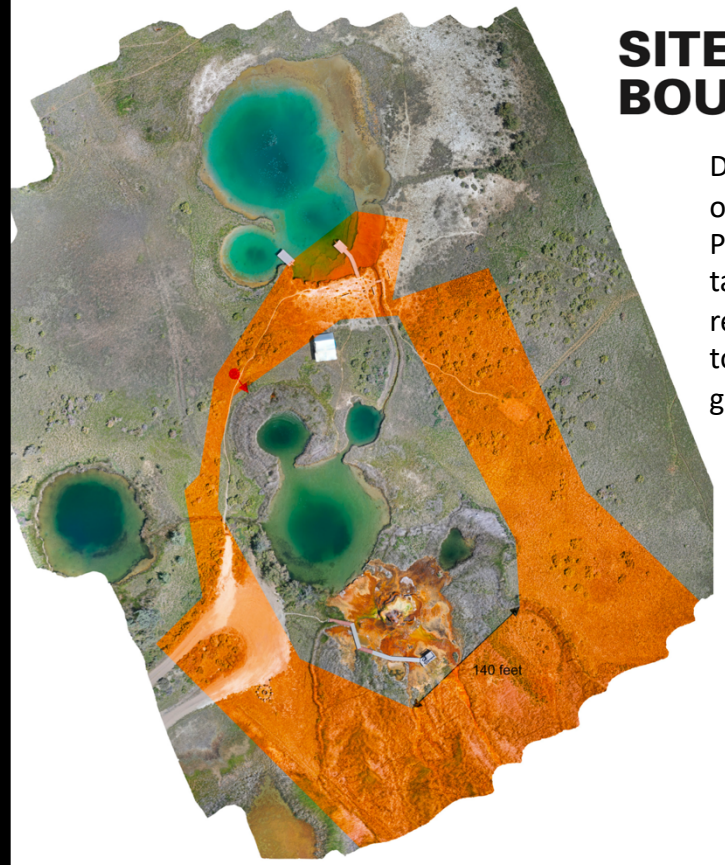
Entries to Copenhagen competition 2014





Zoom shot from camp

teams of 4 students • 3 weeks • 3 design workshops with LAGI



SITE BOUNDARY

Design goes in orange area; Photograph is taken standing at red circle facing towards the geyser.

Students were given this design brief, which describes the deliverables and scope of the project as well as flora and fauna, cultural history and solar and wind resources of Fly Ranch.

DESIGN BRIEF

1

Your artwork must be designed as a three dimensional form that includes solar, wind, or kinetic harvesting technology. In your written description tell us what technology you've integrated and why.

2

How will your artwork fit onto the existing design site? How will people interact with it? Make sure that you show how big your artwork is (is it at the right scale?). In your sketches, write down some of the dimensions in feet or meters.

3

Develop a message that you want to communicate to the people who will come to see your artwork (this is sometimes called the "concept"). Your message or concept can be absolutely anything you can imagine. Tell us about it in your written description.

4

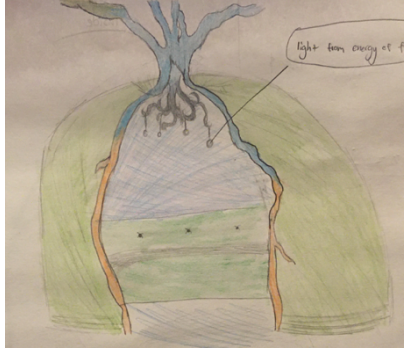
How will your artwork relate to the natural world? Think about where the materials came from that you would use to build your full-scale artwork. Does your artwork disturb habitat of any animals, birds, or insects? Or does it provide new homes for wild creatures? Put some of these thoughts down in your written description.

the designs

The Power Plant

Amber's Group:

a Juarez, Heidi Macfarlane, Kaliska Deschiney, and Jake Simmons



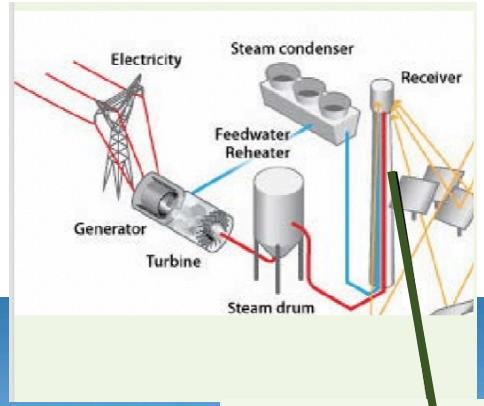
The inside of our barrel cactus is **inspired by the interactive artwork at MeowWolf** in Santa Fe, NM.

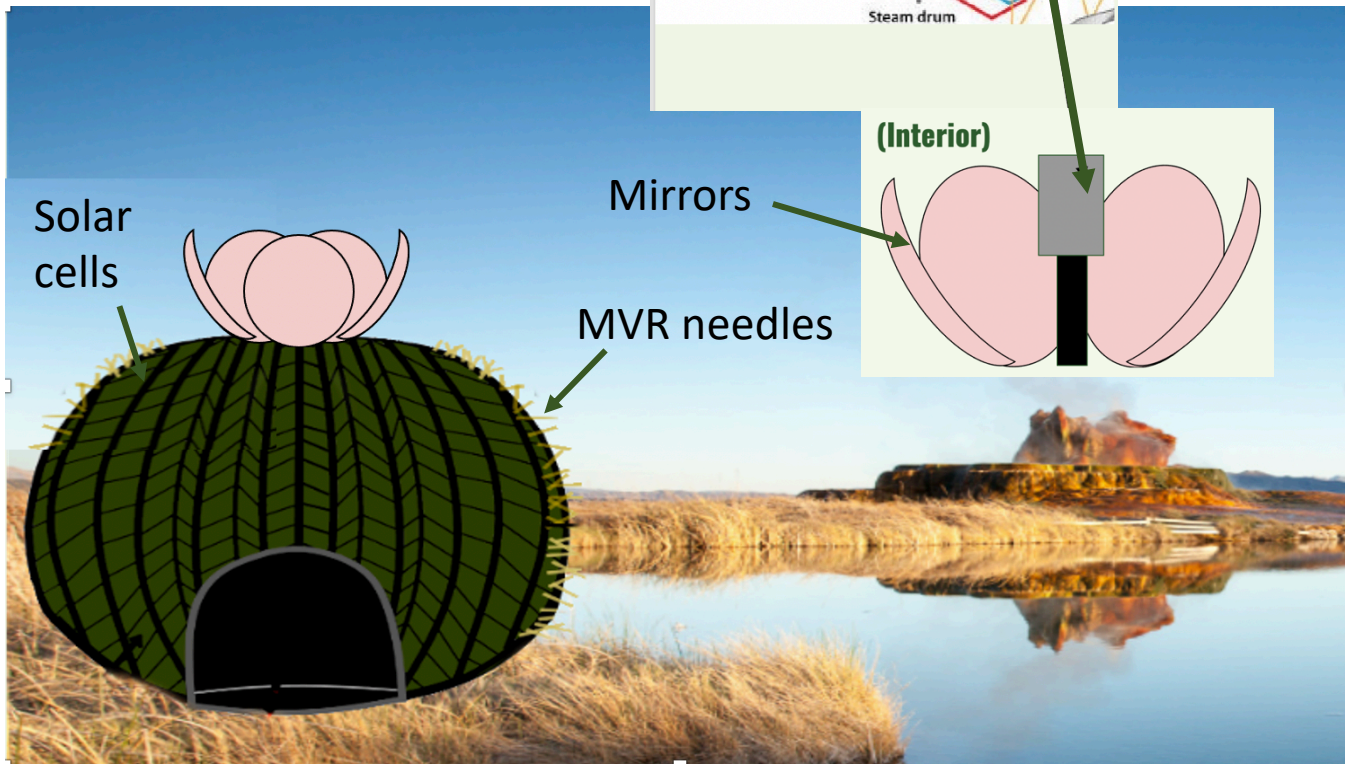
Inspired by the resilient barrel cactus found on the gravelly slopes of Nevada, our artistic, yet functional, walk-in cactus (20' w x 15'h) allows you to feel small in a world full of big problems.

Power

- **Cactus skin** is made from 1,200 ft^2 green-tinted mono-crystalline PV **solar panels**
- **Energy harvesting** is from 5-in-long polystyrene **needle mechanical vibration rectifiers** (MVR) (top for wind, bottom are softer for horses to rub against, collecting movement and static electricity)
- **Flowers** consists of 5+ **parabolic mirrors** focused on a center receiver that converts thermal solar energy to electrical energy via a small **steam turbine generator**.

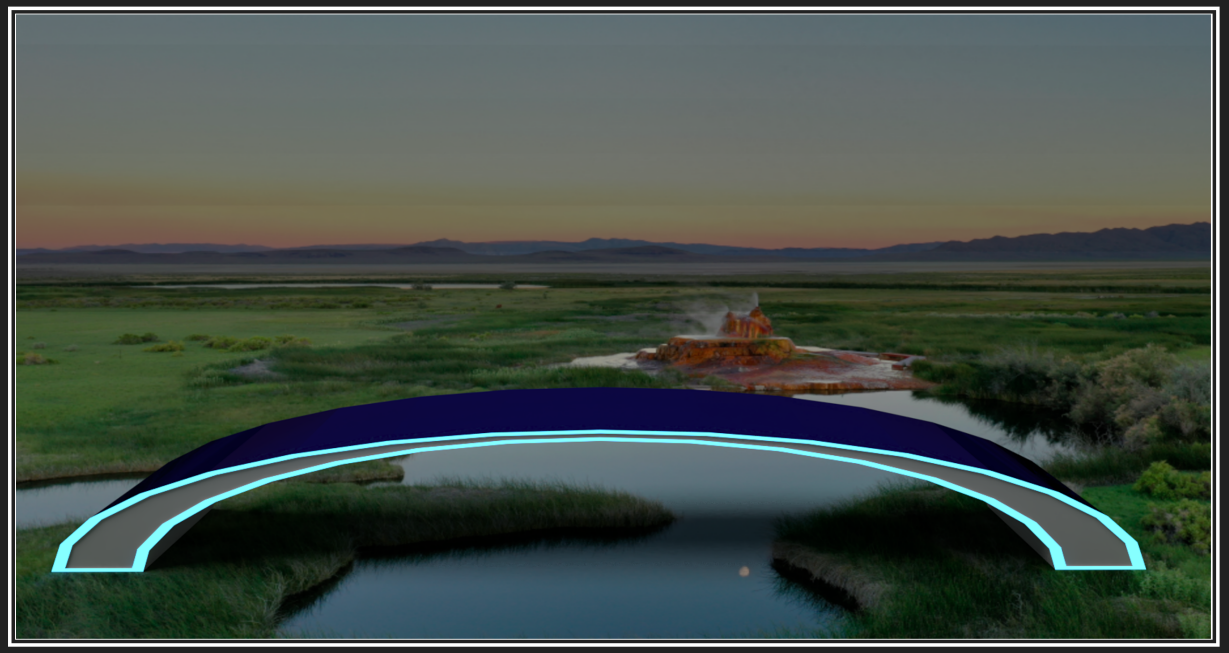
PV alone powers 8 houses





Gateway to the Future

Landon Flemming, Isaac Yang,
Isaac Rankin, Daniel Feng



- Solar Panels on the top of the arch
- Dimensions: 20’ w X 40’ h X 140’ l
- Based on St. Louis Arch

Powers 10 houses

- The arch symbolizes the fragility of nature, and how if you were to take away any part of nature, or the arch in this case, it will end up collapsing
- We want to become closer to a cleaner future
- We want to contribute to the trend of clean energy use
- We want to save the Earth

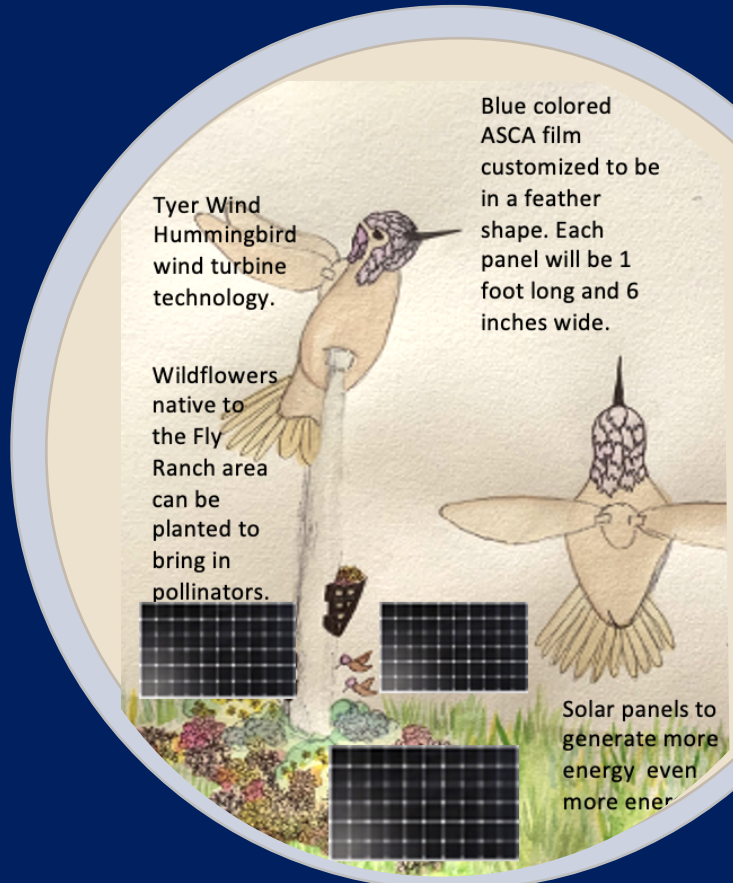
Land Art Design

Jaden Malone, Courtney Chavez,Jessica Tran, And Juaquin Sanchez

hummingbirds

Our installation is based on the natural beauty of the Rufous and Costa's hummingbirds that call Nevada home. These birds' wings will harvest wind energy and, the vibrant head feathers will be made of flexible jewel-colored thin film organic solar cells that will generate electricity.

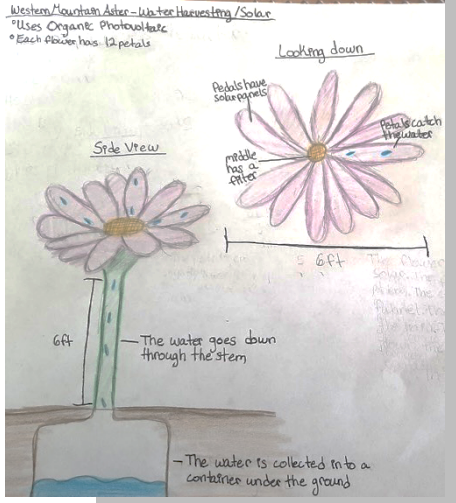
Other pollinators in the area will be able to interact with the installation, since flowers native to the area will be planted around the ground of the installation and along the6-12 feet high poles, which hold the hummingbirds up.



Solar from 4 Birds generates 2,477 kwhr/year

Energy Forest

By: Jarret Lee, Pauline Nelson, Micaela Romero, Emelia Howe
Mentor: Orlando Garayburu



Western Mountain Asters have organic photovoltaic solar petals. Centers capture water.

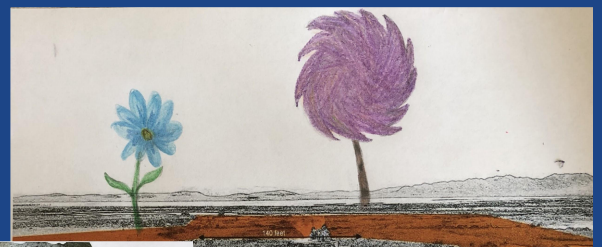
flowers

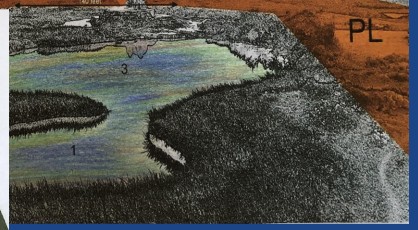
We used Dr. Seuss' "The Lorax" as inspiration because of the memorable look and message (it's not too late to save our world.) 10 flexible, tinted photo-voltaic thin-film amorphous silicon, 25' tall trees.

trees

Field Map:

Using the Fly Ranch map, we decided to place the flowers and trees to make the tourists feel as though they were in an enchanted forest. Given that the trees will be a little abstract, it provides the destination with a whimsical effect.





10 flowers and 5 trees power 10 houses

waterfall

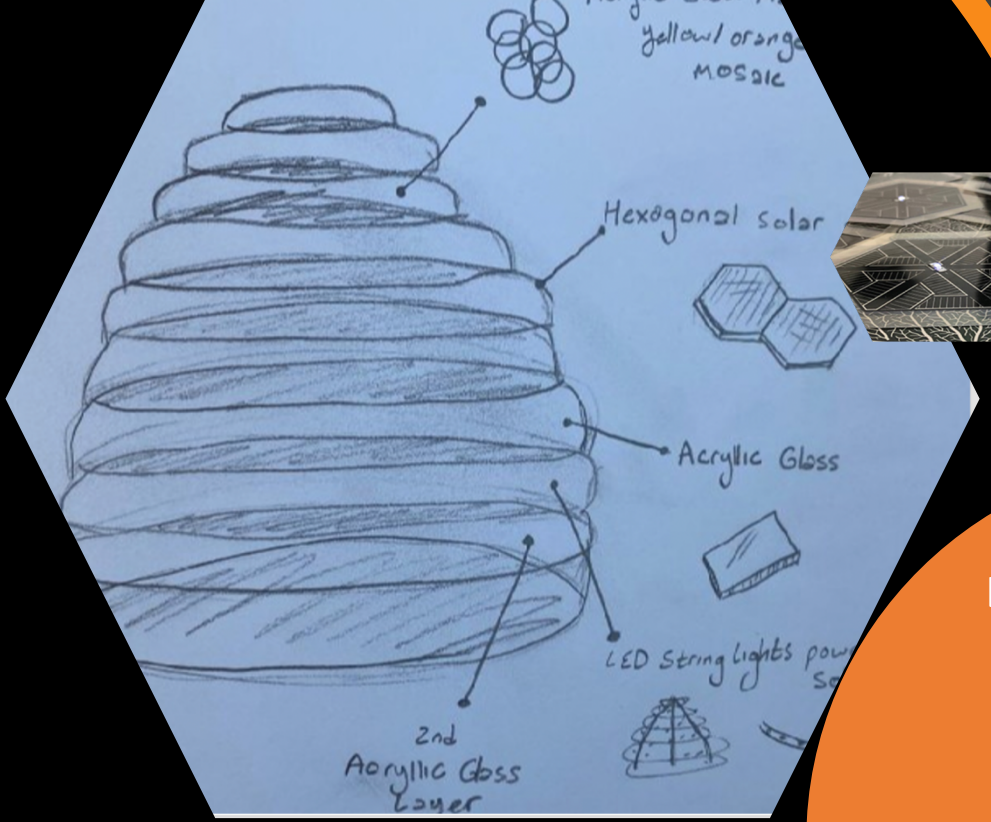
Translucent photovoltaic panels circulate water in 30' tall waterfall. An addition thermal system traps waste heat to heat water for the community and cool the PV panels.

lizard

Powers 10 Houses

Design

Based on Nevada's Common Side-blotched Lizard ● Skin & Spots are thermophoto-voltaic solar cells ● Museum inside lizard ● The 50' long, 10 ' wide lizard is called *El Agil Quemado*, or "Burnt Agile One." ● 90' tall Wood's Rose wind turbine flowers. Salts Marsh Birds Beak flowers have photovoltaic petals & will light up the lizard.

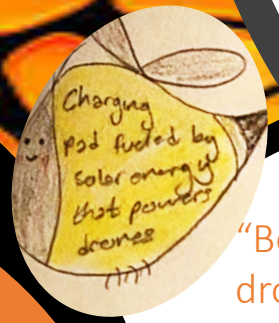


10 Hives, 3 meters in diameter, 5 meters tall

Lilly Gallagher, Matias Vigil, Lorena Madrid Larranaga, Anthony Altamirano

Mentor: Michael Tanguay

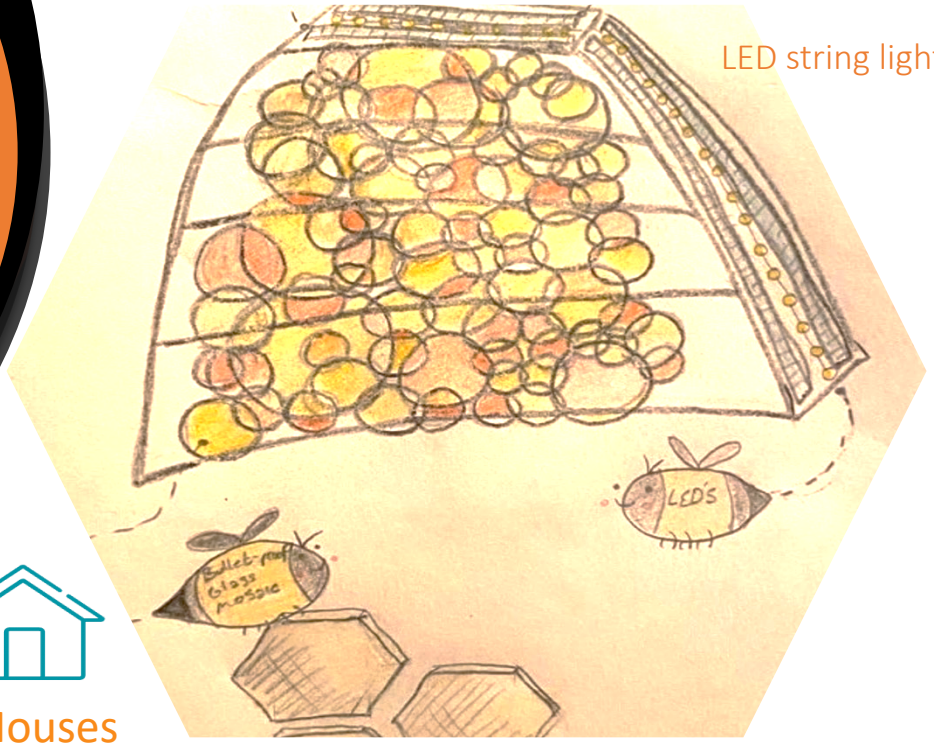
The Hives



"Bee" drones fly from hive to hive

museums inside

This project brings to light colony collapse



LED string lights

Powers

9 Houses

Mosaic orange/yellow bulletproof glass interior

LAGI 2020 - FLY RANCH THE GEYSER

Elijah Jarmillo, Marcos Martinez, Antonia McCulley, Adam Tedesco | Mentor: Samipya Bhattarai

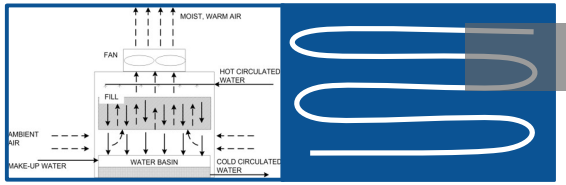
TECHNOLOGIES

DYE SENSITIZED SOLAR CELLS

Used for coverings // roof
Conversion rate: 9 -12%

POLYCRYSTALLINE SOLAR PANELS

Used for walls and are made thinner for flexibility.
Conversion rate: 15 - 17.2 %



WATER COOLING SYSTEM

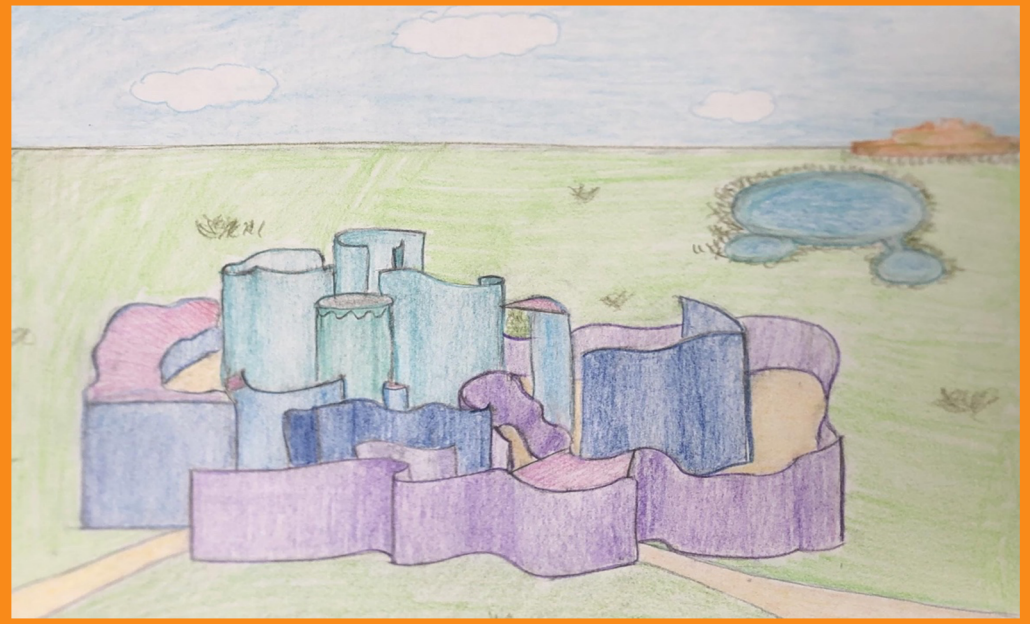
Wet cooling tower - crossflow
Array of pipes along the back of panels

Reflections

Our Geyser sits directly across the pond from the natural geyser

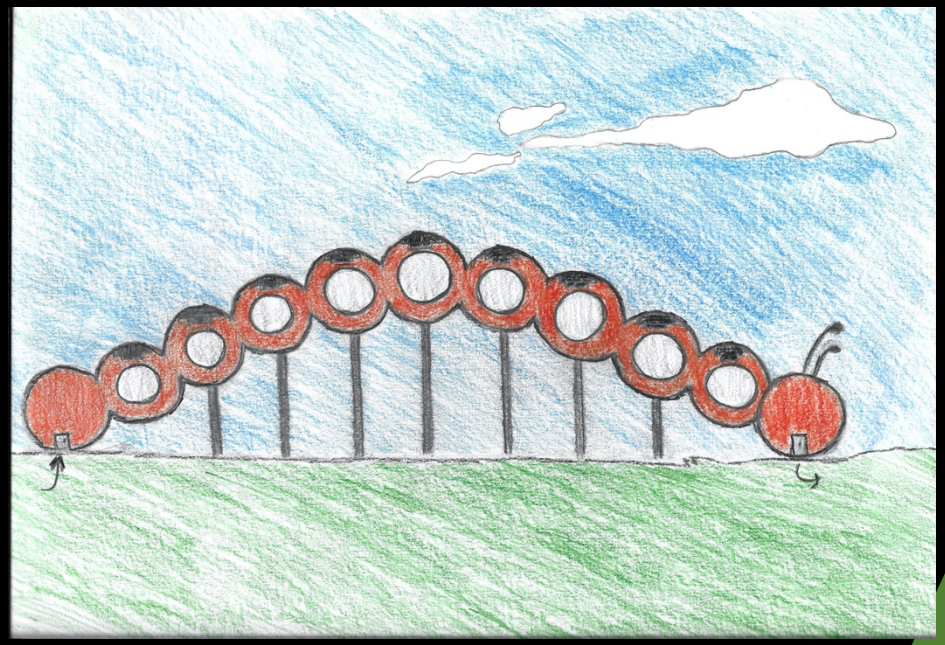
As you walk through our geyser you are invited to reflect on your impact on the environment, native lands, the world

Native plants line the pathways of the mirrored and translucent walls



Powers

16 HOUSES



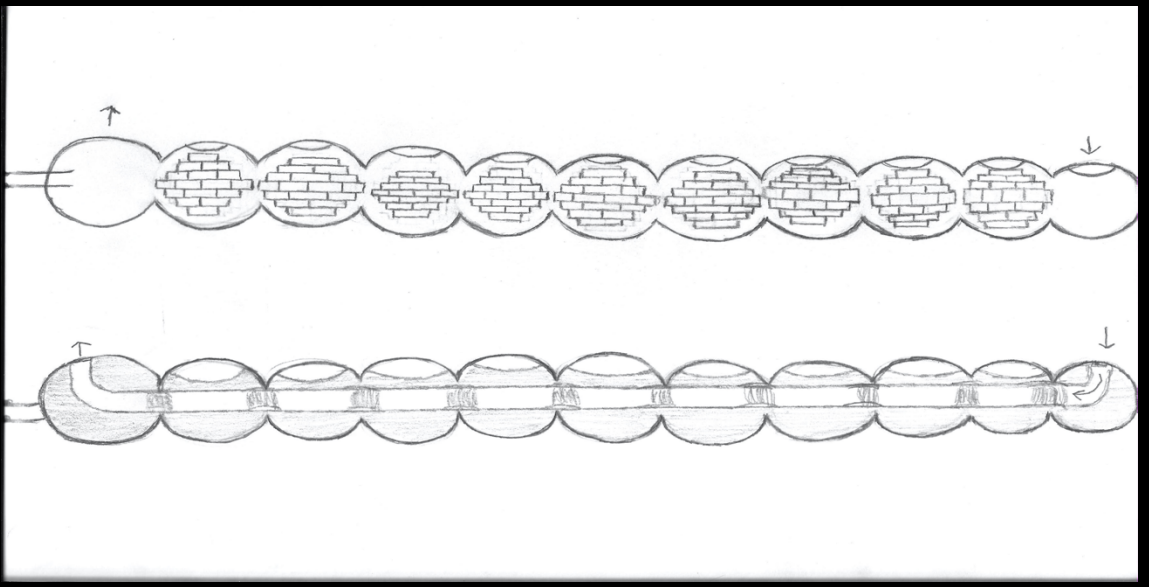
Side View

The Solar Caterpillar

By Lily Macfarlane, Phoebe Jones, Diego Carrillo, J. Lee

Tesla Solar Shingles : 900 ft^2

Top view

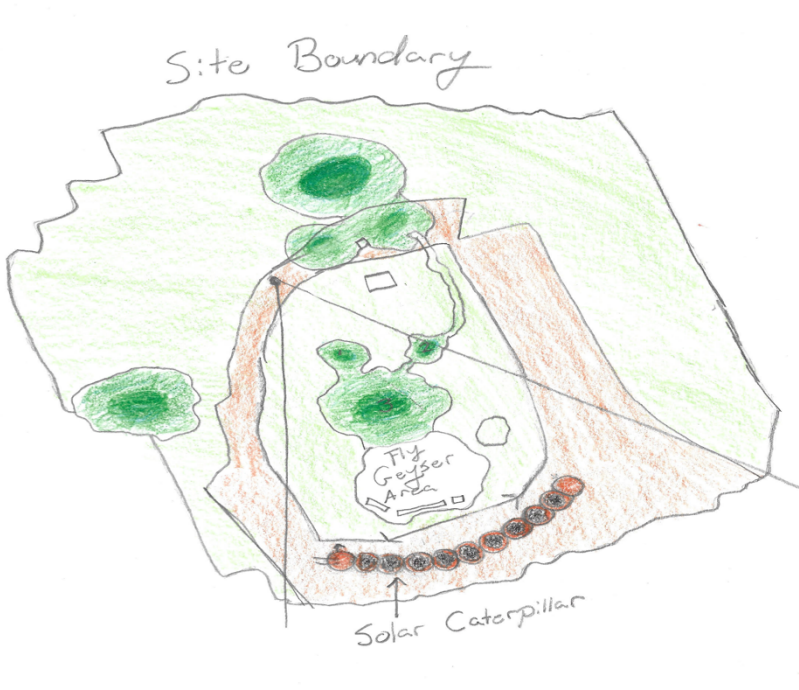


Length - 176 ft,
Height - 32 ft,
Width

Glass : 1,809 cubic feet

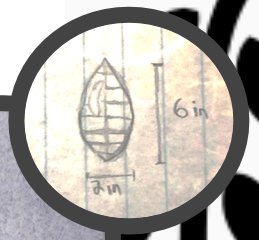
Steel : 10,454 cf

Powers 2.6 houses



Let's nurture our nature so we can have a better future

-5 Willow Trees: 10ft by 9ft
-Leaves: 6 in x PV cells; 5000 leaves/tree
-Space between plants: 8ft



Nevaeh Silva

Courttney -Dona Kersi

Syliva Holesinger

Sofia Juarez

Kevin Huang

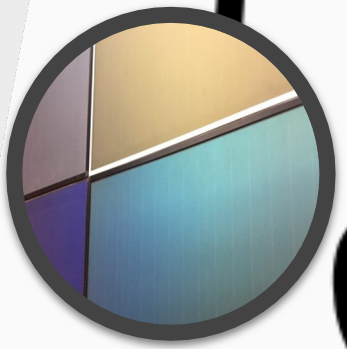
250+ days of sunlight at Fly Ranch

Powers 9 houses

Garden supports wildlife

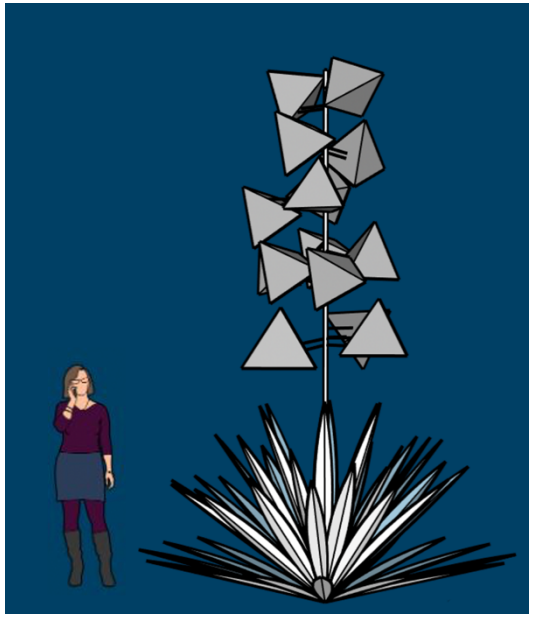
"Willonewable Energy"

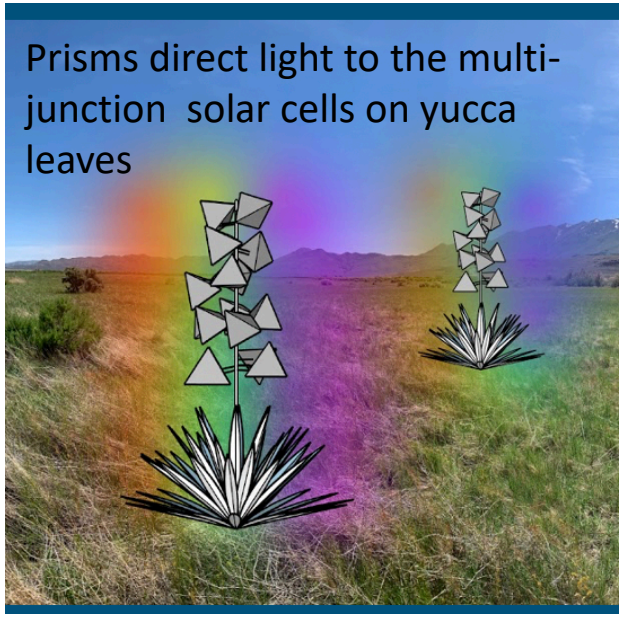
-Tree support from branches to ground and from nearby trees



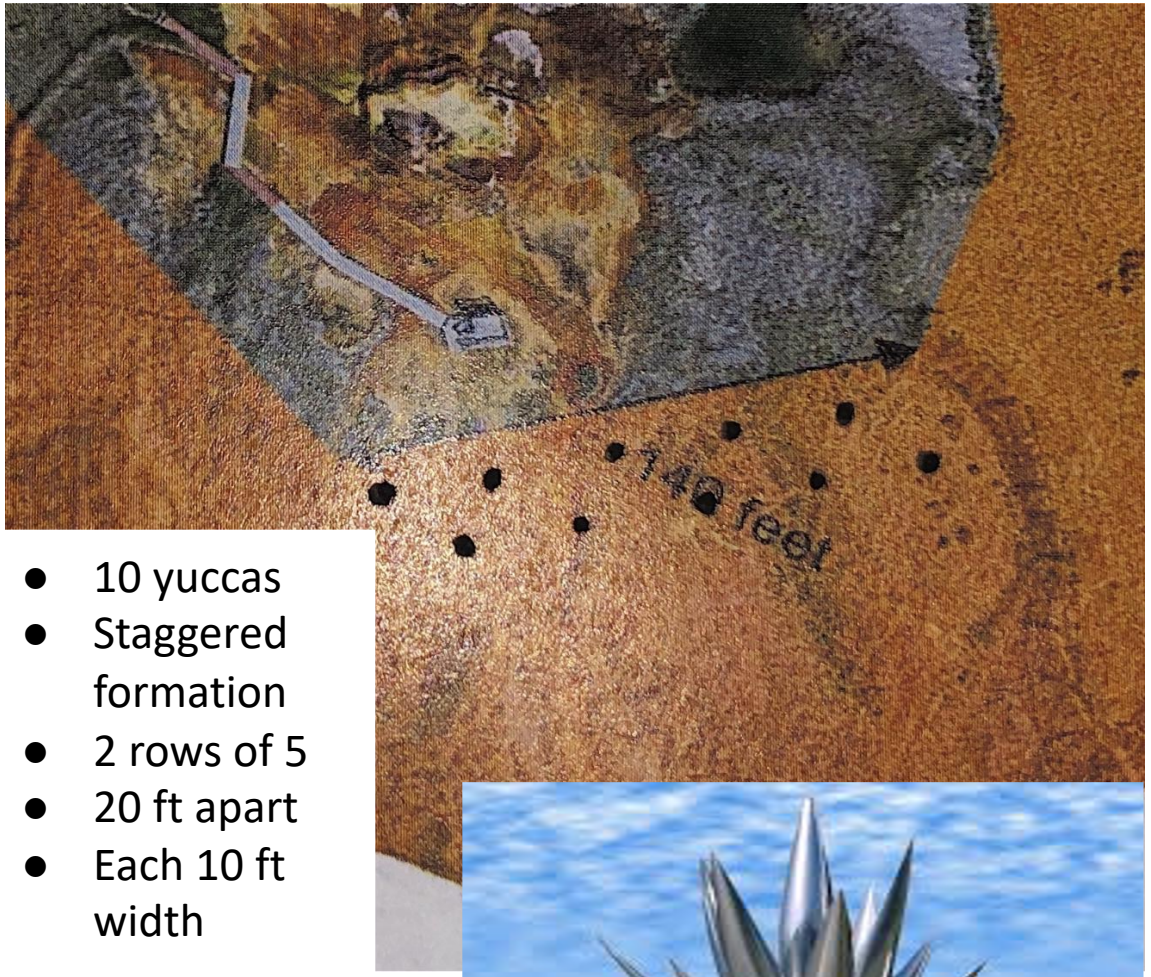
Kromatix thin film modules add color to solar cell leaves.

Bifacial solar cell leaves collect solar energy from both sides. We also use Heliostatic dual-axis sun tracking.





Seeing the rainbow is always a wonderful thing. The rainbow is a symbol of hope, inspiration, promise, good fortune, and wishes coming true. - everydaypower.com



- 10 yuccas
- Staggered formation
- 2 rows of 5
- 20 ft apart
- Each 10 ft width

Powers 7 Houses

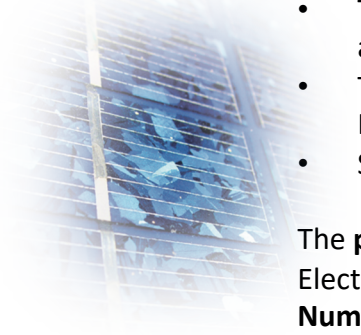
Guide to some energy and power calculations

Power is the **rate** of energy generated per time **(energy/time).** A laptop uses about 35 Watts (joules/sec) of power.

How much **Energy** does it use in one hour? 35 watts x 1 hour = 35 **watt-hours** [or 35 joules/sec X (60 sec /minute) X (60 minutes/hour) = 126,000 joules].

The average American home uses 10,909 kilowatt-hours of electricity per year.

Solar



The sun delivers 1,000 watts/meters^2 of solar power perpendicular to the surface of the earth when it is shining at noon on a clear day. How much of that power gets converted into electrical power depends on:

- The efficiency of solar cells, which can range from about 10% to 80% depending on the kind of cell/system. Most cells in these projects had efficiencies around 12-20%. Projects with solar trackers have higher efficiencies.
- The capacity factor CF. This accounts for the time only when the sun is getting to the solar cells, excluding nighttime, clouds, dusk, dawn, weather. For Fly Ranch we use 20% or .2
- Surface area of the project solar cell system.

The **power** of a system is: 1000 watts/m^2 X Efficiency (e.g., ~.2) X CF (.2) X Surface Area

Electrical **energy** produced by system in 1 year = Power (watts) x 8760 hours = Energy (watt-hours)

Number of houses supported in 1 year = Energy/1000 ≑ 10,909 kilowatt hours

Wind

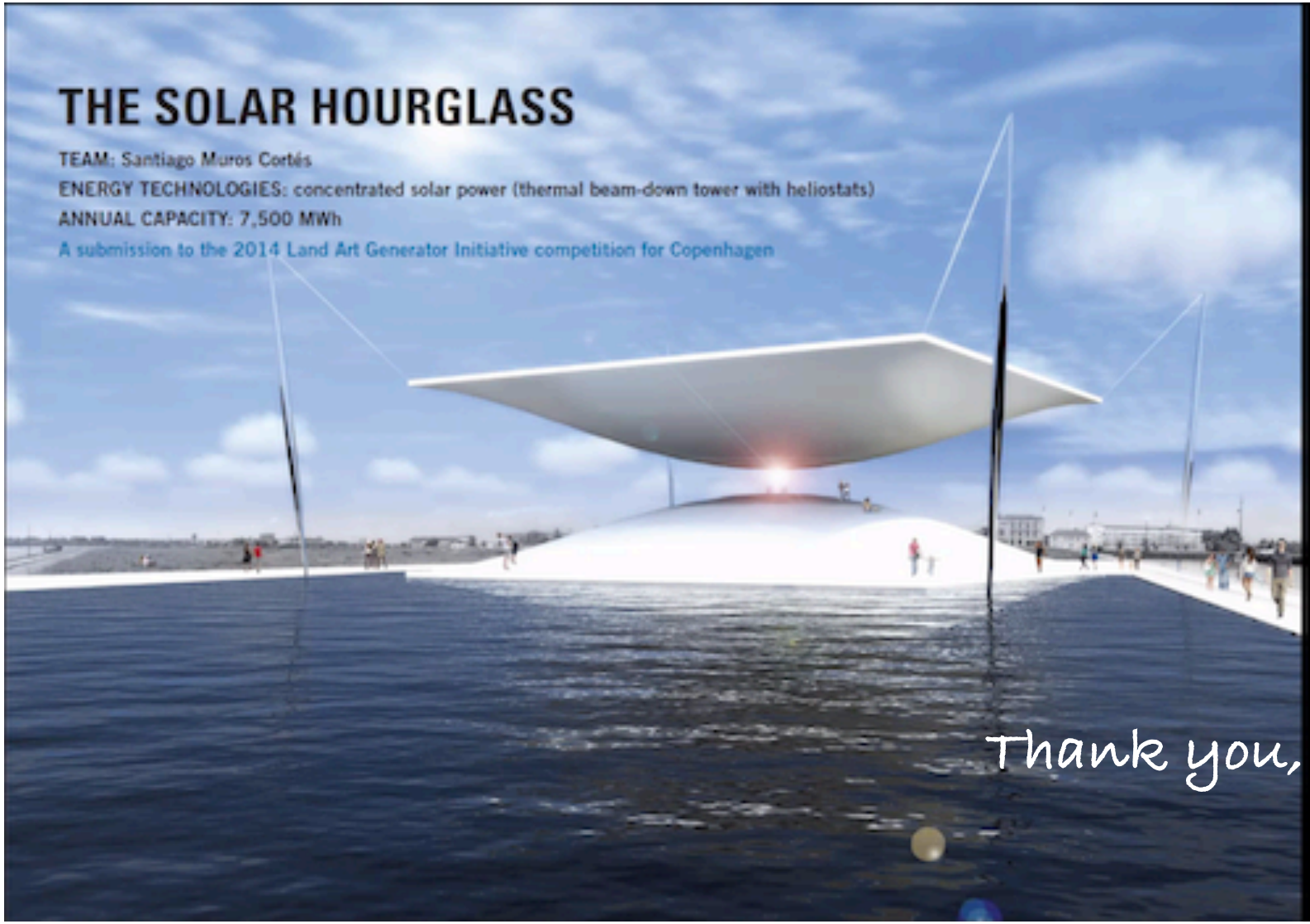
The **power** generated by a wind turbine depends on the windswept area **A=** πr^2 in square meters. ($m^2 = ft^2/10.764$) where $\pi = 3.14$ and r is the length of the blade.

The **peak power** capacity is estimated by dividing the windswept area **A** by 6. For example, a turbine with a windswept area of 30 square meters will have a peak power capacity of 5 kWp (kilowatts peak). That means that it can make that much power at a moment in time when the conditions are perfect (the wind is strong and consistent, and the unit is functioning perfectly).

To find out how much **energy** it produces in one year, multiply your kWp x 8,760 (hours in a year).

Multiply by the capacity factor for small wind (0.25). At Fly Ranch, a more realistic CF = .2

A 5 kWp turbine can be expected to generate 10,950 kWh (kilowatt-hours) per year.



Thank you, Robert and Elizabeth

https://landartgenerator.org