Sources of Puha.

“The Northern Paiutes believe in a force called Puha that gives life to the physical world. It is the power that moves the elements, plants, and animals that are a part of that physical realm. Humans are seen to be very much a part of that world, not superior or inferior, simply another component. ” W. Walker & K. Venzor in Contemporary Archaeologies of the Southwest

The native Pauite people recognize Puha as the energy of life, as a physical and spiritual flux. Shamans could draw Puha from sacred sites, specific topographic landmarks, hot and cold springs, caves... Puha is energy, in a holistic definition.

Sources of Puha want to embody this holistic energy in striking and integrated artworks, in human/nature hybrid sculptures emerging from the unique physical and metaphysical geologic landscape of the Black Rock desert.

Inspired by the existing man made geysers of Fly Ranch, Sources of Puha are structures that work symbiotically with Nature: they are geothermal heat and power gathering systems combined with outdoor thermal baths.

Their geometry is inspired by the formation of the Fly geyser, combining a vertical spiraling heat exchanger, connecting soil and sky and a horizontal spiraling series of pools, returning water back to the landscape.

Sources of Puha consist of four main parts: a geothermal well, a heat to water exchanger to produce domestic water, a heat to vapor exchanger to produce electricity and cascading thermal pools for body wellness.

1.Geothermal well.

The underground well reaches the faults where water is boiled by the heat produced by the nuclear reactions in Earth's core: this hot mineralized water is set free at the surface and slowly forms a man-made geyser. Only this time the heat coming from the geyser will be harvested by the sculpture and distributed on site for diverse uses in different forms (heat, electricity, vapor...).

2.Domestic hot water.

The spiraling metal structure that crowns the sculpture is an aluminum frame holding a spiraling copper coil acting as a heat exchanger between the geothermal mineralized water/vapor from the geyser and a loop of demineralized water (direct use of water from the geyser would clog the pipes). The resulting hot domestic water (around 60°C/140°F) will be distributed via a network of pipes across the Fly Ranch site and could be extended to the nearby town of Gerlach. It can be used in various ways, directly or mixed with cool water from the artesian wells to reach ideal temperature for heating and cooling of any building on site (floor and wall heating/cooling), bathrooms, cooking, kitchens...

3.Electricity.

It is tempting to suggest producing electricity from the geothermal heat at Fly Ranch, but, according to the data, the temperature of the existing geyser is too low for a “classical” geothermal electricity plant (using direct vapor from the ground to power a turbine, like they do in Iceland).

Instead there is a solution for low temperature geothermal sources: binary geothermal plants. That would be the way Sources of Puha produce electricity: the heat from the geyser is transferred to a loop containing a low boiling point fluid that can vaporize at low temperature. This vapor powers a turbine producing electricity. In order to be reused, this fluid needs to be condensed back to liquid form. We could do this by transferring the excess heat back to the thermal pools, so no heat is wasted.

Since geothermal energy is not dependent on daily or seasonal cycles, the electricity would be produced continuously, on demand, without major storage needs, which is a significant advantage compared to other sustainable electricity generation systems.

4.Thermal baths.

After heating the copper coils, the water from the geyser would be recovered in a series of cascading thermal pools made of ferrocement (method for the easy construction of free-form and light structures using metal meshes covered with a thin layer of concrete) that would support human activities without damages. The pools are semi-buried in the landscape and filled with mineralized water from the geyser, ranging in temperature from 40°C/104°F to 20°C/68°F. The pool surrounding the geyser is too hot for bathing but can be accessed for viewing from a path that also distributes every pool, avoiding damage to the surrounding vegetation.

As the water from the geyser moves from pool to pool, it cools and its minerals are deposited on the concrete and create with time a second skin, covering the pools in a natural orange stone. In the hottest pools, the conditions would be perfect for thermophilic bacteria to flourish and give a green tint to the water.

The last pool would be the largest and deepest, allowing for swimming. Its water would overflow in the desert like the other geysers and penetrate the subsoil, returning to the underground fault where it came from, closing the loop.

Prototype.

As a proof of concept we propose to build a scaled version of the sculpture, using hot water from an existing geyser to test the heat exchange systems. In a second time, we could build a scaled version with new geothermal drilling, then build the full scale project.

Material needs.

For the full scale sculpture: 2500m of copper tube, 650m of aluminum beams are needed. The depth of the drill depends on geological surveys. Around 250m3 of concrete and steel meshes for the ferrocement pools are needed.

A 1/5 scale prototype would need 20% of the listed materials.

Modular Earth Domes.

“When individuals join in a cooperative venture, the power generated far exceeds what they could have accomplished acting individually” Buckminster Fuller

“Don't fight the forces, use them” Buckminster Fuller

“Resources and energy are scarce, geometry is free”

Earth domes are a scalable, modular, collaborative construction principle for future buildings at Fly Ranch. More than a fixed design or plan for the development of activities at Fly Ranch, we propose a set of construction principles that can be tested, replicated, improved and upgraded by the community. These principles are based on our analysis of the forces and resources naturally available at Fly Ranch, trying to find the best suitable options for a sustainable development of future structures on site.

Earth domes are a combination of different self-construction techniques adapted to the singular Fly Ranch environment. Inspired by Pauite earth lodges, geodesic domes and superadobe construction.

1.Semi-buried superadobe walls and floors, geothermally tempered.

Using the landscape and the thermal mass of the ground to improve the interior comfort of a building is one of the common sense building principles that our civilization lost on the way. To protect from the sun, wind and temperature variations (daily and seasonal), a semi-buried shelter is a good option. The first act of building would be to excavate the soil, creating both space and resources for construction!

Superadobe is an earth construction technique developed by architect Nader Khalili that consists in filling bags with soil, stacking and tamping them layer by layer, forming free-form walls or domes. This technique seems very suitable in Fly Ranch because soil is the main available resource and because it can be done by anyone with no construction background, allowing the community to be radically included in the building process. We prefer this solution to clay 3D printing that seems to be less democratic and too technological.

2.Light wooden dome, naturally insulated.

Dome is a recurrent and fascinating shape in nature, because it encloses the most space with the minimal surface area, optimizing the use of scarce resources thanks to geometry. We naturally choose this efficient structure to build shelters at Fly Ranch.

Since we want to give a maximum scalability and modularity to the constructions the domes need to be lightweight and allow big spanning. A metal structure would probably be the most efficient, but also would cause a big energy and carbon footprint that we want to avoid. That's why we designed a cross laminated wood dome that can allow sufficient span and trap carbon at the same time.

The dome structure can be prefabricated and assembled on site with light equipment.

The structure is then filled with wooden sandwich panels: two plates of wood filled with natural, local insulation, hay for instance. The structure can also be filled with transparent panels (glass, recycled plastic, ETFE...). Scalable combinations can be found according to the desired use of the building.

A final layer of soil covers the dome, enhancing the insulation and blending in the landscape.

Modular Earth Domes is a replicable design, with modular construction, scalable and adaptive dimensions and is self-buildable by the community. The design can also be shared for other communities worldwide.

With this “recipe” a multitude of buildings with various usages and sizes can be built, largely including the community in the process: greenhouses, temporary shelters, workshops, housing, event buildings...

Prototype.

As a proof of concept, we can build a small scale shelter using the principles of Modular Earth Domes, built with the help of the community, celebrating the act of building something meaningful in common. This first shelter could be used by the community for short overnight stays at Fly Ranch.

Later we could build different sizes of shelters improving the techniques according to the development of the site.

Material needs.

For a 20m diameter dome: cross laminated wood structure: 500m, surface of panels: 400m2 + 40m3 of insulation

Excavated soil: 600m3

Plastic bags: 600m of bags filled with 50m3 of soil

Heating system: 700m of pipes

Material needed for a 5m diameter dome prototype would basically be 25% of this list.

Learning man: environmental impact summary.

“The cleanest energy is the one you don't need”

If we want to succeed as a species we will need to change our way of life towards a more efficient and shared usage of resources and energy. But transition can't only be technological, we need to change our relationship to the natural world we are entirely a part of. We need to reduce the philosophical gap we invented between Nature and Culture. This change of paradigm implies that we need to tend towards a joyful frugality: enough is more! We need to detoxify our lives from the overconsumption of energy and resources and focus more on our immediate relationships with others and our surroundings.

However we are a technological species and we need to use this asset, but in synergetic ways, in symbiosis with nature, not against it (and so,not against ourselves).

In our proposal for the LAGI2020 at Fly Ranch, we try to develop a multiple loops ecosystem of resources and energies. These loops are intimately linked to the environment and work together as hybrid biological/artifacts.

Local energies, reasonable uses.

Sources of Puha are intended to generate useful energy (exergy) from the heat of the ground. This exergy will be used on-site to avoid loss during transport, providing heat and electricity to the Modular Earth Domes and other future experimentation at Fly Ranch.

Since the dome design tends to low energy consumption thanks to its insulation by earth and hay, its energy need is way lower than “conventional” construction.

Local material use and carbon storage.

As the domes are mainly built with soil (around 90% of the total weight of the building), most of the materials don't need to be transported or processed. The 10% consists of wood and hay that store carbon.

The use of wood can be seen as cost in the carbon footprint since wood is not produced locally. This carbon cost can be balanced by the carbon storage of the wood as long as it doesn't decompose or burn. The use of this material in an efficient geometry contributes to lower this carbon cost on the project. In regard to the efficiency and scalability offered by the wooden domes, it seems this cost is negligible. Another possible solution would be to reuse potential left other wood from the Burning Man.

Carbon costs.

Plastic bags for the construction of the semi-buried domes are a source of CO2 and non biodegradable materials. Further research and on-site tests should be conducted to try materials of substitution such as jute or bioplastic bags. Since we don't know if these materials are suitable for superadobe, we suggest reusing misprinted grain bags from the agricultural industry to lower the impact.

The metal and light concrete used for the Sources of Puha has a non negligible carbon cost. It is used to produce hot water and electricity without emitting any CO2 or other harmful substances in the environment, so the cost can be seen as an investment that can easily be balanced by the regeneration of the local wetlands and vegetation in the long run.

After all, we think the main carbon cost of our project in Fly Ranch would be caused by the transportation of people gathering on-site for building, maintaining and enjoying the project. Since the project in Fly Ranch is an experimental scalable demonstration of a possible sustainable future, this cost can be seen as a good investment in the future of mankind !