LAGI 2025
FIJI LAND ART GENERATOR
RENEWABLE ENERGY CAN BE BEAUTIFUL

LAGI 2025 Fiji Narrative

1. Concept Narrative

Living in a natural bowl the tree roots stopping the maroo village from being washed away in the floods. Yet don't hold water in the dry season. However the nitrogen rich leaves of the Vai Vai freeze in the night.

In the absence of roots…the plant can take up water through its leaves.

Designing with absence.
Absence is the abundance of potential
Only using what is in-situ
In the absence of water, the school is closed, leaving the potential of the town as an educational hub.
In the absence of solar, ice has stored potential to be a heat energy
In the abundance of global warming, we create a space of absence.

This project proposes a closed loop energy system that blends traditional passive cooling with cutting edge solar and cryogenic technologies. The design is inspired by the Persian Yakhchal which harvested and stored ice in desert climates. Reinterpreting this with LN_2 (liquid nitrogen) cryogenic storage to convert solar energy into stored potential via nitrogen phase changes.

Constructed with the earth and modular frame. The outer form blends with the environment and community gathering space, the inner geometry sculpts air and houses the cryogenic technology and potentially cold storage for fish catch and medicine.

And inspired by the Via Vai tree, with its frost prone leaves, known for its nitrogen-fixing abilities. The ground turns green as a result of the nitrogen-rich flowers and pods decaying in the soil. Now imagine a close collaboration between air and cryotech to produce energy; the grass is greener using the stored potential in ice and sunlight.

2. Technical Narrative

• What technologies does your design incorporate? Why did you choose them?

Investigated how the biological processes of the Vai Vai could be translated into technology*1. Night time technology uses a nitrogen powered heat engine that allows the absence of solar. The potential to harness air (78% nitrogen). Next integrating " thermal battery"we borrow the traditional features of traditional persian architecture called a Yakhchal (Hareth Pochee and Gunstone, 2018).

Ice is not being used as fuel but the difference in temperature to do the mechanical work. generate electricity from the heat energy contained in ice blocks creates an energy deficient(Skylights.org, 2024) so using a photovoltaic solar mini grid as primary power source of consumable power and fuel for the heat engine and cryocooler (liquifying nitrogen)

The technical narrative describes a closed-loop system that extracts nitrogen from the surrounding air and cools it to liquid nitrogen. Using liquid nitrogen twice in the system to generate electricity and provide material supply. Interacting with ice and water, respectively. when in contact with ice a thermal mass that can absorb heat and expand the nitrogen as gas which spins a microturbine generating electricity. Electricity is generated for consumption and self-sufficiency in the system. Daily when liquid nitrogen is used to treat pond water, it freezes into ice, which is then stored in the yakchal, and the cycle is repeated.

Address airflow insulation and physics in a technical narrative that connects the past, present, and future technologies. The primary source is high-tech solar panels, which are supported by a futuristic concept of ice-powered heat engine. The engine is sustained in a yakchal's low tech passive design. These technologies were chosen because they compliment the heat engine taking advantage of wasted solar electricity midday and maintaining generation through the night and cloudy days. The cultural resonance of the yakhchal geometry is set to complement Experimental studies on parallel wavy channel heat exchangers with varying channel inclination angles. Based on this study the current concept design proposes 20 degree angles and vertical channels.

I'd like to continue this technical narrative design through participatory design in collaboration with University of the South Pacific and the Marou community. Intentionally under design as I am proposing the use of and structural changes similar to traditional bures (Fijian thatched-roof huts) found on Yasawa islands.

- How much energy and water does your installation generate each year?

Annual generation estimates

Energy 90,000-120,000 kWh/year (based on 75 kW PV solar system adjusted for efficiency)
Will sustain baseline energy electricity needs for the 67 homes lighting, refrigeration and small appliances.

Assuming the average home daily demand of 3-4kWh.
The output will sustain all 67 households throughout the year
approximately 73,000-98,000 kWh/year.

The rain catchment and cooling ponds can harvest 50,000-100,000 liters/year of water (depending on rainfall and catchment design).

- What are the system inputs? (for example, sunlight or rainwater)
  Sunlight (for solar power electricity)
  Ambient air (for nitrogen extraction-heat engine)
  Rainwater(collected via catchment features)

- What are the system outputs? (for example, electricity or clean drinking water)
  Electricity(via nitrogen expansion)
  Refrigerated space (for food, medicine)
  Cultural and educational programs (via built in public access and display zones)

3. Prototyping and Pilot Implementation Statement

Collaboration with USP will begin during the prototyping stage. The team and the community will test the system at 50% capacity on representative terrain. Excavating the underground storage chamber and installing the dome frame using the removed soil, locally adapted tools and technology. The frame supports the cryogenic turbine and ice extraction tubes. Passive cooling will be tested with ambient loads. Workshops will be held throughout the prototype and build phase to teach participants how to assemble, maintain, and expand the system. This will provide ownership and long-term modular design.

4. Operations and Maintenance Statement

The system is modular, so it can be expanded to meet the needs of the village. Foundation spikes allow for modular expansion of the solar wall, increasing energy and shading capacity without requiring disassembly. As with the dome, the original circumference excavation allows it to expand at its base to 25% more than its original volume. Local youth will be trained in cryo-system monitoring workshops, likewise villagers in solar and water cooling systems. Elders from the community will oversee cultural stewardship and potential.

5. Environmental Impact Assessment

The installation is intended to have a minimal environmental impact. It is constructed from local soil and does not use or emit combustion fuels or pollutants. LN_2 is non-toxic to the environment and safely returns to the atmosphere. Despite being non-lethal, training and personal protective equipment (PPE) will help us avoid burns. There is no expected harm to the flora and fauna.

To protect the ecosystem, catchment overflow will be used to irrigate surrounding green zones. Solar array alignment reduces shading and erosion during the day. Thermal insulation mitigates heat island effects. The goal is to work in harmony with the natural environment rather than disrupt it.

Reference list

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