**Concept Description**

The project is a land art installation consisting of three cable-stayed structures united in a spatial composition. Each of them is designed in the shape of a bat's wing—a species native to Fiji and symbolizing adaptation, invisible support, and a connection to nature. This image is not chosen randomly: it reflects the idea of harmonious coexistence between technology, art, and ecology.

The upper part of the structures consists of “solar fabrics” made from flexible CIGS panels capable of converting solar energy into electricity, as well as an innovative material that condenses water from the air (similar to the technology used in fabrics inspired by the structure of beetles from the Namibian desert). Depending on the module, different surfaces are used: some structures feature more solar panels, others have more water-collecting elements, making each structure unique.

The structures are supported by thin columns, creating the effect of “floating” above the ground. These columns perform not only a structural function but also an ecological one: they incorporate a vertical hydroponic system that draws moisture from the collected water. Thus, the water extracted from the air becomes a source of life for the plants planted along the entire height of the columns. This forms a living green façade that cools the air, purifies it, and creates a shady public space under the structures.

The project is not limited to energy and water generation—its purpose is to become a part of the local community's life. The spaces beneath the structures are open for meetings, rest, educational, and cultural events. Here, one can sit in the shade, charge devices, learn about the installation's operation, and even participate in plant care.

The composition integrates harmoniously into the landscape, preserving natural connections. The materials used are eco-friendly and designed for long-term use in the tropical climate. The project’s architecture combines high technology with biomimetic forms, offering visitors not only functional but also aesthetic value.

The shared use of land is also a cornerstone of the concept: the installation provides an alternative to individual consumption—a collective resource hub that encourages sustainable living. It is simultaneously an art object, an engineering solution, and a public good, created with respect for Fiji's nature and cultural heritage.

**Technical Description**

**Solar Energy: Autonomous Power Supply via Flexible CIGS Panels**

The primary function of the first feature of the structure is to provide autonomous power supply for the needs of a small settlement, including lighting, device charging, pumps, and water filtration equipment.

**Type of Panels and Operating Principle**

The project uses next-generation flexible CIGS panels with high efficiency (13–17%) that are ideally suited for the tropical climate of Fiji due to their excellent characteristics:
• Efficiency even under diffuse light and high humidity.
• Flexibility and light weight, allowing the panels to be integrated into the fabric structure.
• Resistance to overheating, salts, and wind loads, making them suitable for harsh climatic conditions.

**Energy Calculations**

• Active area of one structure: ~25 m².
• Daily generation per structure:
25 m² × 150 W/m² × 5.5 hrs × 15% efficiency = ~3.1 kWh/day.
• Annual generation: ~1130 kWh per module.

For 11 structures:
• Daily generation: ~34.1 kWh/day.
• Annual generation: ~12,430 kWh/year.

**Calculation for 100 people:**

Average consumption per person:
~0.25–0.3 kWh per day (lighting, charging, pumps, water filtration).

For 100 people:
25–30 kWh/day or ~9125–10,950 kWh/year.

**Conclusion:** 11 structures generate 12,430 kWh per year, which fully covers the energy needs of 100 people with a small reserve.

**Energy Storage and Distribution**
• Battery type: LiFePO₄, resistant to overheating and safe for long-term storage.
• Batteries are integrated into the columns of the structure.
• Energy reserve: for 1–2 cloudy days, with MPPT controllers and inverters if needed.

**Maintenance**
• Quarterly cleaning of panels.
• Annual inspection of batteries.
• Monitoring system for charge, temperature, and performance (locally or via Wi-Fi).

**Hydroponic System: Vertical Greening and Food Security**

The columns of the structure function as vertical gardens, providing live greening, CO₂ absorption, and improving the microclimate.

**Operating Principle**
• System: Drip hydroponics with nutrient solution recirculation.
• Water collected from the air is supplied upwards, slowly flowing down to irrigate plant roots. Excess water is collected at the bottom and fed back into the system.

**Crops**
Fast-growing and heat-resistant plants are grown in the hydroponic columns:
• Greens: basil, mint, coriander, arugula.
• Leafy: amaranth, lettuce, tropical spinach.
• Fruit: chili pepper, cherry tomatoes.

One column (~3.5 m) holds 30–60 plants.
The project includes 5 out of 11 columns with hydroponics.
Total number of plants: 150–300.

**Water and Energy**
• Water consumption: 1 column uses 4–6 liters of water per day × 5 columns = 20–30 liters/day.
• Energy consumption: ~10 W × 6 hrs × 5 columns = ~0.3 kWh/day.

**Calculation for 100 people:**
• Minimum need for fresh greens: 20–30 g/person/day, totaling 2–3 kg/day for 100 people.
• Yield per plant: ~300 g in 30 days.
• 300 plants can provide ~90 kg of greens per month (3 kg/day).

**Conclusion:** 5 hydroponic columns will meet the needs of 100 people for greens at a sustainable level.

**Maintenance**
• Check nutrient solution every 2–3 days.
• Remove wilted leaves weekly.
• Clean filters and channels monthly.

**Water Collection**

The moisture condensation system provides an important supplement to the solar and hydroponic functionalities of the structure.

Each structure is equipped with a system that collects moisture from fabric and plastic surfaces:
• Average moisture collection per structure: 10–15 liters/day (under the high humidity of Fiji).
• For 11 structures: 110–165 liters/day.

This is sufficient for:
• Drinking water (after filtration): ~150–200 liters/day (for 100 people).
• Hydroponics: ~30 liters/day.

**Conclusion:** The moisture condensation systems almost fully meet the water needs of 100 people, combining water collection with filtration and reservoirs.

**Prototype Development and Pilot Implementation**

**Prototype Creation**

1. **Designing**
• Development of project documentation, including drawings and diagrams of the cable-stayed structure with solar panels and water-collecting fabric.
• Selection of suitable materials considering local climatic conditions (high humidity, solar radiation, wind loads).
• Load and strength calculations to ensure the stability of the entire system.
2. **Prototype Assembly**
• Assembly of structural elements and installation of solar panels integrated into the fabric structure.
• Installation of the water collection system using water-collecting fabrics and integration of vertical hydroponic columns.
3. **Testing**
• Conducting prototype testing under real conditions in Fiji to verify its performance:
	* Evaluation of solar panel efficiency under variable cloud cover and high humidity.
	* Testing the moisture condensation system and its ability to meet water needs.
	* Evaluating the hydroponic system's performance in terms of plant growth, water, and energy consumption.

**Pilot Implementation**

1. **Collaboration with the Local Community**
• Engaging local residents in the installation and maintenance of structures, creating jobs and ensuring the sustainable operation of the project.
• Training local specialists for regular technical maintenance (panel cleaning, hydroponic column maintenance, monitoring of water and energy systems).
2. **Scaling**
• After successful testing and identifying necessary improvements, the project will expand with the installation of additional structures.
• Each new structure will include solar panels, a water collection system, and hydroponic greening for sustainable support of settlements.
3. **Evaluation and Optimization**
• Continuous monitoring of system performance through sensors and network systems that track the efficiency of all components (energy, water, harvest).
• Based on the collected data, the system will be optimized to improve its efficiency and stability in the long term.

The implementation of this prototype will provide energy and water independence for small settlements in Fiji and will enable further expansion and application of the technology in other regions with similar conditions.

**Operating and Maintenance Instructions**

**System Operation**

1. **Solar Panels**
	* Regular inspection of the solar panels should be performed at least once a month. Assess the condition of the panels for dirt (dust, mud), as well as potential mechanical damage.
	* Clean the panels using soft materials and without the use of aggressive chemicals to ensure maximum energy production efficiency.
2. **Water-Collecting Fabric**
	* Periodically check the water-collecting fabric for any damage and assess its ability to efficiently collect water.
	* Clean the fabric from debris, blockages, and dead droplets that may affect its functionality.
	* Check and remove condensate from the fabric surface to prevent the formation of water deposits.
3. **Hydroponics**
	* Regularly check the pump systems, filtration, and the condition of the plants.
	* Maintain the optimal level of water and nutrients, replacing them regularly to keep the plants healthy.
	* Assess the drip irrigation system's performance and adjust its parameters based on the plants' needs.

**Technical Maintenance**

1. **Support by Local Community**
	* Train local residents in basic system maintenance operations, including cleaning solar panels, water-collecting fabrics, and hydroponic setups, as well as performing minor repairs.
	* Organize regular training sessions to maintain worker qualifications and ensure effective task completion.
2. **Solar Panel Maintenance**
	* In case of damage or reduced performance of the solar panels, procedures will be in place to replace or repair individual components (e.g., replacing elements, cleaning, or diagnostics).
	* Access to consultations and support from technical specialists will be available to solve more complex issues.
3. **Hydroponics**
	* Regularly check and maintain the drip irrigation system, including replacing filters and other worn-out parts.
	* Preventive replacement of parts of the hydroponic system if defects or reduced efficiency are detected.

**Long-Term Maintenance**

* A dedicated technical maintenance team will be established to monitor and regularly check the condition of all system components to ensure long-term operational stability.
* The local community will be actively involved in performing routine tasks, such as cleaning and maintaining functionality, which will ensure sustainable system operation without the need for constant external interventions.
* As part of long-term maintenance, scheduled checks, component replacements, and equipment upgrades will be carried out, taking into account new technologies and improvements.

**Environmental Impact Assessment**

**Ecological Impact**

1. **Solar Panels**
	* Solar panels significantly reduce carbon dioxide emissions, as they do not require the burning of fossil fuels to generate energy. This helps to reduce the carbon footprint. An important aspect is the proper disposal of panels at the end of their service life, which minimizes their environmental footprint.
2. **Water Collection System**
	* The water collection technology has minimal impact on the ecosystem, as it only uses atmospheric moisture and does not deplete natural water resources. This makes the system environmentally safe and reduces pressure on traditional water sources.
3. **Hydroponics**
	* The hydroponic system requires significantly less water compared to traditional farming, which helps reduce pressure on local water resources. The water in the system is recirculated, minimizing consumption and increasing resilience to climate change.

**Measures to Mitigate Negative Effects**

1. **Periodic System Testing**
	* To reduce environmental impact, regular tests will be conducted to assess the efficiency of all systems. This will allow for the identification of any potential negative effects and adjustment of system components if necessary.
2. **Component Disposal**
	* In the event of component failure, such as solar panels or other system parts, they will be recycled with minimal waste. A system for collecting and disposing of outdated materials will be organized to prevent them from entering the natural environment.
3. **Use of Local Materials**
	* Environmentally friendly, accessible, and local materials will be preferred for the construction and maintenance of the system. This will reduce the carbon footprint and support the region's sustainable development, minimizing the need for transportation of materials from distant locations.