

Multi-Spectrum Energy Harvesting System

Pre-Failure Research Group LLC · Jason McCoy · Concept Recovery Document

Concept recovery document. The original work was developed by Jason McCoy and lost when his phone was factory reset. This document reconstructs the architecture from memory. Sections marked NEW DEVELOPMENT contain additions made Oct 2026.

Conceptual Origin: The Planetary Dyson Sphere

This system is rooted in Dyson sphere thinking applied at planetary scale. A Dyson sphere captures all energy radiated by a star by surrounding it with a collecting shell. This concept applies the same logic to Earth: rather than letting the atmosphere filter and scatter incoming energy, orbital collectors intercept it at the outermost practical shell and beam it down to a managed planetary energy system.

The ground is not just a surface to build on — it is the battery.

Architecture: Two-Tier Collection

Tier 1 — Orbital (Satellite) Collection

Satellites in orbit collect energy from spectrums the atmosphere partially or fully absorbs before reaching the surface:

- **Solar** — full-spectrum, unfiltered by atmosphere
- **Microwave** — collected directly in orbit
- **Radio** — broad radio-frequency capture

Once collected, the satellite converts and **beams the energy down** to ground-level collector arrays, bypassing atmospheric absorption losses.

Tier 2 — Ground-Level Collection

Surface collector arrays receive beamed-down energy from satellites and also harvest spectrums available at ground level directly. All collected energy feeds into the storage layer.

Storage: Earth as the Medium

The ground itself serves as the primary storage medium — an earth battery using the planet's thermal mass and electrical conductivity. All energy types are stored into the ground:

- Solar energy
- Microwave energy

- Radio frequency energy
 - Thermal energy
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Multi-Array Surface Capture (Rectenna Network)

The surface collector is a dynamic wide-spectrum rectenna network — a modular array of interconnected receiver tiles rather than a single capture point. This distributes the raw energy load across an expansive physical footprint and eliminates single-point thermal bottlenecks at injection.

Array Capabilities

- **Modular Broad-Spectrum Reception** — each tile handles different components of the incoming beamed energy, converting high-frequency microwave, laser/optical paths, or radio frequency streams simultaneously
- **Dynamic Load Balancing** — the array splits the incoming energy load and routes it to specific ground coordinates based on real-time capacity data from the Edge-AI sensor nodes; no single conduit carries the full beam
- **Atmospheric Scatter Deflection** — if weather causes the orbital beam to bloom or scatter, the wide array footprint captures peripheral energy, minimizing atmospheric transit losses
- **Fault Tolerance** — if a single tile fails or is overloaded, surrounding modules absorb the delta or instruct the orbital collector to modulate beam footprint

Ground Injection Mechanism

The array injects energy into the soil via deep-driven electrode grids. The edge-AI nodes already measure electrical conductivity as a primary variable, implying the storage mechanism is electrochemical/electrostatic. The conductivity map maintained by the node network provides routing intelligence for electrode injection. Thermal exchange pipes remain possible as a parallel subsystem but the primary injection path is electrical.

Orbital Feedback Loop — Satellite Emergency Messaging Uplink

The array routes beam modulation requests (footprint, frequency, intensity) back to the orbital collector via the satellite emergency messaging system. This is a dedicated, space-qualified, low-bandwidth channel separate from the energy beam itself. The surface array requires no custom comms infrastructure.

NEW DEVELOPMENT — Oct 2026 (Army xTech submission): Using the satellite emergency messaging system as the control uplink gives the system resilience against conventional disruption and

dual-use value as hardened critical infrastructure.

Edge-AI Sensor Node

The ground sensor node embeds a local AI system that processes multi-environmental data streams directly at the edge. Processing moves into the node itself, preventing network congestion and making each sensor an autonomous checkpoint.

Node Capabilities

- **Local Feature Extraction** — the embedded AI analyzes raw chemical and electrical data on-site, filtering environmental noise before transmitting telemetry
- **Environmental Matrix Testing** — continuous mapping of soil pH, ambient temperature, volumetric water content, and electrical conductivity
- **Dynamic Routing Decisions** — the local AI calculates the ground's immediate capacity to absorb or discharge energy at that specific coordinate
- **Pre-Failure Detection** — anomalous surge or sudden moisture shift triggers an instant pre-failure flag

Node Power: Parasitic Harvesting

Each node powers itself from the ground battery it monitors — fully self-sustaining, no external dependency. **Node health is battery health:** if local energy capacity degrades, the node loses power and goes offline before it can make bad routing decisions. A dark node is itself diagnostic information.

Inter-Node Communication (Cooperative, Non-Authoritative)

Nodes communicate with neighbors but **no node overrides another**. Each shares situational awareness; routing decisions belong to the node at that coordinate or the human technician. The system reports what needs fixed and where — the human acts.

Data Payload Structure

Each node transmits to the primary grid:

- **Node ID and coordinate** — precise location
- **Soil readings** — pH, temperature, moisture, electrical conductivity
- **Local energy state** — current capacity, charge/discharge rate
- **Neighbor node status summary** — awareness of adjacent nodes

- **Pre-failure flag** — condition description and trigger reason, when active

Zero-Trust Alignment

No node is trusted to act on another's territory. Every node operates within strict code constraints. Anomalies surface to the technician rather than being silently corrected by a neighboring node.

Energy Flow

```
[Satellite Orbit] <-- Dyson shell analog
  Solar / Microwave / Radio capture
    |
    Beam down
      |
      | <-- emergency messaging uplink (NEW)
      | <-- beam modulation feedback
      |
[Multi-Array Rectenna Network]
  Modular tiles, load balancing, scatter capture
    |
    Deep electrode grid injection
      |
[Earth Storage Medium]
  Thermal mass / Earth battery
  Regulated by Edge-AI sensor network
    |
  [Edge-AI Nodes] -- self-powered, cooperative, non-authoritative
    |
[End Use / Grid]
```

Areas Still Being Reconstructed

Details from the original concept not yet fully recalled:

- Beaming mechanism specifics (laser, phased-array microwave, rectenna conversion detail)
- Storage retrieval — how energy is drawn back out of the ground for use
- Scale parameters — original sizing estimates, coverage models
- Additional spectrums beyond solar / microwave / radio

Living document. Add details as they come back.