

RegistryOS

Open-Source Infrastructure for Hourly Energy Attribute Certificates

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The Problem: Annual RECs Can't Support 24/7 CFE

What's Changing

- **RE100** now requires hourly matching (2025+)
- **GHG Protocol Scope 2** evolving toward temporal granularity
- **24/7 CFE Coalition** (Google, Microsoft) driving hourly standards
- **SEC climate disclosure** rules demand defensible accounting

The gap: Existing EAC registries issue monthly/annual certificates — no native hourly capability.

Why It Matters

- Annual matching allows "buying solar at night"
- Overstated emissions reductions
- No signal to build storage or firm clean power
- Corporate claims increasingly challenged

500+

RE100
companies

24/7

New standard

0

Open GC
engines

The Solution: RegistryOS

A meta-registry engine that adds hourly granularity to *any* EAC tracking system — without replacing existing infrastructure.

Core Capabilities

- **Granular Certificate (GC) Issuance** — Time-stamped, location-specific instruments
- **EAC Linkage** — GCs linked to underlying RECs/GOs via cryptographic hashes
- **Storage Records (STARs)** — Novel instrument for time-shifting clean energy
- **Chain-of-Custody** — Synchronized lifecycle prevents double-counting

Standards Compliance

- **EnergyTag v2** — Full Config 1 & Config 2 support
- **24/7 CFE Coalition** — Aligned with Technical Criteria v1.01
- **GHG Protocol** — Scope 2 market-based method ready

Key differentiator: Works with your existing RECs. No registry replacement required.

Why Open Source? Why LF Energy?

The Case for Open Source

- **Standards evolving rapidly** — GHG Protocol, EnergyTag, 24/7 CFE all in flux
- **Interoperability critical** — Registries, corporates, auditors need common infra
- **Trust requires transparency** — Open code = auditable, verifiable claims
- **Adoption accelerates with collaboration** — No single vendor can drive global standards

Why LF Energy?

- **Neutral governance** — Not controlled by any single registry or buyer
- **Energy sector focus** — TAC understands grid, markets, decarbonization
- **Proven model** — OpenSTEF, SOGNO, GXF all thriving
- **Global reach** — EU + NA + APAC participation

The Opportunity

Become the reference implementation for granular certificate infrastructure — the way Linux became the reference for operating systems.

Business Model: Red Hat for EAC Infrastructure

Open Source (This Proposal)

- GC issuance & retirement engine
- Storage records (STAR) logic
- EnergyTag v2 compliance layer
- API specifications
- Reference UI/portal

License: Apache 2.0 — Community-maintained methodology as standards evolve.

Commercial Services (Clean Incentive)

- Enterprise deployment & SLA
- Registry integration services
- Global Granular Registry operation
- Consulting & onboarding

Who Benefits

- **Existing EAC registries** — Add hourly capability
- **Corporates** — Deploy internal tracking
- **New entrants** — Launch registries faster

Architecture Overview

Core Components

| Component | Function |
|-------------------------|---|
| GC Engine | Issuance, transfer, retirement of Granular Certificates |
| STAR Engine | Storage Time-shift Attribute Records (FIFO) |
| EAC Bridge | Sync with underlying registries (M-RETS, PJM-EIS) |
| Meter Ingestion | API for validated generation/consumption data |
| Compliance Layer | EnergyTag v2 Config 1 & 2 validation |
| Portal UI | Reference web interface for all operations |

Tech Stack

- Backend: Python / FastAPI
- Database: PostgreSQL
- Frontend: React
- API: REST + OpenAPI spec
- Auth: OAuth 2.0 / OIDC
- Deploy: Docker / K8s

Current Integrations

- M-RETS (US/Canada)
- PJM-EIS (US)
- AIB Hub (Europe) — planned
- I-REC (Global) — planned

Who Would Benefit

EAC Registries

Add hourly granularity without rebuilding infrastructure

- M-RETS
- PJM-GATS
- European GOs
- I-REC issuers

Corporate Buyers

Meet 24/7 CFE commitments with auditable data

- RE100 members
- 24/7 CFE Coalition
- Tech (Google, Microsoft)
- Industrial offtakers

Software Providers

Build on open infrastructure

- Energy management
- Carbon accounting
- PPA management
- ESG reporting

Collaboration opportunity: Open-source infrastructure means registries can collaborate on methodology without giving up competitive position on services.

Current Status

Production Pilots

- **Hannon Armstrong** — Targeted procurement of high-impact granular certificates for renewable energy investments
- **Akamai Technologies** — Tagged RECs with timestamps and carbon impact data using GCs for internal sustainability reporting
- **Battery Storage Pilot** — Ongoing pilot issuing Storage Time-shift Attribute Records (STARs) for time-shifting GCs (*announcement coming soon*)

Production Infrastructure

- **Live registry** — granular-registry.com
- **Full GC lifecycle** — issuance, transfer, retirement
- **EnergyTag v2** — Config 2 implemented
- **REST API** — Production-ready

Ready for Open Source

- **[Done]** Core engine extracted and modular
- **[Done]** API documentation complete
- **[Done]** GitHub org created by LF Energy
- **[In Progress]** License headers to add
- **[In Progress]** CI/CD setup for public repo

Initial Committers

- Clean Incentive engineering team (2-3)
- Open to community committers immediately

Demo: Registry in Action

Device management

ACCOUNT: White River Solar Proj

5 Total Devices
5 Wind turbine

200657 MW Total Capacity
200657 MW Wind turbine

Device management table:

| Device name & ID | Technology type | Production start date | Device capacity (MW) | Location | Actions |
|------------------|-----------------|-----------------------|----------------------|---------------|-------------------|
| E_MARK-1 | Wind turbine | 2015-01-01 | 55 | Some Location | Edit, Upload Data |
| T_ABRBO-1 | Wind turbine | 2015-01-01 | 99 | Some Location | Edit, Upload Data |
| T_RATS-1 | Wind turbine | 2015-01-01 | 505 | Some Location | Edit, Upload Data |
| E_BLARW-1 | Wind turbine | 2015-01-01 | 99999 | Some Location | Edit, Upload Data |
| C_PSMAR001 | Wind turbine | 2015-01-01 | 99999 | Some Location | Edit, Upload Data |

Device Management Dashboard

Granular Certificates

ACCOUNT: White River Solar Proj

353 Total Certificates

88 Certificates Transferred

0 Certificates Cancelled

White River Solar Project

Table with columns: Issuance ID, Device Name, Certificate Period Start, Certificate Period End, Production (MWh), Status.

Hourly Granular Certificates

Storage Time Allocation Records (STARs)

View issued STARs with charge/discharge hour pairing and energy conservation tracking

7182 Total STARs

166167.702 Charging Energy (MWh)

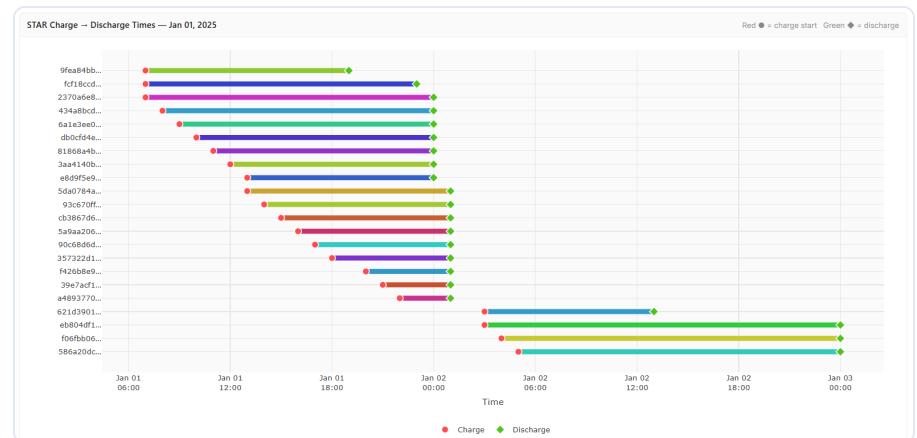
132287.011 Discharge Energy (MWh)

79.6% Round-Trip Efficiency

All Accessible Accounts table:

| STAR ID | Asset | Charge Hour | Discharge Hour | Time Shift | Charging Energy | Loss Energy | Discharge Energy | SCR ID | SDR ID | SLR ID |
|-------------|-------------|------------------|------------------|------------|-----------------|--------------|------------------|--------|--------|--------|
| 9fae84bb... | Device 1009 | 2025-01-01 01:00 | 2025-01-01 13:00 | 12h | 12.355000 MWh | 2.532000 MWh | 9.823000 MWh | [ID] | [ID] | [ID] |
| 237306a8... | Device 1005 | 2025-01-01 01:00 | 2025-01-01 18:00 | 17h | 17.503000 MWh | 0.870000 MWh | 16.633000 MWh | [ID] | [ID] | [ID] |
| 434a85cd... | Device 1005 | 2025-01-01 01:00 | 2025-01-01 17:00 | 16h | 2.229000 MWh | 0.111000 MWh | 2.118000 MWh | [ID] | [ID] | [ID] |
| 6a1e30e0... | Device 1009 | 2025-01-01 01:00 | 2025-01-01 18:00 | 17h | 15.050000 MWh | 3.084000 MWh | 11.966000 MWh | [ID] | [ID] | [ID] |
| db0c694e... | Device 1009 | 2025-01-01 01:00 | 2025-01-01 17:00 | 16h | 2.664000 MWh | 0.548000 MWh | 2.116000 MWh | [ID] | [ID] | [ID] |

Storage Time-shift Records (STARs)



STAR Charge -> Discharge Visualization

Live demo: dev.granular-registry.com

Roadmap



Q1 2026

Sandbox acceptance
Initial code release



Q2 2026

Community governance
OpenSSF badge



Q3 2026

First external deploys
AIB integration



Q4 2026

Incubation proposal
Expanded TSC

Near-Term (Sandbox)

- Publish code to LF Energy GitHub
- Complete documentation + contribution guide
- Establish TSC + governance
- OpenSSF Best Practices badge (Passing)
- First community contributors

Medium-Term (Incubation Path)

- European registry integrations (AIB Hub)
- GHG Protocol Scope 2 updates alignment
- Multi-organization committers
- Production deployments by 2+ registries
- Conformance/certification program

The Ask

Accept RegistryOS into the LF Energy Sandbox

What We're Committing

- Apache 2.0 licensed code release
- Transfer of relevant trademarks to LF
- Open governance + TSC formation
- Active maintainership from Clean Incentive
- Path to Incubation within 12 months

What We Need from LF Energy

- Neutral home for the project
- GitHub org (already created)
- Collaboration infrastructure
- Community visibility + outreach
- Guidance on governance best practices

Why This Matters

Granular certificates are the future of clean energy accounting. Open-source infrastructure ensures the methodology evolves transparently, adoption accelerates globally, and no single vendor controls the standard.

Thank You

Questions?

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PROPOSED LICENSE: APACHE 2.0