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ASIA CLEAN ENERGY FORUM 2026

Beyond Transition: Building Secure, Resilient, Inclusive, and Intelligent Energy Systems

Track 4: Fostering Intelligent Energy Systems
Session 4.1: Smart Grid Integration & Real-Time Energy Management

Scaling DER Integration in Sri Lanka: A Utility-Led Approach to Real-Time Monitoring, Solar Forecasting, and Generation Management

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Sri Lanka's DER Challenge: Scale, Variability, and Control

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Rapid DER growth is outpacing grid management capability — a challenge shared across emerging economies.

Sri Lanka: The Context

~ 7,320 MW
Total installed capacity

~ 3,600 MW
NCRE — 49% of total

400+
NCRE Plants

148,000+
Rooftop solar connections

7.6 M
Distribution customers

Visibility Gap

No unified real-time view of 148,400+ distributed generators (solar, wind, mini-hydro) — operators are flying blind during high-generation periods.

Reactive Operations

Without generation forecasts, operators cannot anticipate excess renewable output — they respond after the problem starts.

No Scalable Control Mechanism

No automated, auditable way to reduce DER output across thousands of customer-owned plants when grid frequency is at risk.

Imprecise Curtailment — Cascading Effects

Over-curtailment forces unplanned hydro dispatch, deviating from energy schedules. Imprecise restoration risks excess generation, compounding imbalance.

These are not unique to Sri Lanka — they are the defining operational challenge for any utility managing rapid DER growth.

Our Approach: Three Integrated Capabilities

Implemented through the In-house CEBAssist Platform — deployed across the national distribution utility and national system operator

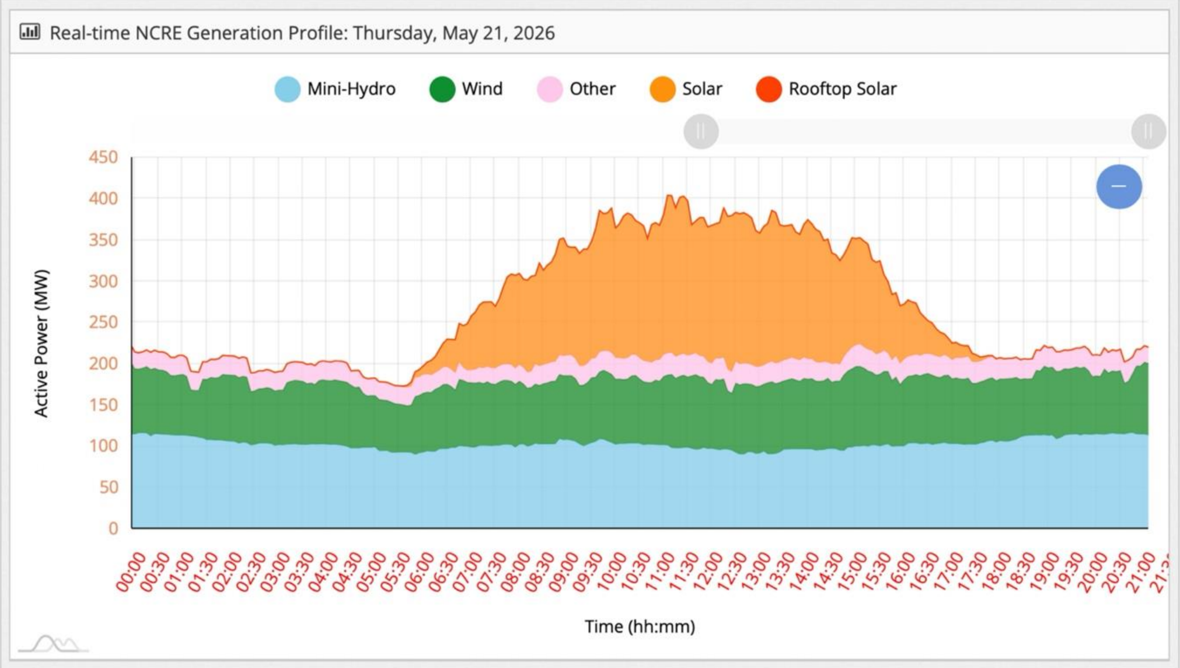
	Challenge →	Methodology →	Outcome
MONITORING	No real-time visibility of DER output across the national fleet.	Hybrid data acquisition: smart meter (AMI) telemetry at connection point + IoT modems at inverter level → unified monitoring platform	Digital twin–enabled, real-time view of the full NCRE fleet.
FORECASTING	Operators cannot anticipate excess solar generation until it is already causing frequency deviation.	ML-based generation forecast using weather and irradiance data, disaggregated to plant cluster level — covering full NCRE fleet.	P50 generation estimates and cumulative daily energy projections available ahead — enabling proactive planning
MANAGEMENT	No scalable, auditable mechanism to reduce DER output when grid stability requires it.	Hybrid control: automated API setpoint dispatch via IoT modems for inverter-based plants; notification for others — last-resort emergency activation only	Remote active power control with zero on-site intervention for API plants; full plant-level curtailed energy accounting.

Key design principle: build on existing infrastructure — no greenfield investment required.

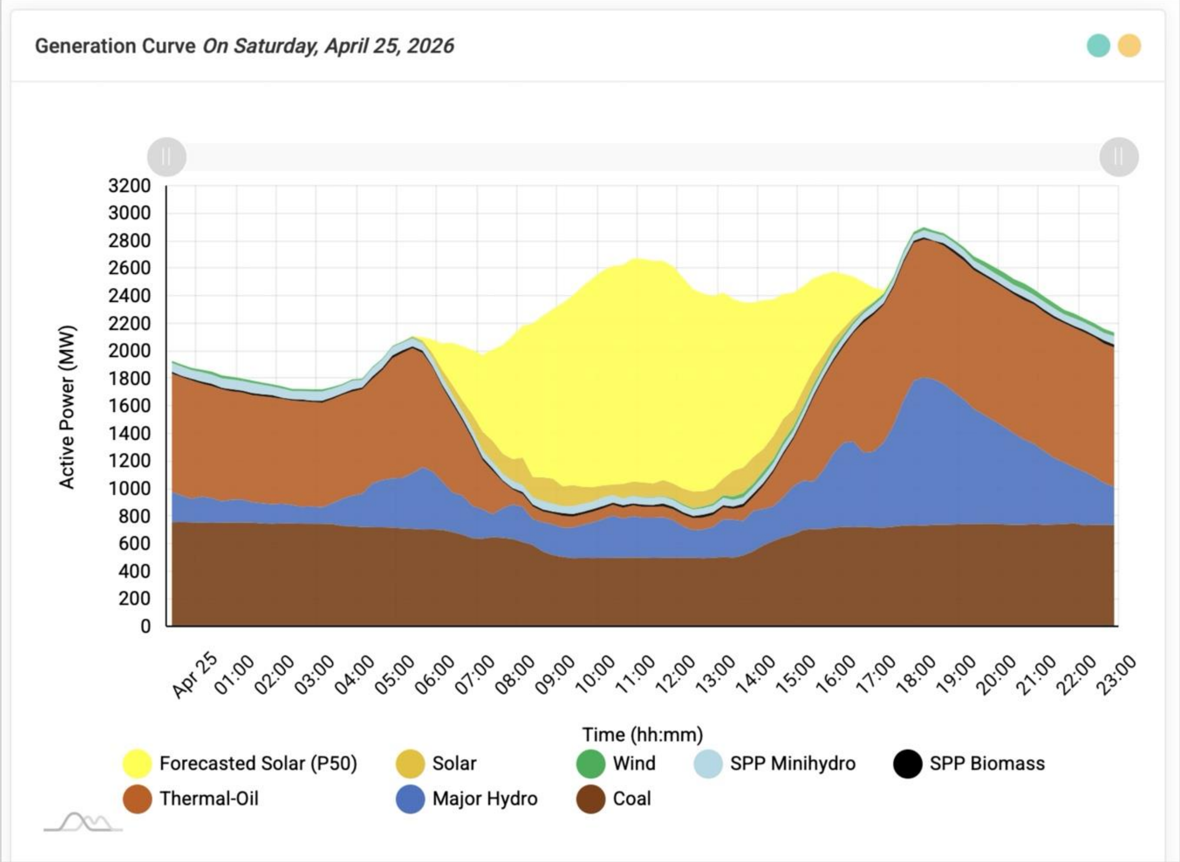
Monitoring: Real-Time DER Visibility

Live national generation profile

Real-time NCRE Generation Profile — CEBAssist Platform

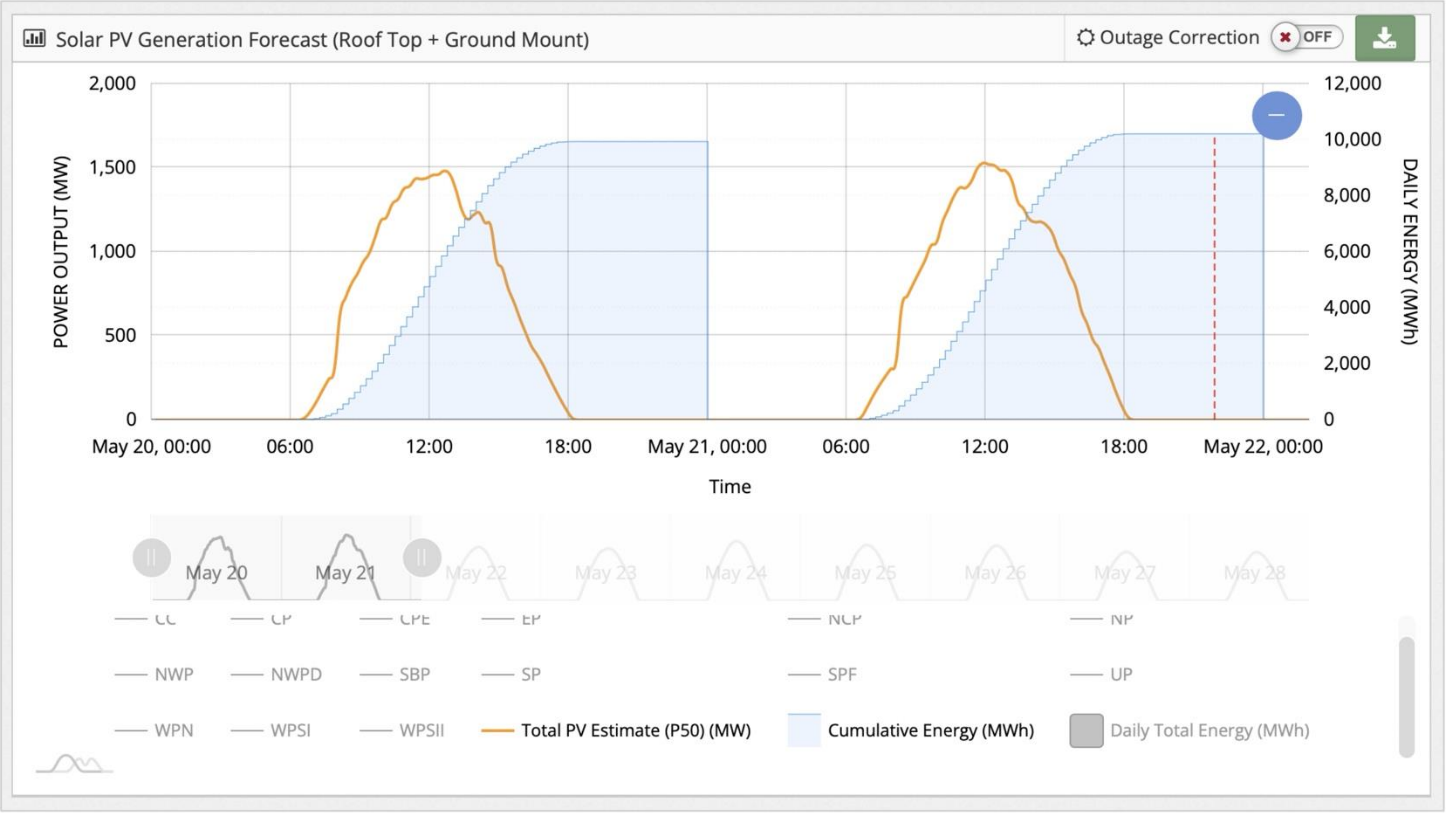


Total Generation Curve — CEBAssist Platform



Forecasting: From Reactive Response to Proactive Management

ML-based solar generation forecasting — covering the full national PV fleet



P50 Forecast + Cumulative Energy Projection – CEBAssist Platform

Methodology

- Weather & irradiance input data
- ML model — cluster-level granularity
- All PV fleet included.
- P50 probabilistic output — hours ahead

Anticipate Excess Generation

Hours before it occurs, not seconds after

Plan Interventions Proactively

Reserve emergency curtailment as true last resort

Management: Addressing Regulatory & Technical Challenge

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Customer-owned assets, diverse technology, no common control interface — the hybrid solution

Key challenge: DER plants are customer-owned. Utilities cannot simply mandate remote control. The approach had to work within regulatory and commercial constraints.

The Hybrid Control Architecture

API-Controlled (Inverter-based plants)

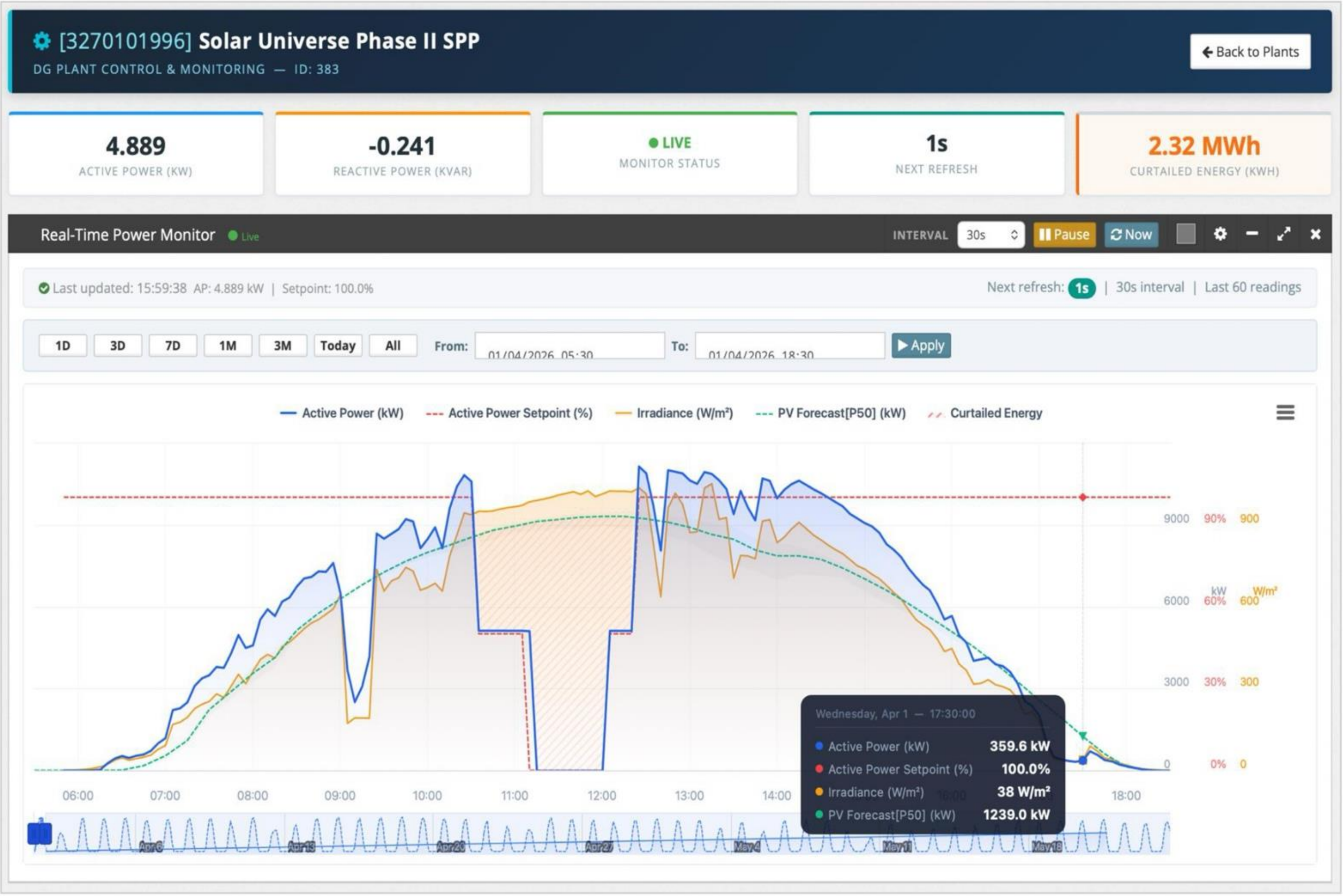
IoT modem at plant → IoT head-end → CEBAssist.

Active power setpoint → inverter responds automatically.

Zero on-site intervention required.

Manual Dispatch (other plant types)

Structured notifications to provincial Distribution Control Centres → field coordination.



Plant-level view: Actual Output vs Setpoint vs Forecast
Curtailed energy tracked in real time

Operational Evidence: RE Generation Management in Practice

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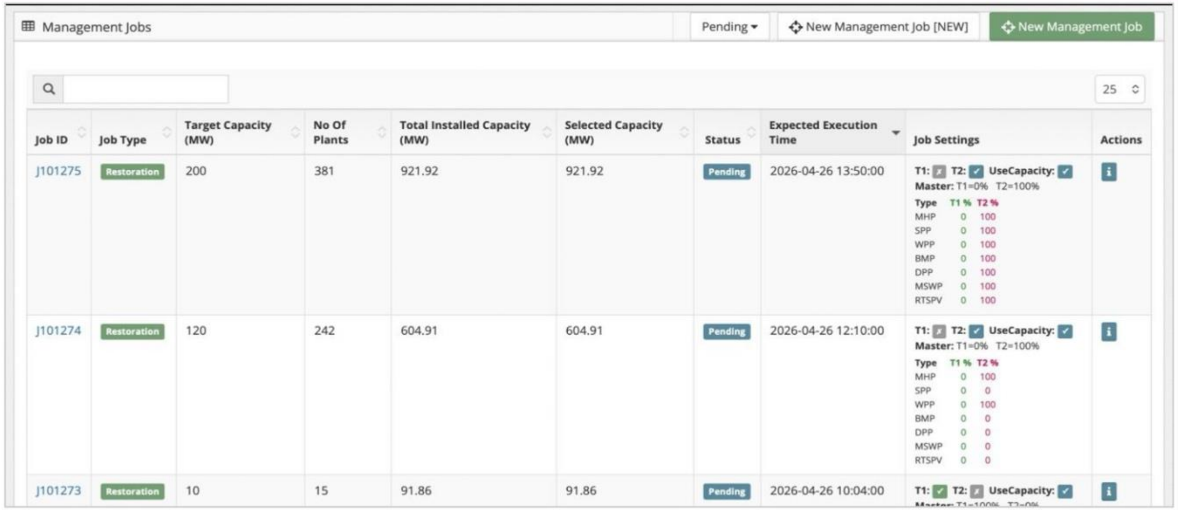
Real dispatch history — RE generation management and restoration jobs executed on the national grid



RE Management Jobs Log — CEBAssist Platform

RE Management Jobs Details — CEBAssist Platform

Curtailment & Restoration

Both job types logged — downward regulation followed by restoration when conditions allow.

Target Set by Operator

Each job specifies the MW target — system auto-selects plants based real-time conditions to meet it.

Full Audit Trail

Job, execution time, plant count — every dispatch is time-stamped and traceable.

Solution Architecture: Integrating Existing Infrastructure

No greenfield required — a layered approach built on what utilities already have

PLANT LAYER	▸ Inverter-based plants with IoT modems (API-controlled) | Other plants via manual coordination
DATA LAYER	▸ IoT Head-End System (inverter-level data via API) | Advanced Metering Infrastructure / Smart Meter Head-End System (connection-point data)
PLATFORM LAYER	▸ Integrated platform: Real-Time Monitoring | Solar Generation Forecasting | Generation Management (CEBAssist)
OPERATIONS LAYER	▸ National System Operator — dispatch decisions | Electricity Distribution Utility Control Centres — field execution.

Forward compatibility: this same infrastructure layer becomes the foundation for BESS and Demand Response Orchestration

Key Findings

What this implementation demonstrates — and what it does not yet solve

What the Approach Demonstrates

- Hybrid data acquisition (AMI + IoT) provides adequate real-time DER visibility without full infrastructure replacement.
- ML-based forecasting at national scale is feasible and operationally valuable, even with partial sensor coverage.
- Automated remote curtailment via IoT is technically proven for inverter-based plants at zero on-site cost.
- A single integrated platform serving both the distribution utility and the system operator is achievable.
- Plant-level curtailed energy accounting creates an auditable record for regulatory and commercial purposes.

Current Limitations & Open Questions

Manual DCC execution for non-API plants introduces timing uncertainty — precise curtailed energy estimation remains challenging

Rooftop solar (2,441 MW — 70% of NCRE) not yet within active control scope — the largest remaining gap

Scaling automated control to 148,000+ rooftop solar installations requires addressing customer consent and regulatory frameworks.

BESS integration needed to shift from emergency curtailment to proactive energy management.

Transferable Lessons for Emerging Economies

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Practical takeaways — applicable to any utility managing rapid DER growth on a constrained grid.

1. Visibility first

Start with real-time DER monitoring on existing infrastructure. Even partial coverage fundamentally changes how operators work.

2. Forecast before you act

ML-based forecasting is accessible today and transforms operations from reactive to proactive — it is the core of an intelligent system.

3. Design for what exists

Hybrid design covering mixed-technology fleets is more practical than waiting for a uniform, fully-modernised grid.

4. Build for the next layer

The monitoring and control infrastructure built for curtailment today is the same foundation for BESS and demand response tomorrow.

5. Keep capability in-house

Utility-led development builds institutional knowledge, reduces vendor lock-in, and produces systems that fit actual operational realities.

An intelligent energy system is not defined by the technology it uses — it is defined by whether that technology enables better, faster, and more informed decisions about real energy flows on a real grid.

Sri Lanka's experience shows this is achievable today, in an emerging economy, with the infrastructure that already exists.

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