SCADADOG

WHITE PAPER

Breaking the Data Silo: A SCADA Integration Playbook for Renewable Energy

How vendor-neutral edge-to-cloud architecture delivers real-time fleet visibility, eliminates manual data wrangling, and unlocks AI-ready operations.

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EXECUTIVE SUMMARY

The $4.2 Billion Blind Spot in Renewable Energy

The renewable energy sector is booming. The U.S. alone added 32 GW of solar capacity in 2024, and battery energy storage systems (BESS) are scaling at 40% year-over-year. But behind the growth lies a quiet crisis: **the data infrastructure hasn't kept pace.**

Most fleet operators manage a patchwork of SCADA systems from different OEMs—each with proprietary protocols, incompatible historians, and siloed dashboards. The result? Engineers spend up to 30% of their time manually wrangling data instead of optimizing assets. Critical alarms get buried. Maintenance is reactive instead of predictive. And the AI-powered operations that boards keep investing in? They stall in pilot mode because the underlying data is fragmented.

> "You can't optimize what you can't see. And when your fleet speaks 15 different SCADA dialects, you're effectively flying blind."

This white paper presents a proven, vendor-neutral approach to unifying industrial SCADA data across distributed renewable energy portfolios. Drawing on real-world deployments across solar, BESS, and wind facilities, we outline a practical architecture that delivers real-time fleet visibility—without ripping and replacing existing systems.

30%	15+	72%	$4.2B
ENGINEER TIME LOST TO MANUAL DATA WORK	SCADA PROTOCOLS IN A TYPICAL FLEET	OF IIOT PROJECTS STALL AT PILOT STAGE	ANNUAL U.S. COST OF UNPLANNED DOWNTIME

01 — THE PROBLEM

Why Renewable Energy Fleets Are Drowning in Data Silos

A modern renewable energy portfolio might include 50+ solar sites, a dozen BESS installations, and a handful of wind farms—each commissioned at different times, by different EPCs, with different SCADA platforms. The result is a technology landscape that looks less like an integrated system and more like a museum of proprietary protocols.

The Three-Layer Problem

Protocol Fragmentation. A single fleet might run Modbus TCP on older inverters, DNP3 on substation relays, OPC-UA on newer smart inverters, and MQTT on BESS controllers. Each protocol has its own data model, polling cadence, and security requirements. Connecting them requires deep OT expertise that most IT teams don't have.

Historian Sprawl. Site-level historians from different vendors (PI, Canary, InfluxDB, proprietary OEM platforms) store data in incompatible formats. Cross-site queries require manual exports, spreadsheet gymnastics, and days of an engineer's time to answer what should be a five-minute question.

Vendor Lock-In. OEM monitoring platforms—designed to sell hardware, not deliver insights—trap operational data behind proprietary APIs. Switching costs are enormous, and operators often can't even export their own historical data without a professional services engagement.

Fig. 1 — Edge devices and IoT sensor networks form the foundation of modern fleet telemetry, but without a unifying architecture, each device becomes another data island.

Real-World Impact: The Monday Morning Report

A fleet operations manager at a major U.S. renewable energy company described their weekly process: "Every Monday, two engineers spend four hours pulling data from six different platforms, normalizing it in Excel, and building a PowerPoint deck that's already outdated by the time it reaches leadership." This is not an edge case—it's the industry norm.

02 — THE SOLUTION

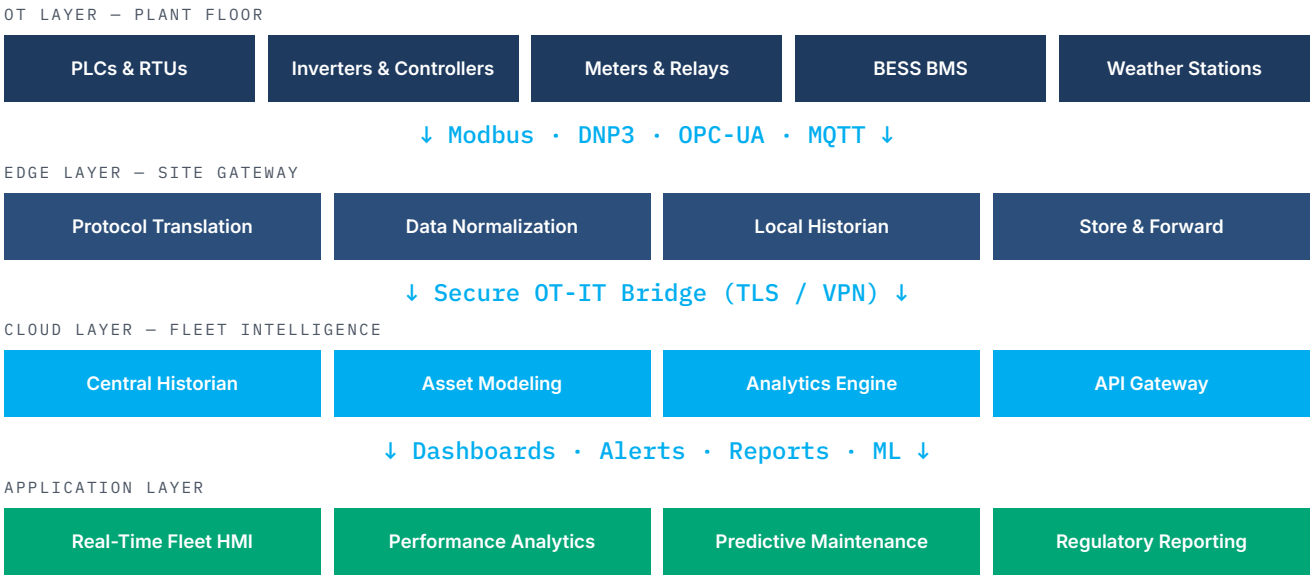
Vendor-Neutral SCADA Integration: The ScadaDog Approach

The answer isn't another monitoring platform. The industry doesn't need more dashboards—it needs a **data integration layer** that sits between existing OT systems and modern analytics tools. One that speaks every protocol, normalizes every data model, and delivers a single source of truth—without replacing a single PLC.

Core Principles

PRINCIPLE	WHAT IT MEANS
Vendor Neutral	No proprietary lock-in. Standards-based protocols (OPC-UA, MQTT, REST) ensure you own your data and can swap components without rewriting integrations.
Edge-First	Data normalization at the edge, not the cloud. Less bandwidth, air-gapped capability, and sub-second control-loop latency.
Incremental Deploy	No "big bang" migration. Sites onboard individually, existing historians stay, and the fleet data layer grows with each connection.
AI-Ready by Default	Normalized, time-aligned, quality-tagged data from day one. When you're ready for ML, the data is already there.

Reference Architecture



Why Edge-First Matters

In a cloud-first approach, raw telemetry from thousands of tags streams directly to the cloud—burning bandwidth and creating latency. Edge-first processes, normalizes, and compresses locally. Only contextualized data crosses the OT-IT boundary. Result: 80% less bandwidth, sub-second alarms, and operation even when the WAN drops.

03 — USE CASE

Fleet-Wide SCADA Integration for a Major U.S. Energy Producer

Fig. 2 — Utility-scale solar facilities generate millions of data points daily. Without integration, each site operates as an information island.

The Challenge

A Fortune 200 energy company with a rapidly growing renewable portfolio faced a scaling problem. Their fleet included 40+ solar sites, 15 BESS installations, and 8 wind farms across 12 states—each with different SCADA systems, OEM platforms, and protocols. The operations team had no unified view of fleet health. Performance benchmarking across sites was impossible without weeks of manual data extraction.

The Engagement

ScadaDog was engaged as the integration engineering partner to design and deploy a vendor-neutral fleet data layer:

- Audit and map existing SCADA infrastructure across all 63 sites
- Deploy edge gateways with multi-protocol translation (Modbus, DNP3, OPC-UA, MQTT)
- Implement tag normalization following ISA-95 / IEC 61850 standards
- Build secure OT-to-IT data pipelines with store-and-forward resilience
- Develop real-time fleet dashboards with role-based access
- Create automated compliance reporting for NERC/FERC requirements
- Design the data architecture for AI/ML predictive maintenance

Key Technical Decisions

DECISION	APPROACH
Edge Platform	Ignition Edge on hardened industrial PCs — native OPC-UA, MQTT Sparkplug B, store-and-forward capability.
Historian	Canary Labs time-series historian — lossless compression achieving 10:1 storage reduction.
Tag Model	Unified Device Templates (UDT) following ISA-95: Enterprise → Site → Area → Equipment → Tag.
Security	Zero-trust segmentation with VPN tunnels, certificate auth, air-gapped options.
Cloud	AWS-hosted analytics with Ignition Perspective for web-based fleet dashboards.

04 — RESULTS

Measurable Impact Across the Fleet

The deployment was executed incrementally over 18 months, with the first 10 sites live within 90 days:

87%
REDUCTION IN MANUAL DATA COLLECTION

4.2x
FASTER INCIDENT RESPONSE TIME

$2.1M
ANNUAL SAVINGS PREDICTIVE MAINT.

100%
FLEET VISIBILITY SINGLE SCREEN

Operational Improvements

From Reactive to Predictive. With normalized, time-aligned data from every asset, the team deployed anomaly detection models within six months. Early fault detection on inverters alone saved an estimated $800K in year one by catching degradation patterns weeks before failure.

Fleet-Wide Benchmarking. For the first time, operations could compare performance ratios across identical equipment in different climates. This revealed 12 sites underperforming their weather-adjusted baseline by 5–8%, leading to targeted interventions worth $1.3M in recovered annual generation.

Automated Compliance. NERC and FERC reporting that consumed 40+ hours per quarter was reduced to automated, scheduled exports—freeing engineers to focus on optimization instead of data entry.

AI-Ready Foundation. The normalized data layer became the foundation for production ML models: BESS state-of-health prediction, solar soiling estimation, and wind turbine bearing wear detection.

Fig. 3 — Real-time fleet dashboards give operators, engineers, and executives role-appropriate views of asset health, performance, and compliance.

> "For the first time, our CEO can open a single dashboard and see the health of every renewable asset we own. That visibility is worth more than any individual optimization."

05 — WHY SCADADOG

The Guide Your Operation Needs

ScadaDog is a vendor-neutral industrial automation and IIoT consultancy that bridges Operational Technology (OT) and Information Technology (IT). Founded by engineers with hands-on experience at Blue Origin and NextEra Energy, we speak both ladder logic and Python.

We don't sell hardware. We don't push proprietary platforms. We design and deploy standards-based integration architectures that give you full ownership of your data and a clear path to AI-powered operations.

Core Capabilities

SCADA & Controls

- System architecture & deployment
- HMI development & visualization
- OPC-UA, MQTT, Modbus, DNP3 integration
- Edge device configuration & management

Software & Cloud

- Custom middleware & API development
- AWS / Azure cloud architecture
- Secure OT-to-IT network design
- Air-gapped & on-prem deployment

Data Engineering & AI

- Industrial data normalization & modeling
- ISA-95 / IEC 61850 asset hierarchies
- AI-ready data pipeline design
- Fleet monitoring & diagnostics

Certifications

- Canary Labs Certified Partner
- Ignition (Inductive Automation) Certified
- AWS Partner Network
- ISN · EEI · SAM Registered

>90%	85%	24/7	IEC
ON-TIME DELIVERY	CLIENT RETENTION	EMERGENCY SUPPORT	STANDARDS COMPLIANT

Ready to Break Your Data Silos?

We'd love to learn about your operation and show you what's possible. No pitch—just a conversation between engineers.

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