ARDEXA

The Digital Control Platform

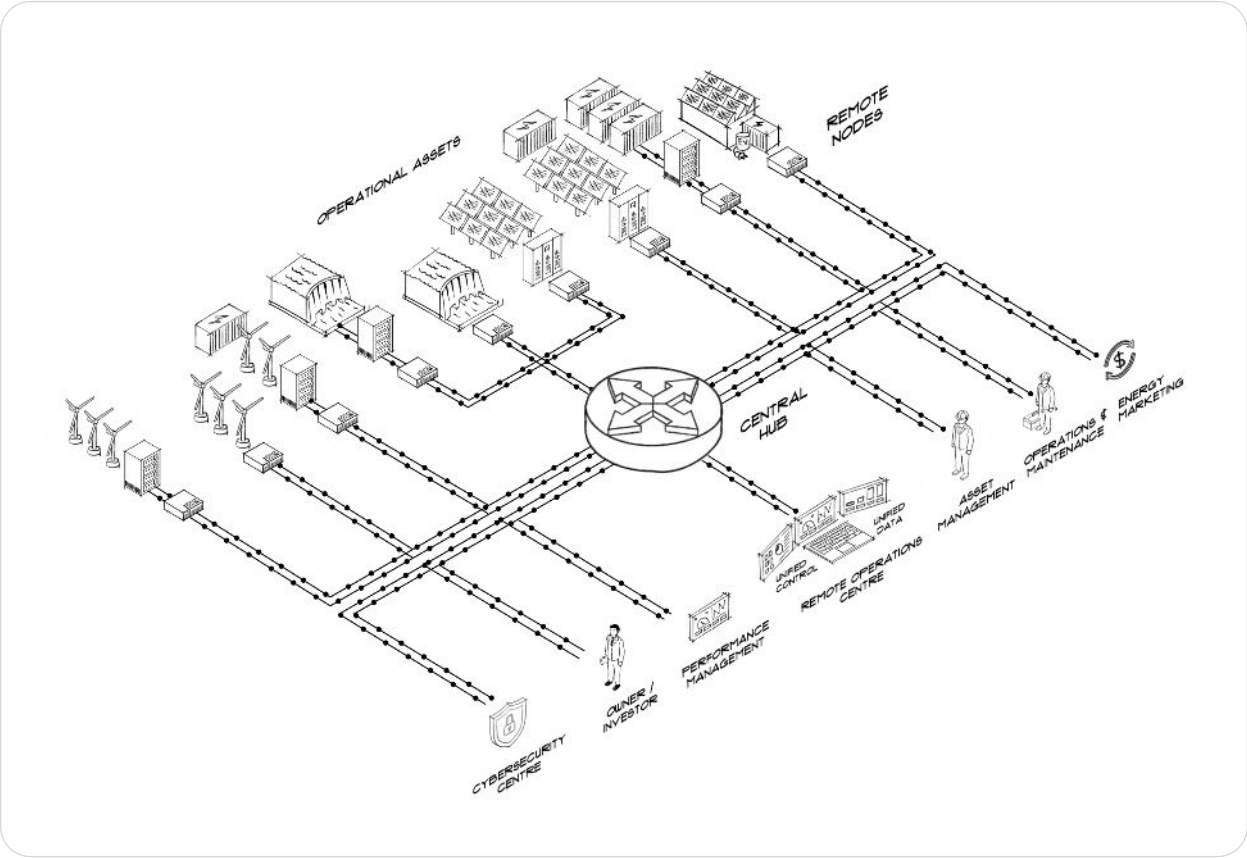
Reinventing SCADA

With a Cloud-Native Approach to Unifying Data

REIMAGINING SCADA FOR TODAY'S RENEWABLE ENERGY OPERATIONS

The rapid expansion of utility-scale renewable energy has exposed the limitations of traditional SCADA systems, which were designed for an era of simpler, more homogeneous power generation. Today's renewable energy operators face unprecedented challenges: managing diverse portfolios of wind, solar, and storage assets; integrating equipment from dozens of vendors; and analyzing massive volumes of operational data to optimize performance; all while maintaining compliance with increasingly burdensome regulations.

The Digital Control Platform (DCP) represents a fundamental reimagining of SCADA for this new reality. By separating data acquisition from proprietary control systems and creating a vendor-neutral data foundation in the cloud, DCPs dramatically reduce the time, cost, and complexity of digitizing renewable operations. This cloud-native architecture enables operators to centralize their operational data, standardize their monitoring and control interfaces, and maintain complete ownership of their data assets - all while supporting the advanced analytics and automation capabilities essential for competitive advantage in the renewable energy sector.



THE ROLE OF DATA IN UNLOCKING THE FUTURE OF RENEWABLE ENERGY

The rapid deployment of battery energy storage, emerging smart grid technologies and green hydrogen along with AI and machine learning are transforming the renewable energy landscape. These and other innovations are reshaping how energy is generated, stored, and distributed, making it crucial for owner-operators to adapt quickly. As the industry evolves, it's impossible to predict which technologies—or combinations of technologies—will drive the greatest efficiency and maximize ROI over time. To stay competitive, companies must consolidate all relevant operational data, regardless of source, ensuring they have access to the insights needed to optimize performance, integrate new energy solutions, and maximize the potential of renewable assets.

Most OT data generated by renewable energy companies is controlled by 3rd parties. It may be held by inverter, logger, or turbine manufacturers, locked in legacy SCADA systems, or managed by third-party O&M providers. Additionally, shifting subsidies, tax incentives, and rapid technical evolution have caused many OEMs to go out of business, leaving critical data trapped in unsupported systems. A great deal of potentially invaluable and accessible source data is not collected at all for a variety of reasons. Without full control over OT data, companies have limited control over their digital future.

Instead of a unified, accessible data lake, companies are left with fragmented data silos—hindering decision-making. With so much to be gained, what is holding the industry back?

FOUR FORMIDABLE CHALLENGES

The challenges to executing a successful digital transformation are significant. One must understand the nature of these challenges before the digital journey can begin. We present here four universal challenges, the "Four C's", that must be overcome to enable digital transformation. We also highlight the critical role of the Digital Control Platform (DCP) in addressing them.

COLLECTING, NORMALISING, ENRICHING ALL OT DATA

CENTRALIZING DATA IN AN INDEPENDENT CLOUD DATA STORE

CONTROLLING DATA WHILE MAXIMIZING ACCESSIBILITY

CYBERSECURITY AND COMPLIANCE

COLLECTING, NORMALISING, AND ENRICHING ALL OT DATA

Operational excellence in an era of rapid change requires portfolio owners to maintain sovereign control over their OT data while making it universally accessible across their organization. While collecting and consolidating data is fundamental to realizing continuous operational improvement, many traditional approaches surrender data control to proprietary SCADA systems or third-party Asset Management or Performance Management SaaS platforms, creating expensive dependencies and unnecessary barriers to data access.

The challenge intensifies with the expanding dimensions of renewable OT data:

Volume: Increasing equipment sophistication generates more data points

Velocity: Higher sampling rates enable advanced analytics and AI applications

Variety: Emerging renewable technologies introduce new data types and formats

OT data is a strategic asset that demands direct ownership and control. Organizations that cede data collection to equipment manufacturers, SCADA providers, or third-party SaaS applications often find themselves locked into rigid systems that weren't designed for enterprise-wide digital transformation. Such legacy platforms typically impose artificial limits on data collection and frequency, while their vendors increasingly monetize access to their user's own operational data.

The protocol diversity in renewable energy further complicates data sovereignty. Collecting comprehensive OT data across different plant types requires mastery of numerous protocols - from open standards to proprietary formats, from industrial to IT protocols, from wired to wireless communications. This complexity often pushes organizations toward consolidated platforms that promise simplicity but demand surrender of direct data control.

CATEGORY	PROTOCOL EXAMPLES
Automation - General	Modbus, IEC, CAN, OPC UA, OPC DA, Profinet, ...
Automation - Proprietary	FINS - Omron PLC, Melsec - Mitsubishi PLC, …
Automation - Serial Buses	Modbus RTU, CAN, Profibus, RS232, RS485, RS422, USB, …
Industry – Power System	IEC60870-5, IEC61850, DNP3, ICCP, …
Industry – Meters	DLMS, IEC61107, M-Bus, …
Application	FTP, MQTT, AMQP, SSH, RTSP, …
Web Service	HTTP, HTTPS, XML, JSON, REST API, JavaScript, oBIX, …
Database	ODBC, JDBC, …
Wireless	LTE, LoRaWAN, Bluetooth, ZigBee, 802.XX, …

What appears to be a somewhat manageable list of protocols masks an exponentially more complex reality of manufacturer-specific implementations. Each vendor applies their own proprietary variations in data mapping, metadata tagging, and coding standards. A robust Digital Control Platform (DCP) shields owner-operators from this complexity by managing thousands of protocol variations behind the scenes, allowing seamless data access across your entire renewable portfolio.

The DCP vendor should shoulder this technical burden, maintaining and updating these protocol implementations so users don't have to. Beyond just collecting and storing data, your DCP should automatically normalize tags and alert data from different manufacturers into a standardized format. This crucial transformation work, handled entirely by your DCP provider, turns a maze of incompatible data streams into a unified, actionable resource - making continuous operational improvement practical and achievable without demanding specialized in-house expertise.

Normalizing data at the source (e.g. inverter, turbine, weather station) represents a fundamental shift from traditional approaches that rely on standardizing on vendor-specific SCADA systems across a portfolio. When data is normalized at the device level, each new data source needs to be mapped only once to be universally accessible across any facility. This "normalize once, deploy anywhere" approach creates remarkable flexibility and agility. Once a device type is integrated into the Digital Control Platform anywhere, it can be instantly deployed at any site, regardless of the local SCADA system or plant configuration. Onboarding new plants and equipment becomes almost effortless.

This contrasts sharply with the approach of standardizing on a single SCADA vendor, which forces owner-operators into a closed ecosystem of proprietary software, expensive licensing, and ongoing dependence on expensive vendor professional services. While SCADA standardization might appear to offer simplified operations as an outcome, it ultimately creates vendor lock-in, inflates costs, and limits operational agility. Source-level normalization preserves operator independence while creating a standardized data foundation that can evolve with changing business needs.

CENTRALIZING OT DATA IN AN INDEPENDENT CLOUD DATA STORE

A foundational principal of the Digital Control Platform is ensuring that all OT data collected is accessible to every facet of the business. The question may be--why should OT data reside in the Cloud? The short answer is--that is where all the innovation is taking place.

Bill Joy, co-founder of Sun Microsystems, famously said, “No matter where you are, most of the smartest people work somewhere else.” This insight applies not only to individual organization but also to the vendor solutions they rely upon. The prudent digital strategy harnesses the collective intelligence of the entire ecosystem, rather than relying solely on one vendor’s vision and ability to deliver. Renewable energy companies that make their OT data accessible through open standards and APIs build a foundation for continuous innovation. This accessibility makes it easier to adopt cutting-edge solutions from both established providers and emerging specialists. Today, that means managing OT data in the cloud, where advancements in machine learning, predictive analytics, and AI are driving the future of the industry.

There are three simple reasons such innovation is taking place almost exclusively in the Cloud: ***Cost. Scalability. Interoperability.***

Cost: Cloud infrastructure costs have plummeted - storage costs down 80% and computing costs halving every three years.

Scalability: Cloud architecture enables innovators to efficiently adapt to changing demands, minimizing costs while maximizing performance and growth potential.

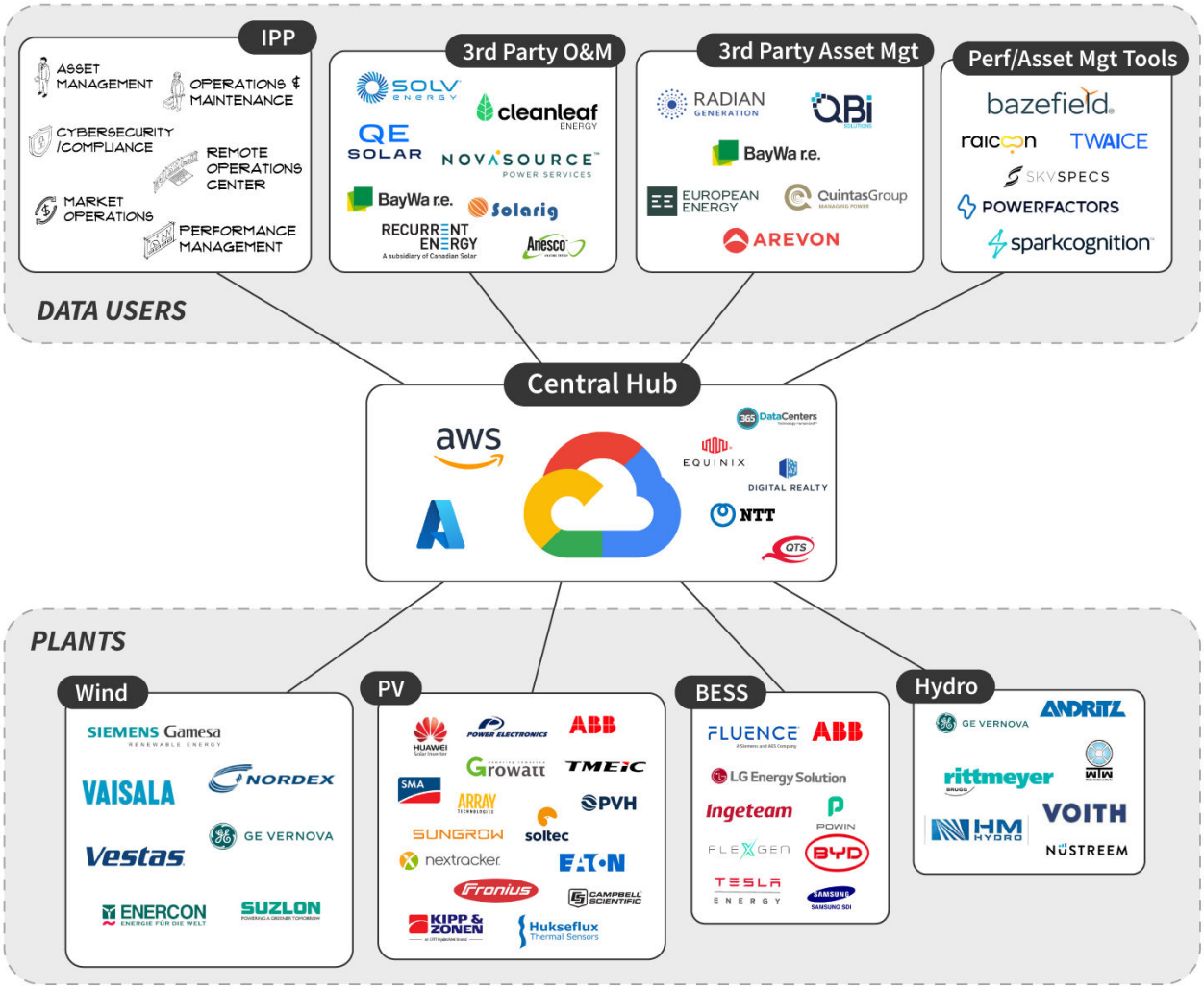
Interoperability: When data resides in the Cloud, with its API-centric architecture, it can be seamlessly integrated with cutting-edge AI, predictive analytics, and machine learning tools.

Public Cloud platforms like AWS, Azure and Google offer tremendous advantages, including scalable resources, cost-efficiency and interoperability. However, for certain critical industries, regulatory requirements necessitate stringent control over data management. For example, the North American Electric Reliability Corporation’s Critical Infrastructure Protection (NERC CIP) standards mandate that any technology capable of controlling power production with potential impact on the grid cannot be hosted in a public cloud. Therefore, a Digital Control Platform should leverage cloud-native technologies while maintaining the flexibility to operate across multiple public cloud environments or deployed within private data centres.

CONTROLLING DATA WHILE MAXIMIZING ACCESSIBILITY

Interoperability also applies to easily sharing OT data with all business stakeholders both inside and outside the four walls of the owner-operator's enterprise. Most renewable energy projects result from collaboration across an entire ecosystem which evolves over the lifecycle of the asset. Business partners, asset owners, investors, asset managers and O&M providers can each obtain, as well as create business value from access to OT data. Asset managers and asset owners need to easily evaluate and compare their O&M providers. Investors and Asset Owners can acquire new PV, Wind or Hydro assets without concerns about integrating disparate equipment and SCADA systems into their existing operations. Third party O&Ms need to quickly and easily onboard new customers and new equipment while easily meeting the ever-expanding demands from clients to provide increased levels of operational visibility.

However, whoever controls the data will reap the lion's share of the rewards of digital transformation, AI and Predictive Analytics. A DCP puts you in control of your data.



While leading SaaS applications for Asset and Performance Management can deliver significant value, there are compelling reasons to opt out of using them for data collection and consolidation. The Digital Control Platform approach offers two key advantages: First, it avoids vendor lock-in, enabling the freedom to choose and easily switch between technologies as needed, by radically lowering switching costs. Second, by establishing a unified data foundation across your portfolio, you can deploy and integrate these SaaS applications much more rapidly, accelerating your time to value and return on investment.

Many users of even market-leading SaaS applications experience frustration due to restricted data access whenever they need to augment vendor capabilities. By reversing the flow by providing data to SaaS applications via a secure, scalable API, owner-operators maintain maximum control and flexibility while leveraging existing SaaS vendor integrations with the Digital Control Platform. This approach also simplifies the testing of new SaaS solutions, allowing portfolio owners to continuously take advantage of the most innovative technology for extracting operational and business insights from their data

CYBERSECURITY AND COMPLIANCE

In today's rapidly evolving renewable energy landscape, cybersecurity and compliance with critical infrastructure regulations have become fundamental imperatives for owner-operators. A Digital Control Platform (DCP) must incorporate security as a cornerstone of its design, not merely to satisfy regulatory requirements, but to streamline the complex processes of achieving and documenting compliance.

The DCP's security posture begins at the data source and extends seamlessly to the cloud through comprehensive end-to-end controls. By maintaining direct control over data from its point of origin in plant networks through its entire lifecycle, organizations can implement systematic monitoring and risk management from the source to the consumer.

One of the most challenging aspects of maintaining compliance involves managing multiple third-party connections to plant networks. Organizations must establish rigorous auditing procedures for these external partners, carefully documenting their security controls and ensuring they align with internal compliance standards. At the foundation of the DCP architecture lies strategic limitation of 3rd party connections to plant networks, creating a carefully controlled environment that minimizes potential attack surfaces and entry points for cyber threats and significant narrowing the scope of compliance documentation.

By implementing regular scanning of plant data sources and networks, the DCP can identify open ports and security vulnerabilities before they can be exploited, enabling proactive risk mitigation. This unified security approach is reinforced by digital certificates that provide trusted authentication and maintain data integrity from source to cloud, ensuring that data remains protected and uncompromised throughout its life cycle. The ability to control and secure data from its origin through its life cycle establishes a robust security foundation.

A crucial component of the DCPs compliance capabilities is its integrated, immutable audit trail that automatically captures and preserves all relevant user actions. This automated, end-to-end approach both simplifies compliance reporting and reduces administrative overhead. By maintaining an unchangeable record of all system activities, organizations can easily demonstrate their compliance status during audits with complete confidence in their documentation.

Data protection forms another critical layer of the security framework, with encryption technologies safeguarding sensitive information. The implementation of mandatory multifactor authentication adds another crucial security barrier, requiring multiple forms of verification before granting system access and significantly reducing the risk of unauthorized access.

Through the holistic implementation of these sophisticated security measures, organizations can establish a Digital Control Platform that not only meets current compliance requirements but also provides a foundation for addressing future security challenges. This comprehensive approach to security and compliance helps ensure the resilience and protection of critical infrastructure while simplifying the ongoing task of maintaining regulatory adherence.

SECURING THE FUTURE THROUGH INDEPENDENT DATA CONTROL

The renewable energy sector stands at a pivotal moment of transformation, driven by rapid growth, evolving market demands, and increasing regulatory complexity. A Digital Control Platform represents the modern approach to navigating these challenges, offering a strategic alternative to the limitations of traditional SCADA standardization or the loss of control inherent in third-party SaaS solutions.

This Digital Control Platform approach enables renewable energy companies to maintain sovereignty over their operational data while ensuring the scalability, openness, and security demanded by today's dynamic energy landscape. As the industry continues its rapid evolution, those who establish control over their OT data today will be best positioned to drive innovation, optimize performance, and maintain competitive advantage in the years ahead

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