Renon Power Distributed Energy Storage Application White Paper

2025 1ST EDITION

Preparation Unit: Renon Power Product and Solution Center/Renon Power Local EMS & Cloud EMS Platform Group
Release Date: November 17, 2025
Version Number: V1.0
Applicable Region: North America/Europe/Asia-Pacific
Confidentiality: ☐Internal Use Only ☑Public Version

E-mail: support@renon-usa.com

Renon Power

We Care About Sustainability

With our own R&D team and automatic production factory, we are dedicated to delivering innovative, reliable, and affordable energy storage solutions to global customers.

At Renon Power, we believe that sustainable energy is the future. We are passionate about reducing carbon emissions and preserving our planet for future generations. That's why we invest heavily in research and development, leveraging the latest technologies to design and manufacture energy storage systems that are efficient, scalable, and adaptable.

Our products are designed to meet the needs of a wide range of applications, from residential and commercial buildings to industrial facilities and utility-scale projects. Whether you're looking to reduce your energy bills, increase your energy independence, or support your sustainability goals, Renon Power has the right solution for you.

Our commitment to quality and customer satisfaction is unwavering. We work closely with our clients to understand their unique needs and provide customized solutions that meet or exceed their expectations. We also provide comprehensive technical support, maintenance, and warranty services to ensure that our customers get the most out of their investment.

Join us on our mission to make renewable energy within reach.

PROVIDE INNOVATIVE, RELIABLE, AND AFFORDABLE ENERGY STORAGE SOLUTIONS TO CUSTOMERS WORLDWIDE.

Contents

Executive Summary

This "Renon Power Distributed Energy Storage Application White Paper" systematically outlines three core platforms for Renon Power's distributed energy storage practices in North America, Europe, and the Asia-Pacific markets:

- 261 AC Platform: Designed for large commercial and industrial sites and multi-site distributed energy storage networks;
- 261 AS Platform: Aimed at small and medium-sized commercial and industrial users, community energy, solar-storage integration, and microgrid/island scenarios;
- 10-Foot AC Platform: Targeted at large centralized energy storage, electric vehicle charging hubs, cold chain parks, and other heavy-load scenarios.

Against the backdrop of rapidly increasing flexibility demands from the grid, accelerating price structure differentiation, and the gradual maturation of VPP/aggregation services, energy storage systems have evolved from simple "battery + PCS" to an integrated distributed energy asset comprising: the equipment platform, Local EMS, Cloud EMS, and the Aggregation/VPP Platform.

To address this trend, Renon Power has developed three standardized distributed energy storage platforms built on a unified technical architecture:

a. **261 AC Platform:** Main platform for large sites + multi-site distributed energy storage

- Utilizes a 261 kWh outdoor liquid-cooled battery paired with an integrated 135 kW PCS.
- Enables the deployment of large-scale sites, with capacities ranging from tens of MWh per site up to 200 MWh through a standardized architecture of **Cabinet → Array (5+1) → Matrix (4 Arrays) → Site (grid connection at 15kV/35kV)**;
- This solution is applicable to high-speed service area fast charging networks in Texas, data center parks in California, and multi-site distributed energy storage networks.

b. **261 AS Platform:** Small and medium-sized sites + Aggregated resource pool platform

- It adopts a combination structure of 261 liquid-cooled batteries + Solis energy storage inverters;
- A single site supports the parallel operation of up to 6 units (with a Local EMS in a 1-master-5-slave configuration), and a single aggregation group supports ≤100 sites;
- It is suitable for suburban community energy projects in California, rooftop PV + energy storage projects, and high-value distributed scenarios such as photovoltaic + diesel engines + energy storage microgrids on the island of Puerto Rico;
- Through cloud EMS + aggregation/VPP platform, aggregates "small sites" into a "Virtual Power Plant (VPP)" to participate in the electricity market and ancillary services.

c. **10-Foot AC Platform:** High power/large capacity centralized energy storage platform

- It adopts an integrated design of 10-foot liquid-cooled batteries + PCS + cabinet-level local EMS;

- Through the architecture of "single cabinet – rack (3+1+1) – matrix (3 rack cabinets) – site (15kV/35kV access, multiple matrix combinations)," centralized energy storage stations of 45 MWh to 75 MWh can be constructed;
- It is suitable for cold chain logistics parks in New York, large high-speed charging hubs (Texas interstate charging hub stations), and other scenarios characterized by high load, high demand charges, and high electricity prices.

In terms of system architecture and platform capabilities, the three major platforms possess the following common characteristics:

a. Modular and standardized hardware structure

- Using "array/rack/matrix/site" as the standard granularity to achieve rapid replication and expansion;
- Facilitates the reuse of solutions under different electricity pricing structures and interconnection rules in California, Texas, New York, Puerto Rico, and other places.

b. Local EMS as "on-site brain", cloud EMS/aggregation/VPP platform as "cloud hub"

- Local EMS is responsible for real-time scheduling, safety control, and data acquisition at the equipment and site levels;
- Cloud EMS and the aggregation/VPP platform are responsible for unified strategies, revenue optimization, and power market interfaces across multiple sites and regions.

c. Unified communication and interface standards

- Supporting various industrial and cloud communication protocols such as Modbus TCP, IEC 60870-5-104, MQTT, RESTful API, etc.;
- Native support for Renon Power's own cloud EMS, aggregation module, and VPP module, while also compatible with third-party platforms;
- Efforts are made to unify point tables, alarm systems, and data models across platforms, which is beneficial for rapid development and maintenance.

On the application level, this white paper focuses on showcasing the project practice ideas of three major platforms in four representative regions: California, Texas, New York, and Puerto Rico, through the following typical scenarios:

- Fast charging + energy storage at highway service areas (Texas);
- Energy storage + electricity price optimization in data center parks (California);
- Community energy + rooftop photovoltaic + energy storage (California);
- Island microgrid: photovoltaic + diesel generator + energy storage (Puerto Rico);
- Centralized energy storage in cold chain logistics parks (New York);
- Interstate highway charging hub supercharging + energy storage (Texas).

This white paper aims to provide a practical, replicable, and scalable distributed energy storage platform and application reference framework for the R&D, product, solution, sales, and delivery teams within Renon Power, as well as for power companies, investors, EPCs, and ecosystem partners, providing a unified technical and commercial foundation for subsequent project execution and market development.

Chapter 1 261 AC Platform Configuration and Application Instructions

1.1 Terminology and Hierarchical Agreements

To unify the language used in internal and external communications regarding the Renon Power distributed energy storage solution, this white paper establishes the following agreements on the key levels of the 261 AC platform:

a. Cabinet

Refers to a single 261 AC battery + 135kW PCS integrated cabinet, which is the smallest equipment unit of the 261 AC platform.

b. Array

A basic and parallel system unit composed of several 261 AC cabinets and matching communication and distribution equipment, with independent protection capability and local EMS control capability at the array level.

In this white paper, the standard definition of an array is: 5 units of 261 AC cabinets + 1 AC distribution cabinet = 1 array.

c. Matrix

A converging unit formed by multiple arrays in parallel at the same voltage level, which is a primary module for site power and capacity expansion.

Standard definition: 4 arrays = 1 matrix.

d. Site

Several matrices are connected to a medium-voltage grid such as 15kV or 35kV via transformers/medium-voltage switches, forming an energy storage station with independent grid-connected/off-grid control capability, managed and monitored uniformly by the station-level EMS.

e. Project

A business entity composed of one or more sites, such as the “Texas 20 Site Distributed 261 Project”, typically managed by a cloud EMS/aggregation platform/VPP platform for unified strategy and revenue optimization.

Requirements: All technical solutions, drawings, BOMs, and point lists must strictly adhere to the above naming and hierarchical definitions in order to avoid the mixed use of concepts like “rows, columns, arrays”, ensuring consistency in design and implementation standards.

1.2 261 AC Cabinet Level and Array Configuration

1.2.1 Cabinet Level Configuration

Single cabinet configuration: 261 AC + 135kW PCS AC integrated machine

a. Battery System Part

- Approximately 261kWh outdoor liquid-cooled battery system;
- Utilizes LFP battery cells, with three levels of monitoring and protection at the cell/module/cabinet levels;
- Protection level (e.g., IP55/IP65, depending on final product specifications) meets the requirements for long-term outdoor operation and corrosive environments;
- Supports advanced battery management functions such as temperature management and active balancing.

b. PCS (Power Conversion System) Section

- Built-in approximately 135kW bidirectional energy storage PCS in a single cabinet;
- Supports both grid-connected and off-grid operating modes;
- Meets relevant grid-connected standards for the target market (such as UL, IEEE, IEC, etc.);
- Supports active/reactive regulation, power factor control, frequency/voltage adjustment, and other control modes (specifics are subject to product specifications).

c. Measurement and Control Protection

- Cabinet-level BMS and internal PCS protection work together to realize protection logic for overvoltage, undervoltage, overcurrent, short circuit, over temperature, etc.;
- Cabinet-level operating status (running, downtime, alarm, fault) is uploaded to the EMS at the array level through communication interfaces;
- Reserve a mechanism for remote upgrades and remote parameter transmission to lay the foundation for subsequent operation and maintenance optimization.

1.2.2 Array “5+1” Standard Configuration

In the 261 AC platform, in order to achieve standardized design and rapid replication, it is defined as:

1 complete 261 AC array = 5 sets of 261 AC cabinets + 1 AC distribution cabinet

The specific composition and responsibilities are as follows:

a. 5 sets of 261 AC cabinets (including 135kW PCS)

- Provide the energy storage capacity and power output for this array;
- Each cabinet is independently monitored and controlled, with unified scheduling by the EMS at the array level.

b. AC distribution cabinet

- Complete the collection and distribution of AC output from the 5 sets of 261 AC cabinets within this array;
- Configure array-level main circuit breakers and protective devices (circuit breakers, fuses, protective relays, etc.);

- Configure array-level energy meters and electrical parameter collection devices for measurement and power quality monitoring;
- Provide a unified AC output connection matrix level, station-level distribution system, or medium voltage side transformer.

Conclusion:

In the 261 AC platform of Renon Power, the concept of "array" is standardized and defined as "5+1". The design, selection, and BOM preparation for all projects should be planned and accounted for using the array as the minimum AC parallel unit.

1.3 261 AC Matrix and Site Grid Connection Capability

1.3.1 Matrix Configuration

A matrix is a collection unit formed by multiple arrays connected in parallel at the same voltage level, and it is a key module for the capacity and power expansion of the 261 AC platform site.

a. Standard Definition:

Four complete 261 AC arrays in parallel constitute one 261 AC matrix.

b. Functional Requirements for the Matrix Side:

- Configure the matrix main incoming circuit breaker and corresponding protective settings (short circuit, overload, etc.);
- Configure matrix-level electrical parameter collection (voltage, current, active power, reactive power, frequency, etc.) to provide decision-making data for the station-level EMS;
- Establish a communication connection with the station-level EMS as part of the hierarchical management of the site;
- Calibrate the matrix rated power, rated capacity, and operational boundaries (maximum/minimum power, SOC limits, etc.) to form a unified parameter template for quick replication and simulation modeling.

1.3.2 15kV Grid Connection Scenario

When the site is connected to the grid at a voltage level of 15kV, the standard capacity planned for the 261 AC platform is: supporting a maximum of 4 parallel-operating 261 AC matrices

a. The corresponding resource scale is illustrated as follows:

- Number of matrices: 4;
- Number of arrays: 4 matrices × 4 arrays/matrix = 16 arrays;
- Number of cabinets: 16 arrays × 5 cabinets/array = 80 units of 261 AC cabinets.

b. Key points for engineering verification:

- Whether the capacity and impedance of the 15kV transformer meet the requirements for maximum power and short circuit current;

- Is the short-circuit capacity of the medium-voltage bus sufficient to withstand the scale of energy storage access;
- Whether voltage fluctuations, harmonics, and power quality meet the technical specifications of the local grid company;
- When necessary, power flow, short circuit, and transient stability simulation analysis should be conducted.

1.3.3 35kV Grid-Connected Scenario

When the site is connected to the grid at a voltage level of 35kV, the standard capacity planned for the 261 AC platform is: supporting a maximum of 12 parallel operating 261 AC matrices.

a. The corresponding resource scale is illustrated as follows:

- Number of matrices: 12;
- Number of arrays: 12 matrices × 4 arrays/matrix = 48 arrays;
- Number of cabinets: 48 arrays × 5 cabinets/array = 240 units of 261 AC cabinets.

b. Applicable Scenarios and Precautions:

- Applicable to large centralized energy storage stations of approximately 80 MWh or less;
- It is necessary to focus on verifying the short circuit capacity, system impedance, and frequency stability on the 35kV side;
- It is necessary to strictly follow the grid connection specifications of the local power grid company (such as peak regulation, frequency regulation, voltage support, and other technical requirements) and to coordinate with a complete design for protection and control.

1.3.4 Explanation and Constraints

a. **"4 Matrix @ 15kV" and "12 Matrix @ 35kV"** are the standard design upper limits and product planning baselines for the 261 AC platform, used for:

- Guiding product model and modular capacity planning;
- Guiding typical scheme configuration, internal training, and external promotion;
- Providing a unified capacity granularity for modeling in the cloud EMS/aggregation/VPP platform.

b. **If actual projects require:** exceeding the above matrix quantities or using other medium voltage connection methods, specialized grid simulation analysis and grid connection review must be conducted, and adjustments to station-level EMS, protection systems, and equipment selection must be synchronized.

1.4 Compatibility of 261 AC Local EMS with Cloud

1.4.1 Local EMS Hierarchical Architecture

a. Array-level EMS (located in the combiner cabinet):

- Responsible for the unified control and data collection of the five 261 AC cabinets within the array;

- Presenting upward as "an array control node".

b. Station-level EMS (located in the station control room or switch cabinet):

- Manages all matrices and arrays within the station;
- Completes active/reactive scheduling, tariff strategy execution, peak shaving and valley filling, demand control, etc.;
- Serves as the sole control interface for the station, connecting to cloud EMS, aggregation platforms, or grid scheduling systems.

1.4.2 Compatibility of Proprietary Cloud Platform

a. 261 AC local EMS natively supports Renon Power’s proprietary:

- Cloud EMS platform;
- Aggregator Module;
- VPP Module.

b. Capability Requirements:

- Support strategy deployment (power curves, operating modes, SOC management, constraints, etc.);
- Support real-time and historical transmission of operational data, events, and alarms;
- Support remote parameter configuration, remote firmware upgrades, remote diagnostics, and other functions.

1.4.3 Third-Party Platform Compatibility

- Support for dispatching from third-party cloud EMS, aggregation platforms, VPP platforms;
- Recommended communication protocols for priority support:
  - Modbus TCP;
  - IEC 60870-5-104;
  - MQTT;
  - RESTful API, etc.
- Provide a unified point table, data structure, and security certification mechanism:
  - Facilitates integration with power company SCADA, ISO/RTO systems, or customers' own platforms;
  - Reduce integrated development costs and project launch cycles.

1.4.4 Consistency of Interface with 10-Foot AC Platform

In terms of point tables, alarm codes, data units, and precision, the 261 AC platform aims to remain consistent with the 10-Foot AC platform; this facilitates Renon Power in achieving a unified cloud EMS and aggregation/VPP scheduling logic across multiple platforms and product combinations.

1.5 Typical Application Scenarios of 261 AC

The 261 AC platform mainly targets the following typical application scenarios:

a. Multi-Site Distributed Energy Storage Network

- Example: In regions such as Texas/California, construct a distributed energy storage network of "20 sites × approximately 10MWh per site = 200MWh/100MW";
- Each site is built based on the 261 AC array/matrix;
- The local EMS is responsible for site-level operation management; the cloud EMS/aggregation platform is responsible for multi-site strategy integration and revenue optimization.
- It is used for peak shaving, demand management, electricity price arbitrage, and regional ancillary services.

b. Peak shaving and demand control for large industrial and commercial users

- **Scenario:** Industrial parks, large manufacturing plants, data centers, commercial complexes, etc.;
- **Goal:** Reduce peak electricity costs, control maximum demand, and improve power quality;
- 261 AC constructs sites in an array/matrix manner, with station-level EMS implementing strategies based on electricity price and load forecasting;
- This can significantly reduce annual electricity bills and enhance electricity safety.

c. Supporting energy storage for public fast charging/supercharging stations

- **Scenario:** Highway service areas, urban complex parking lots, chain retail/restaurants charging stations, etc.;
- **Goal:** Alleviate the distribution pressure caused by supercharging, reduce demand costs, and enhance the charging experience;
- 261 AC integrates local EMS with cloud EMS to smooth charging loads and optimize electricity prices;
- A combination scheme of "Small Station 261 AC + Large Hub 10-Foot AC" can be formed with the 10-foot AC platform.

d. Renewable Energy + Energy Storage Integrated Project

- **Scenario:** Energy storage paired with photovoltaic power plants/wind farms, or integrated source-network-load-storage projects;
- The 261 AC serves as a standard energy storage module on the power plant/user side, in conjunction with cloud EMS to achieve peak shaving, valley filling, smooth output, and participate in peak regulation/frequency modulation;
- This helps improve the renewable energy absorption rate and project IRR.

e. Aggregation/VPP Hardware Base

- As the standardized hardware base for the aggregation/VPP platform, the 261 AC provides a unified equipment model and operating characteristics;
- In conjunction with cloud EMS and aggregation/VPP modules, multiple 261 AC sites can be packaged into a "virtual power plant" to participate in electricity market trading and ancillary services.

1.6 Typical Project Case Study of the 261 AC Platform (Texas/California)

To facilitate understanding of the application of the 261 AC platform in actual projects, this section selects two representative areas, Texas and California, and presents two standardized cases.

1.6.1 Texas Highway Service Area Multi-Site Fast Charging + 261 AC Energy Storage Project

a. Project Pain Points and Needs

- Project Location: Highway service areas along I-35 and I-45 in Texas.
- With the intensive deployment of 150–350 kW DC fast charging stations, the peak load in the service areas has surged, and the existing distribution capacity is nearing its limit.
- Under the ERCOT pricing system, peak electricity prices and demand charges constitute a significant portion of the electricity costs, making operators highly sensitive to electricity cost.
- The grid company has imposed constraints on peak demand, power quality, harmonics, etc. If demand control is not implemented, high-cost expansions will be necessary.
- Investors hope to:
    - Minimize large-scale expansion of the distribution system;
    - Quickly launch high-power fast charging services;
    - Keep the project payback period within the range of 4–5 years.

b. Project Objectives

- Under the existing distribution capacity constraints, support stable operation of ≥8–12 fast charging parking spaces at each station.
- Through peak shaving and demand control, reduce annual electricity expenses by 15–20%.
- Designed for future integration with Cloud EMS and Aggregation/VPP platforms, with the potential to participate in ERCOT's DR/ancillary services.
- Establish a standardized "fast charging + energy storage" station model that can be replicated throughout the Texas highway network.

c. Project plan and configuration

- **Network scale:** A total of 20 high-speed service area sites distributed along major highway trunk lines.
- **Single station 261 AC configuration:**
    - 1× 261 AC array:
    - 5×261 AC cabinets + 1×AC distribution cabinet;
    - Station-level local EMS: Interface with the station's fast charging pile control system, main distribution cabinet, and bidirectional energy meter;
    - Grid connection method: Connect to the 13.8kV / 15kV distribution network according to the actual situation of the site.
- **Control strategy:**
    - Off-peak period at night: 261 AC charges according to cloud EMS strategy instructions, utilizing low-cost electricity for energy storage;
    - Daytime and evening peak:
        - 261 AC discharges to provide partial power support for fast charging loads;

    - The station-level EMS executes demand limit control, restricting peak power draw from the grid to avoid transformer overload;
  - Cloud EMS: Conducts horizontal comparisons and rolling optimizations of operational data from 20 stations, continuously adjusting strategy parameters for each station.

d. Business Model

- **Investment entity:** Charging operators, or joint establishment of SPV with high-speed operators/energy investors.
- **Renon Power:** Provides 261 AC platform, local EMS, cloud EMS access solutions, and commissioning training services.
- **Grid side:** Depending on the ERCOT and retail policies, DR incentives or other flexibility subsidies may be superimposed.
- **Operation and Maintenance Model:**
  - Customer self-operation and maintenance + Renon remote technical support;
  - or sign a 5–10 year maintenance contract (including annual inspections, firmware upgrades, fault response).

e. Profit Model

- **Direct Revenue:**
  - Significantly reduce electricity costs by utilizing peak and off-peak price differences and load reduction;
  - Avoid or delay capital expenditures for distribution capacity expansion.
- **Indirect Revenue:**
  - Enhanced service capacity and charging experience at fast charging stations, driving increased traffic at service areas and boosting revenue from dining/retail businesses;
  - After connecting to the ERCOT market, obtain additional revenue through DR/ancillary services.

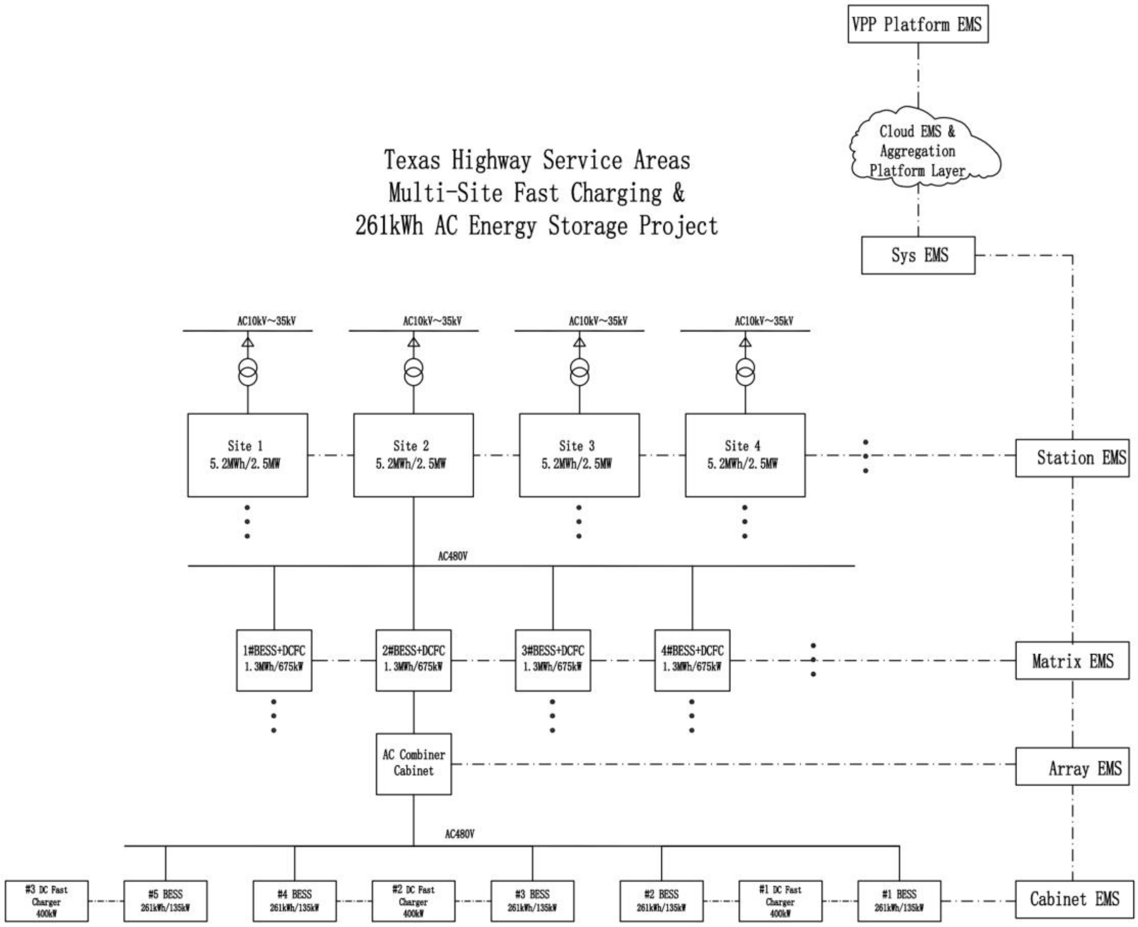
f. Investment Returns

- Total investment per station (including energy storage system, EMS, installation, and commissioning): approximately 0.9–1.1MUSD.
- Annual electricity bill savings + potential DR incentives: approximately 0.22–0.28MUSD/year.
- Static payback period: approximately 4–5 years.
- If combined with federal IRA and other policy incentives, the project's IRR is expected to increase to the range of 14–18% (specifics depend on electricity pricing structure and subsidy intensity).

g. Project Evaluation

- Using the 261 AC standard array and station-level EMS, rapid multi-site deployment can be replicated within the Texas high-speed network.
- The project addresses three critical factors: grid constraints, electricity costs, and charging experience," making it a typical high-cost performance solution.
- It lays an important benchmark project foundation for Renon in the Texas high-speed charging and service area scenario.

h. System Topology Diagram



i. Rendering Description

1.6.2 California Data Center Park 261 AC Energy Storage + Electricity Price Optimization Project

a. Project Pain Points and Needs

- Project Location: Data Center Cluster in the San Francisco Bay Area.
- The combination of high-density IT loads and cooling loads results in significant peak demand and TOU pricing costs.
- California has strict requirements for carbon emissions, renewable energy ratios, and energy efficiency indicators for data centers, and clients increasingly prioritize ESG performance in bidding.
- Clients hope to:
  - Reduce overall electricity costs;
  - Decrease reliance on diesel backup power;
  - Provide flexible dispatching capabilities for future "Renewable Energy PPA + Energy Storage Combination."

b. Project Objectives

- Reduce comprehensive electricity expenditure for the data center park by 10–15%.
- Provide 5–15 minutes of energy storage support time for critical loads during short-term grid disturbances, reducing the number of diesel start-stop operations and operating hours.
- Increase the "green electricity usage rate" in the park, enhance ESG indicators, and support obtaining higher-level green certifications.
- Create a replicable integrated solution template for other data center parks in Los Angeles, Sacramento, and beyond.

c. Project Plan and Configuration

- **Single park configuration for 261 AC:**
  - 2 sets of 261 AC matrices:
  - Each matrix has 4 arrays, totaling 20 units of 261 AC cabinets;
  - Total energy storage capacity: approximately 10.4MWh (calculated based on 261kWh × number of cabinets);
  - Total PCS power: approximately 5.4MW (indicative value).
- **EMS integration:**
  - Station-level local EMS: connects to the data center building management system (BMS), existing UPS system, diesel engine controller, and power metering system;
  - Cloud EMS: develops and issues daily/weekly/monthly scheduling strategies based on electricity prices, load forecasts, and PPA contract terms.
- **Operating strategy:**
  - Normal operation: Using energy storage to peak shaving and valley filling, controlling maximum demand, and smoothing the load fluctuations caused by the start and stop of chillers;
  - Grid disturbances or short-term power outages: The energy storage system collaborates with UPS to provide short-term support, reducing frequent switches to diesel generators;
  - Long-term optimization: Prioritizing the use of "green power + energy storage" based on renewable energy procurement, reducing the consumption of "brown power".

d. Business Model

- Data center operators invest directly or jointly with infrastructure funds/green energy funds.
- Renon Power provides: 261 AC hardware platform, EMS solution design, integration implementation, and long-term operation and maintenance support.
- Can adopt:
  - Traditional CAPEX + OPEX model;
  - Or introduce EMC / contract energy management model to pay part of the investment and service fees with the savings on electricity bills.

e. Profit Model

- **Direct Revenue:**
  - Significantly reduce electricity expenditure through demand control and TOU pricing optimization.
  - Reduce fuel and maintenance costs by decreasing diesel generator usage.
- **Indirect Revenue:**
  - Improving ESG performance helps achieve certification through "green data centers";
  - When collaborating with cloud service customers and large internet clients, enhance bargaining power and brand advantages;
  - If accessing the CAISO market, additional revenue can be generated by participating in certain ancillary services through aggregation/VPP.

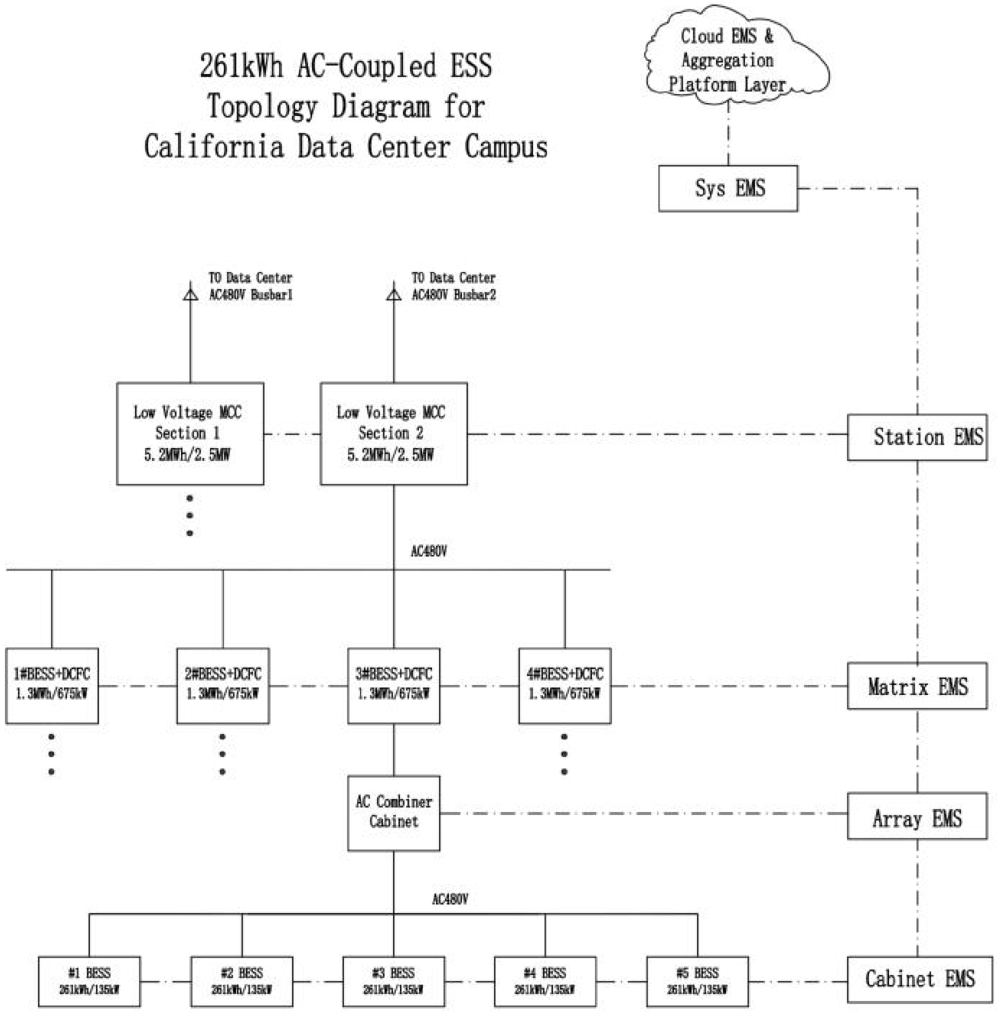
f. Investment Returns

- Investment in energy storage + EMS: depends on project capacity and the difficulty of electrical upgrades on-site.
- Annual comprehensive cost (electricity + diesel + operation and maintenance) savings ratio: usually up to 10-15%.
- Static payback period: approximately 5-7 years.
- If combined with green financial tools, tax breaks, and policy incentives, the IRR is expected to increase significantly.

g. Project Evaluation

- The modular architecture of the 261 AC array/matrix is particularly suitable for the "cabinet-based expansion" characteristic of data centers.
- The solution aligns closely with California's high electricity prices, strong ESG requirements, and renewable energy policy environment.
- The project has dual value as a technical and brand demonstration, serving as an important model for Renon Power to enter and deepen its involvement in California's data center market.

h. System Topology Diagram



i. Rendering Description

Chapter 2 261 AS Platform Configuration and Application Instructions

2.1 261 AS Unit and Site Configuration

2.1.1 261 AS Unit Definition

a. Basic Definition

In this white paper, the 261 AS Unit is defined as:

1 unit of 261 liquid-cooled battery cabinet + 1 external Solis 125kW energy storage inverter (AC-Coupled) + local EMS control unit inside/outside the cabinet is the minimum independently operable energy storage unit of the 261 AS platform.

b. Battery Section

- Battery Capacity: Approximately 261 kWh (based on specific cell/module configuration);
- Cell Technology: LFP (Lithium Iron Phosphate) cells, supporting three-level monitoring and protection for cells/modules/cabinets;
- Thermal Management System: Liquid cooling system, equipped with inlet/outlet temperature monitoring, cooling loop monitoring, and fault alarm;
- Protection Level: Meets outdoor installation requirements (e.g., IP54 and above), and considerations for coatings and corrosion measures in coastal/high humidity/high salt mist environments.

c. Solis Energy Storage Inverter Section

- Power Rating: Approximately 125kW per unit (based on the specific Solis model), matched with a 261kWh battery capacity;
- Electrical Characteristics:
  - Supports parallel operation on the AC side;
  - Supports grid-connected / off-grid operation modes (depending on the final model configuration);
  - Meets corresponding grid connection standards (such as UL 1741, IEEE 1547, IEC, etc.).

d. Local EMS Unit

Each 261 AS comes with a built-in local EMS control unit, equipped with the following capabilities:

- Collects various operational data of the battery and inverter within this unit (voltage, current, active power, reactive power, SOC, temperature, alarms, etc.);
- Executes power commands, operation mode switches, and SOC control strategies issued by the station-level EMS;
- Provide external communication interfaces (Ethernet/RS485, etc.), connect to station-level EMS or directly connect to cloud EMS;
- Capable of certain local autonomous operation (such as executing local protection logic during communication interruptions, limiting power/safe shutdown, etc.).

Note:

The 261 AS unit is essentially an "AC coupled distributed energy storage standard module," suitable for scenarios such as small to medium-sized commercial users, communities, microgrids, and island projects.

2.1.2 Site Configuration (Parallel Operation Capability)

a. Single Station Configuration Baseline

In the 261 AS platform, a standard site (Site) is defined as follows:

A site consists of a maximum of 6 units of 261 AS in parallel + customer-side AC distribution cabinet.

That is to say:

- **Maximum configuration at the site level:**
  - 6×(261kWh battery + 125kW inverter)
  - Total energy storage capacity: approximately 1.566MWh;
  - Total inverter power: approximately 750kW (indicative value).
- **AC bus:**
  - 6 units of 261 AS connected in parallel on the AC side, connected to the customer's self-built AC bus / distribution cabinet;
  - The customer's distribution cabinet is responsible for the AC side bus, protection, and metering of all 261 AS units at this site;
  - Renon Power provides electrical parameter and protection recommendations for the 261 AS connection ports, and the customer completes the on-site distribution design according to local regulations.

b. Local EMS Site Architecture

- The local EMS architecture within a single station adopts: 1 Master + 5 Slaves
- Logical relationship:
  - 1 unit of 261 AS serves as the site master control unit (Master EMS located in the cabinet);
  - The remaining up to 5 units serve as slave control units, receiving power and operational instructions from the master station.
  - All 261 AS units are connected via Ethernet / RS485 to form an intrastation communication network.

c. Principle of Scale Expansion

If the capacity/power required for a single station exceeds 6 units of 261 AS:

- Generally, expansion is achieved through multi-site deployment + cloud aggregation, rather than infinitely increasing the number of units at the same site;
- Reason:
  - To maintain a clear structure at a single site and simplify operations and maintenance;
  - This is conducive to “multi-site integrated” scheduling and revenue optimization via cloud EMS / aggregation platforms.

2.2 261 AS Local EMS Architecture (1 Master, 5 Slaves)

2.2.1 Architecture Definition

a. Overall Structure

- The local EMS architecture of the 261 AS site is: 1 Master EMS + up to 5 Slave EMS devices.
- Each 261 AS cabinet is equipped with an EMS control unit:
  - One is configured as the Master role;
  - The other devices, up to 5, serve as Slave roles.

b. Site Network Topology

- Communication Network:
  - It is recommended to use a star or ring Ethernet structure, with the Master EMS as the central node;
  - Industrial switches can also be used to form redundant links;
- Communication Protocol: Modbus TCP/RTU or internal private protocols can be used within the site, while external interfaces are uniformly abstracted as a standard point table and API.

2.2.2 Master EMS Responsibilities

Master EMS, as the site-level "on-site brain," performs the following main responsibilities:

a. Site-level Control and Strategy Execution

- Receive site-level instructions issued by the cloud EMS/scheduling center/customer upper-level system:
  - Power curve (P–t);
  - Operating mode (peak shaving, valley filling, standby, island support, etc.);
  - SOC control range (upper/lower limits);
  - Safety limits and operational boundaries.
- Decompose site-level targets into individual cabinet-level power instructions and issue them to each Slave EMS.

b. Data aggregation and Reporting

- Aggregate real-time data from all 261 AS units at this site:
  - Voltage, current, active power, reactive power, frequency;
  - SOC, SOH, temperature;
  - Alarm / Fault information, etc.;
- Provide a unified data interface to the outside:
  - Report to the cloud EMS / Aggregation platform;
  - Connect to customer SCADA / Energy Management System (if available).

c. Protection and Safety Logic

- Execute local protection strategy in the following situations:
  - Communication exception (cloud / upper-level system interruption);
  - Measured site-level parameters exceed limits (such as voltage, frequency, power exceedances, etc.);

  - Failure of one or more 261 AS units leading to changes in system operational boundaries.
- Protective behaviors include but are not limited to:
  - Power derating operation;
  - Single cabinet withdrawal;
  - Orderly shutdown of sites, etc.

d. Master-slave Management within the Site

- Maintain the Slave EMS list and status;
- Manage internal address allocation and heartbeat detection;
- Isolate/reset instructions for abnormal slaves.

2.2.3 Slave EMS Responsibilities

Slave EMS, as the 261 AS unit-level control unit, has the main responsibilities including:

- Executing power and operational instructions for the single cabinet issued by the Master EMS;
- Collect all key operational data of the batteries and inverters in this cabinet;
- Realize rapid protection actions (such as overcurrent, overheating, short circuit, etc.) at the cabinet level and report to the Master;
- When communication with the Master is interrupted, enter a preset safe mode (such as power limiting, local shutdown) to avoid impacting the overall site.

2.2.4 Master-Slave Communication and Fault Tolerance Principles

a. Communication Link Requirements

- It is recommended to use industrial-grade switches and redundant network structures;
- If necessary, dual network ports and dual-channel configurations can be employed to enhance reliability.

b. Heartbeat and Fault Determination

- Establish a heartbeat mechanism between the Master and each Slave;
- If no heartbeat response is received within the set time, determine that the Slave is disconnected:
  - Zeroing the station power command or reverting to safe mode;
  - Report alarms / faults to the cloud EMS.

c. Master Fault Handling

- When the Master itself malfunctions, the recommended strategy is:
  - Put the entire site into "safety mode": all 261 AS units will reduce power or shut down in an orderly manner;
  - In certain enhanced deployments, a standby Master may be reserved (main-standby switch), as determined by project-level design.

Guideline:

It is preferable to temporarily reduce or halt power output rather than continue high-power operation during control anomalies.The design of the 261 AS platform prioritizes safety and system stability.

2.3 Aggregation and VPP capabilities

2.3.1 Aggregation Scale Design Baseline (single group ≤ 100 sites)

a. Aggregation Dimension

- The 261 AS platform is highly suitable for aggregating numerous small sites into a "virtual power plant/virtual energy storage plant" through a cloud EMS/aggregation platform.
- The aggregation dimension can be based on:
  - Geographical areas (such as the same city / district / area of the distribution network);
  - Customer types (such as all community energy projects);
  - Market roles (participating in the same DR / ancillary service project).

b. Scale Baseline

- For the convenience of system planning and capacity modeling, this white paper recommends:

That a single aggregation group should not exceed 100 261 AS sites.

- This baseline considers:
  - Communication bandwidth and real-time performance;
  - The complexity of strategy distribution and status feedback;
  - Group management of cloud EMS computing capabilities.

c. Multi-aggregation Group Expansion

When the project scale requires more than 100 sites:

- It can be achieved by dividing into multiple aggregation groups (Group A, B, C…);
- The upper layer is managed by the Aggregation/VPP module for unified strategy and market transaction management across multiple aggregation groups.

2.3.2 Aggregation and Expansion Constraints

a. Communication and latency constraints

For sites participating in real-time scheduling or ancillary services (such as frequency regulation) in the electricity market:

- It is necessary to ensure that the round-trip latency from the cloud EMS to the site control layer is within an acceptable range;
- If necessary, Edge Node/Edge EMS should be deployed on the regional edge to reduce inter-regional latency.

b. Strategy Complexity and Calculation Constraints

The larger the aggregation scale, the larger the scale of strategy optimization issues:

- It is necessary to design standardized strategy templates for typical scenarios of 261 AS (such as community energy and microgrids);
- Strategies should be hierarchical (cloud-level overall strategy + local strategies at edge/sites) to reduce computational complexity.

c. Operational and Maintenance Constraints

- The number of sites within a single aggregation group is also limited by:
  - The operations and maintenance team's capability to handle alerts and incidents;
  - Customer on-site service resources.
- Thus, it is recommended to consider the “manageability” of operations and maintenance management, alongside technical feasibility.

2.4 Typical Application Scenarios of 261 AS

2.4.1 Community Energy

a. Application Objects: Suburban residential communities, small commercial blocks, small industrial parks, etc.;

b. Energy Structure: Rooftop photovoltaic + public distribution + 261 AS centralized storage;

c. Application Goals:

- Increase the self-consumption rate of photovoltaic energy;
- Reduce residents' electricity bills (especially TOU peak prices);
- Create a “visual” green energy demonstration project for the community.

2.4.2 Photovoltaic + Storage Integration (PV+Storage)

a. Scenarios: Rooftop photovoltaic projects, small industrial and commercial rooftop power stations, community photovoltaics, etc.;

b. Solution Features: Photovoltaic generation and 261 AS storage are coupled on the low voltage side, achieving “PV prioritizes load supply, excess electricity charges, peak discharges” through local EMS;

c. Effects:

- Reduce photovoltaic curtailment and low-price grid connections;
- Utilize energy storage to shift "excess sunlight during the day" to "high-price periods at night."

2.4.3 Microgrid Applications

a. Scenarios:

- Independent power grids in industrial parks;
- Remote town/construction sites;
- Areas with local energy autonomy requirements.

b. Role of 261 AS in Microgrids:

- As a core resource for "frequency regulation/peak shaving/backup" in microgrids;
- Working with photovoltaic systems, diesel generators, or other distributed power sources to maintain voltage/frequency stability in island mode;
- As a key load, the "power buffer".

2.4.4 Island/Remote Applications

a. **Typical Targets:** Puerto Rico, Caribbean islands, remote mountain towns, mining camp sites, etc.;

b. **Current Pain Points:**

- High diesel generation costs;
- Fuel transportation difficulties and instability;
- Weak grid, frequent power outages during extreme weather.

c. **Value Provided by 261 AS:**

- Building a "clean + economical + resilient" microgrid with photovoltaics and diesel;
- Significantly reducing diesel consumption and carbon emissions;
- Enhancing power supply resilience and recovery speed in disaster scenarios.

2.4.5 Principle Summary: The "Small Sites + Multi-Aggregation" Virtual Power Plant Concept

Core Idea:

261 AS does not pursue single super-large stations, but aims for "small to medium-sized sites that are aggregated through the cloud into a dispatchable virtual power plant."

a. **Single Station:** Primarily consists of 1 to 6 units of 261 AS, with a clear structure and simple construction;

b. **Multi-Station:** Through cloud EMS + aggregation/VPP system, packages 10, 50, 100+ sites into a unified dispatchable resource;

c. **Market:** Participates in peak shaving/frequency regulation/reserve in the electricity market or DR projects as a "virtual power plant" to generate revenue.

2.5 Empirical Case Studies of the 261 AS Platform (California/Puerto Rico)

This section selects two typical scenarios: the suburban community energy project in California and the island microgrid project in Puerto Rico, showcasing the application paths of the 261 AS platform in community energy and island microgrids.

2.5.1 Suburban Community Energy + Rooftop PV + 261 AS Energy Storage Project (California)

a. Project Pain Points and Needs

- Project Location: A residential community in Southern California (located within the SCE/SDG&E service area).
- Changes in photovoltaic policy: After the adjustment of the NEM policy, the on-grid electricity price has decreased, and residents are more concerned about "self-consumption" and TOU peak pricing;
- Load characteristics: Electricity consumption during the evening peak is concentrated on lighting, air conditioning, and home appliances, with a significant impact of peak pricing on bills;
- Grid-side concerns: Distribution companies are worried about reverse flows, localized voltage fluctuations, and the stability of the distribution network.
- **Customer Demands:**
  - Increase the self-consumption rate of rooftop photovoltaics and reduce low-priced grid feed-in;
  - Utilize energy storage to shift "daytime solar generation" to "high-price evening periods";
  - The overall electricity expenses for the community should show a perceivable decrease;
  - The project itself must have a demonstration effect, making it easier for government and media promotion.

b. Project Objectives

- Increase the self-consumption rate of community photovoltaics to ≥70%;
- Achieve a 10–15% decrease in overall community electricity charges;
- Reserve access capacity for future Utility DR/community-level VPP projects;
- Build a replicable "California Solar+Storage Community" demonstration site.

c. Project Plan and Configuration

- The distribution structure: The community has a unified distribution room, with one or more community main busbars on the low-voltage side.
- Solar photovoltaic part: Multiple residential rooftops collect photovoltaic energy into several photovoltaic inverters, which are then connected to the community's low-voltage busbar.
- **Energy Storage Part:**
  - Concentrated installation near the community distribution room: 4 sets of 261 AS units (4×261kWh + 4×125kW Solis storage inverters);
  - 4 sets of 261 AS connected to the community low-voltage busbar in parallel on the AC side;

  - The local EMS adopts a 1 master 3 slave architecture (with the capability to expand to 1 master 5 slaves).
- **EMS Integration:**
  - Local EMS connection:
    - 4 sets of 261 AS;
    - Rooftop photovoltaic inverters;
    - Community main distribution cabinet and meter system;
  - Cloud EMS: Records community-level PV, load, and energy storage operational data, generating community energy visualization reports.
- **Control Strategy:**
  - Daytime: Prioritizes using photovoltaic power for community load, with excess electricity stored in 261 AS;
  - Evening / Peak: 261 AS discharges, reducing the community's electricity purchase from the grid;
  - Specific DR periods: Actively reduce power draw from the grid according to Utility DR / VPP strategies to obtain additional revenue (e.g., participating in future DR projects).

d. Business Model

- **Model One:** Community-led
  - The community owners' committee leads and collaborates with energy service companies (ESCO);
  - Community residents participate in the project through a one-time investment or monthly service fees.
- **Model Two:** Third-party investment
  - Fully or largely funded by a third-party energy company;
  - Charges the community through a "packaged electricity price + service fee" model, allowing residents to obtain electricity at a price lower than the original electricity rate.
- **Renon Power Role:**
  - Provides 261 AS hardware platforms, local EMS, cloud EMS platforms, and implementation services;
  - Offers technical solutions, debugging, and training for third-party ESCOs or communities.

e. Profit Model

- **Direct Revenue:**
  - Resident-side electricity cost savings (reduced peak pricing);
  - Photovoltaics + integrated storage to enhance overall IRR.
- **Investor Returns:** Recover investments through price differences, service fees, and possible local subsidies;
- **Additional Value:**
  - The community becomes a "green demonstration community," which helps enhance property values and attract media and government attention;
  - Subsequent value-added services like EV charging and intelligent home load management can be integrated.

f. Investment Returns

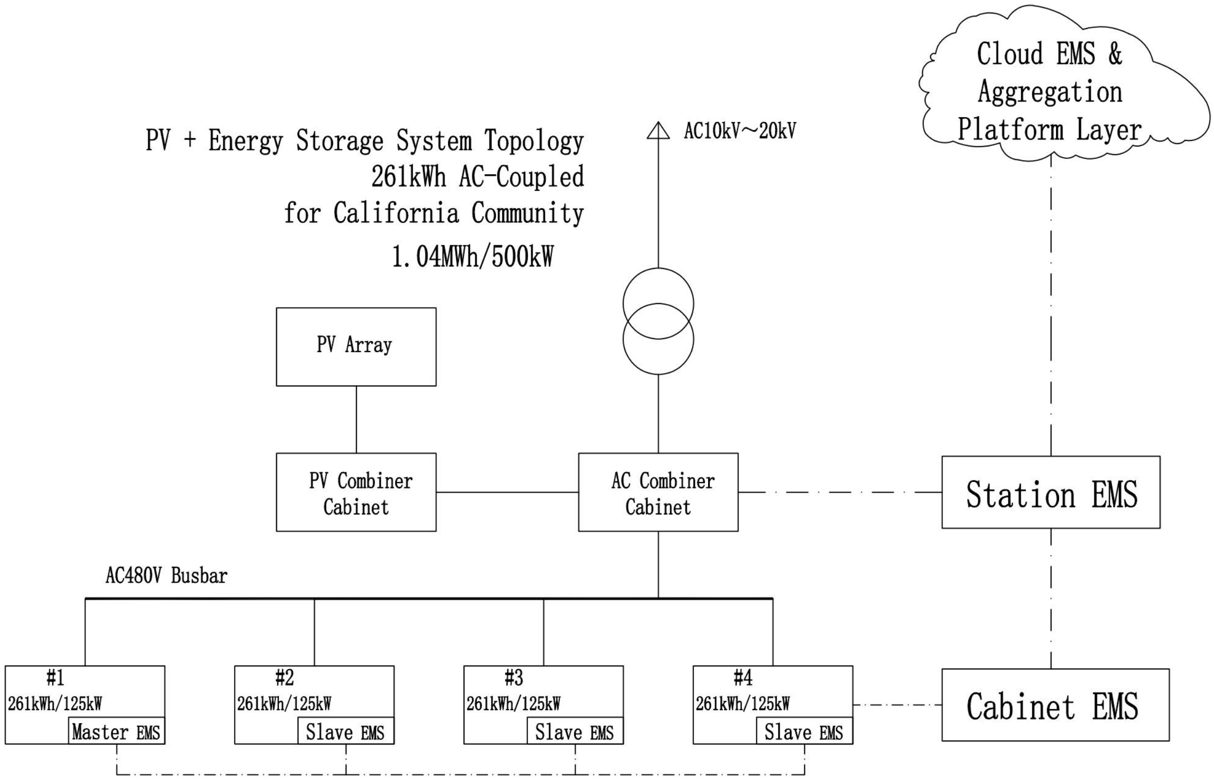
- Storage investment: Approximately 0.4–0.6MUSD (based on 4 sets of 261 AS, including system, installation, and debugging).
- Annual electricity cost savings + incentive revenue: approximately 0.09–0.13MUSD.
- Static payback period: approximately 5–6 years.
- If local incentives or green financing tools are layered, the payback period can be shortened by an additional 0.5–1 year.

Note: Specific returns need to be calculated in detail based on the local TOU electricity price structure, photovoltaic scale, and residential electricity usage curve.

g. Project Evaluation

- 261 AS serves as a community-level station with 4–6 units, offering a moderate scale, clear structure, and convenient construction, making it very suitable for community scenarios;
- It highly aligns with California's environment of "NEM policy adjustments + high TOU electricity prices + strong ESG awareness";
- The project can serve as a model project for Renon Power to promote "community energy + storage + VPP" in California.

h. System Topology Diagram



i. Rendering Description

2.5.2 Puerto Rico Island Microgrid — Photovoltaics + Diesel Generator + 261 AS Energy Storage Project (Puerto Rico)

a. Project Pain Points and Needs

- Project Location: Coastal towns and surrounding island areas of Puerto Rico.
- Current Pain Points:
  - The power grid infrastructure is fragile, leading to frequent power outages due to typhoons and extreme weather;
  - Heavily reliant on diesel power generation, with high fuel costs and transportation difficulties;
  - Electricity prices have been high for a long time, placing a heavy burden on residential and commercial users.
- Customer demands:
  - Reduce diesel consumption and fuel costs;
  - Enhance power supply reliability and disaster response capabilities;
  - Increase the proportion of renewable energy, improving the environment and tourism image;
  - Make use of external green funding, development banks, or subsidies to support project financing as much as possible.

b. Project Objectives

- Reduce diesel consumption by 40–60%;
- Increase the share of renewable energy (PV) in power supply to ≥40%;
- Ensure that critical loads can maintain power supply for several hours during grid failures or power outages caused by typhoons;
- Transform the project into a "Resilient Island Microgrid" demonstration.

c. Project Plan and Configuration

- **System Composition:**
  - Photovoltaic power station: 0.8–1.5MWp centralized photovoltaic array (depending on available site);
  - Diesel generator set: 1–2 diesel engines, serving as backup power;
  - Energy storage system: 6 sets of 261 AS units, forming a fully equipped station (1 Master + 5 Slave);
  - Load side:
    - Critical loads: hospitals, small water plants, communication equipment, etc.;
    - Ordinary residential and commercial loads.
- **Microgrid Structure:**
  - All generation sources (PV, Diesel, 261 AS) and loads connect to a microgrid bus;
  - The local EMS acts as the control core of the microgrid;
  - The cloud EMS provides remote monitoring and reporting support.
- **Control Strategy:**
  - Normal Weather:
    - Daytime: Photovoltaics prioritize supplying the load, and excess electricity charges 261 AS;
    - Nighttime: Powered by 261 AS + diesel generators to minimize low load operation of the diesel generator;

- Before Extreme Weather: During a typhoon warning, ensure 261 AS is fully charged in advance to cope with potential prolonged power outages;
- During Power Outages:
  - Microgrid operates in island mode: Photovoltaics + 261 AS + diesel generators jointly supply power;
  - Priority is given to ensuring critical loads such as hospitals, water plants, and communications.

d. Business Model

- **Investment Entities:**
  - Local Government / Utility Company;
  - Can jointly invest with multilateral development banks, green funds, or international assistance projects.
- **Role of Renon Power:** As a provider of technology and system solutions, offering 261 AS platform, EMS solutions, and project EPC / technical services;
- **Residents' side:** By optimizing the electricity pricing structure / tiered electricity pricing, part of the revenue will be redirected for project debt repayment and operation & maintenance;
- **Possible external funding sources:**
  - Low-interest loans from multilateral development banks;
  - Support from climate funds / green funds;
  - Funding from international aid projects, etc.

e. Profit Model

- **Direct economic benefits:** Significant reduction in diesel fuel costs, transportation costs, and maintenance costs;
- **Environmental and social benefits:**
  - Reduction in emissions and noise, improving the experience for residents and tourists;
  - Enhancing disaster response capabilities and recovery speed, increasing social and political recognition;
- **Medium- and long-term benefits:**
  - Project experience can be replicated to other islands/towns, forming “solution outputs”;
  - Enhance local credibility in international aid and green financing.

f. Investment Returns (indicative)

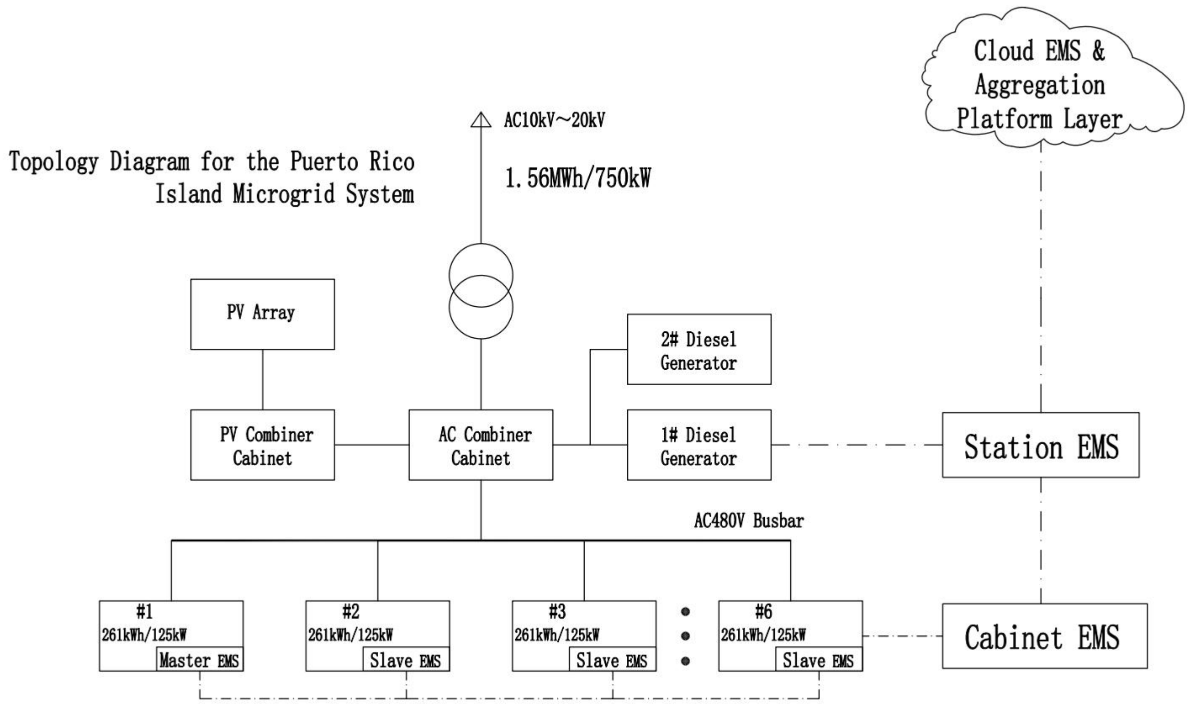
- Assuming the LCOE of diesel generation is 0.35–0.45 USD/kWh;
- After introducing photovoltaic + 261 AS, the overall electricity supply cost could drop to 0.18–0.25 USD/kWh;
- Depending on varying oil prices, subsidies, and financing conditions, the project’s static payback period is about 5–8 years;
- Considering social, environmental, and disaster resilience benefits, the overall project value is even higher.

g. Project Evaluation

- The 261 AS platform, with its characteristics of “small to medium sites + high flexibility,” is particularly suitable for islands and remote areas;

- The project balances economy, environmental friendliness, and social resilience, making it a typical “model project”;
- It can provide a benchmark case for Renon Power’s entry into the Caribbean and Latin American island markets.

h. System Topology Diagram



i. Rendering Description

Chapter 3 10-Foot AC Platform Configuration and Applications

3.1 Hierarchy and Unit Definition

3.1.1 Definition of 10-Foot AC Single Cabinet

In this white paper, a 10-foot AC single cabinet is defined as: 1 set of 10ft container-type liquid-cooled battery system + 1 set of PCS (including high and low voltage electrical systems) + a cabinet-level local EMS control unit, serving as the minimum equipment unit for the 10-foot AC platform, with complete capabilities of "battery + PCS + control + protection".

a. Battery System Part

- Cell technology: LFP (Lithium Iron Phosphate);
- Structural form: Container-integrated liquid-cooled battery system;
- Monitoring dimensions: Multi-level monitoring and protection of cell/module/cluster/cabinet;
- Thermal management: Fully liquid-cooled system with cooling loop monitoring, temperature monitoring, and cooling fault alarms;
- Protection level: Meets protection levels for long-term outdoor operation (e.g., IP55/IP65), anti-corrosion, and high salt spray requirements.

b. PCS Part

- Bidirectional PCS matched with battery capacity;
- Supports grid-connected/off-grid operation modes (depending on the project and model configuration);
- Meets relevant grid connection standards for the target market (UL/IEEE/IEC, etc.);
- Supports active/reactive regulation, power factor control, frequency/voltage adjustment, black start (if configured), and other operating modes.

c. Cabinet-level Local EMS Functions

- Monitors all key operating data of the cabinet: voltage, current, active power, reactive power, frequency, SOC, SOH, temperature, alarms, etc.;
- Executes power commands and operating modes issued by the superior EMS (row level/station level) for individual cabinets;
- In cases of communication failure, parameter exceedance, etc., executes cabinet-level protection and safety shutdown logic;
- Provides a unified interface for upward communication (e.g., Modbus TCP, etc.) to connect to the row-level local EMS.

3.1.2 Row Cabinet Definition

In a 10-foot AC platform, a row cabinet is defined as: 3 individual 10-foot AC cabinets + 1 communication cabinet (with built-in row-level local EMS) + 1 AC distribution cabinet.

That is to say:

a. 3×10 feet AC battery cabinet: Provides the energy storage capacity and power of this cabinet;

b. Communication Cabinet:

Built-in row cabinet level local EMS, responsible for:

- Managing the operation and data collection of 3 single cabinets within this row cabinet;
- Executing row cabinet-level instructions issued by the matrix/station-level EMS;
- Connecting to matrix/station-level EMS as a control unit.

c. AC Distribution Cabinet:

- Completing the busbar, protection, and measurement of the AC side output from 3 10-foot AC single cabinets inside the row cabinet;
- Providing a single AC outgoing line, connecting to the matrix-level distribution or site-level distribution system.

Conclusion:

In the 10-foot AC platform, "row cabinet" is the smallest standard AC parallel system unit, and all engineering configurations and BOM suggestions should be planned based on the granular unit of "row cabinet."

3.1.3 Matrix and Site Definition

a. Definition of Matrix

Three row cabinets in parallel = one 10-foot AC matrix

That is to say:

- Composed of 3 sets of "3+1+1" row cabinets: a total of 9 10-foot AC single cabinets + 3 communication cabinets + 3 AC distribution cabinets;
- Paralleled busbars at the same voltage level;
- Serves as the primary foundational module for site capacity and power expansion.

b. Definition of Site

A site is a storage facility unit connected to a medium voltage network of 15kV or 35kV through transformers/medium voltage switches, unified dispatch and monitoring by station-level EMS.

In the 10-foot AC platform:

- 15kV scenario:
  Three matrices constitute one standard site (approximately 45 MWh level);
- 35kV scenario:
  A standard site consists of 5 matrices (approximately 75 MWh level);

c. Project Definition

- Multiple sites are combined regionally to form a project, for example:
  - A multi-site project of "New York Cold Chain Logistics Park + 2 surrounding sub-parks";
  - A multi-site project of "4 high-speed charging hubs in Texas".
- Unified strategy and revenue optimization are conducted via cloud EMS/aggregation platform/VPP platform.

3.2 Row Cabinet and Matrix Configuration

3.2.1 Row Cabinet Configuration (3+1+1)

A standard 10-foot AC row cabinet includes: 3 × 10-foot AC single cabinets + 1 × communication cabinet (row cabinet-level local EMS) + 1 × AC distribution cabinet

a. Functional Division

- 3×10 feet AC Single Cabinet: Provides the energy storage capacity and power output of this cabinet;
- Communication Cabinet (Local EMS for cabinet level):
  - Summarizes the operating data of the 3 single cabinets in this cabinet;
  - Responsible for internal control and balancing of the cabinet;
  - Acts as a logical node connecting to the matrix level / station level EMS;
- AC Distribution Cabinet:
  - Collects the AC output of the 3 single cabinets in this cabinet;
  - Provides cabinet level protection (circuit breakers, protective relays, etc.) and metering;
  - Supplies a unified AC outgoing line to the matrix level / station level.

b. Advantages in Engineering and Operation & Maintenance

- Design standardization: A "3+1+1" structure can be replicated and applied across various projects;
- Convenient construction: The cabinet can be used as a prefabricated unit for factory pre-integration and quick installation on site;
- Clear operation and maintenance: Fault location can be quickly identified among "single cabinet / row cabinet / matrix / site".

3.2.2 Matrix (3 Row Cabinets) Configuration

In the 10-foot AC platform, the matrix is defined as: 3 standard 10-foot AC row cabinets in parallel forming 1 matrix.

a. Composition

- Number of row cabinets: 3;
- Number of 10-foot AC single cabinets: 3 row cabinets × 3 single cabinets/column = 9 single cabinets;
- AC structure: Each row cabinet's AC output is connected in parallel to the matrix level junction point;
- Matrix-side power distribution and protection: Configure matrix incoming circuit breakers, protective relays, power metering, etc.

b. Role Positioning

- The matrix is the foundational module for site expansion: By increasing the number of matrices, different levels of sites such as 45 MWh / 75 MWh can be constructed;
- From the EMS perspective: The matrix can be managed as a logical unit (such as power limits, SOC range, etc.), facilitating the configuration of templated strategies.

3.3 Site Configuration and Expansion (10-Foot AC)

3.3.1 15 kV Access Scenario (approximately 45 MWh level site)

When the site is connected to the grid at a voltage level of 15 kV, the standard configuration for a 10-foot AC platform is: 3 parallel 10-foot AC matrices = approximately 1 site at the 45 MWh level

a. Structural Overview

- Number of matrices: 3;
- Number of cabinets: 3 matrices × 3 cabinets/matrix = 9 cabinets;
- Total number of single cabinets: 9 cabinets × 3 single cabinets/cabinet = 27 10-foot AC single cabinets;
- Connection method: Connected to a 15 kV medium voltage network through a site-level transformer;
- EMS: The station-level EMS performs unified scheduling for three matrices.

b. Applicable Scenarios

- 45MWh level centralized energy storage station;
- Peak shaving and valley filling in large cold chain parks/industrial parks and demand control;
- Medium-sized fast charging stations, urban charging hubs, etc.

3.3.2 35kV Connection Scenarios (Approx. 75MWh Level Stations)

When the station connects to the grid at the 35kV voltage level, the standard configuration for a 10-foot AC platform is: 5 parallel 10-foot AC matrices = 1 station of approximately 75MWh level

a. Structural Overview

- Number of matrices: 5;
- Number of rows of cabinets: 5 matrices × 3 rows of cabinets/matrix = 15 rows of cabinets;
- Total number of cabinets: 15 rows of cabinets × 3 single cabinets/row of cabinets = 45 10-foot AC single cabinets;
- Connection method: Connected to the 35kV medium voltage network through the station-level transformer;
- EMS: The station-level EMS is responsible for coordinating the five matrices with other equipment in the station (such as charging piles, park loads, etc.).

b. Applicable Scenarios

- 75MWh level large-capacity centralized energy storage station;
- Interstate fast charging hub/highway service complex;
- Regional energy hub (such as ports, airports, super-large industrial loads).

3.3.3 Distributed Multi-site Deployment and Expansion

a. Sites as Distributed Basic Units

- In distributed deployment, it is recommended to use "site" as the basic unit:

  - One 45MWh level site;
  - or one 75MWh level site.
- Multiple sites can be deployed in: multiple parks, multiple cold chain bases, multiple highway hubs, etc.

b. Cloud EMS and Aggregation/VPP Expansion

- Each site is equipped with local EMS to complete site-level control;
- Cloud EMS/Aggregation Platform:
  - Aggregates multiple 10-foot AC sites into a "Regional Flexibility Asset Pool";
  - Uniform participation in DR, auxiliary services, and capacity markets.

c. Expansion Principles

- Technically:
  - The number of matrices within a single site is configured according to the 3/5 standard;
  - The number of multi-site locations can expand based on regional demand (e.g., 3 sites / 5 sites / 10+ sites).
- Management: It is recommended to divide aggregation groups by region and business type (cold chain, charging, industrial, etc.).

3.4 Local EMS and Cloud Compatibility (10-Foot AC)

3.4.1 Local EMS Hierarchy

a. Cabinet-level EMS (inside communication cabinet):

- Manage 3 units of 10-foot AC single cabinets in this cabinet;
- Implement internal control and data aggregation.

b. Station-level EMS:

- Manage all matrices and cabinets within the station;
- Access campus loads, charging pile systems, and other distributed power sources (e.g., PV);
- Present the station as a unified schedulable node to the outside.

3.4.2 Compatibility with Proprietary Cloud Platforms

a. Natively supports Renon Power proprietary:

- Cloud EMS platform;
- Aggregator Module;
- VPP Module.

b. Functions include:

- Strategy distribution: power curves, operating modes, SOC constraints, etc.;
- Data feedback: operational data, alarms, events, and historical curves;
- Remote operation and maintenance: parameter configuration, firmware upgrades, fault diagnosis.

3.4.3 Compatibility with Third-Party Platforms

a. The 10-foot AC local EMS supports connection and scheduling with third-party cloud EMS, aggregation platforms, and VPP platforms;

b. Supported typical communication protocols:

- Modbus TCP;
- IEC 60870-5-104;
- MQTT;
- RESTful API, etc.

c. Provides a unified point table and data model, facilitating integration with:

- Power company SCADA;
- Industrial park EMS;
- Cold chain enterprise energy management system integration.

3.4.4 Consistency with the 261 AC Platform Interface

a. The point table structure, alarm codes, data units, etc., should be as unified as possible with the 261 AC;

b. Facilitate the unified scheduling of the "261 AC + 10-foot AC" combination by cloud EMS and the aggregation/VPP platform within the same project.

3.5 Typical Application Scenarios for 10-Foot AC

3.5.1 Centralized Energy Storage Stations at the Park Level

a. Application targets: Industrial parks, cold chain logistics parks, large storage bases, etc.;

b. Application goals:

- Reduce park electricity costs (peak electricity prices + demand charges);
- Improve power supply reliability and power quality;
- Support future additional charging loads/new production line loads in the park.

3.5.2 Large Public Fast Charging

a. Application Objects:

- Interstate highway charging hubs;
- Urban supercharging centers;
- Comprehensive charging stations in highway service areas.

b. Value of 10-Foot AC:

- Provides capacity and power support for large-scale DC ultra-fast charging piles;
- Smooths out charging load impacts, reducing demand and distribution expansion costs;
- Offers short-term backup and black start support capabilities (depending on configuration).

3.5.3 Multi-site Energy Storage Clusters and Regional Flexibility Asset Pools

a. Scenario: Multiple parks/cold chain bases/charging hubs distributed in the same area;

b. Plan:

- Deploy 45MWh or 75MWh level 10-foot AC stations at each site;
- Unified scheduling through cloud EMS + aggregation/VPP platform;

c. **Value:** Form a regional "Flexibility Pool" to participate in electricity and capacity markets.

3.6 Typical Project Case Studies of 10-Foot AC Platform (New York/Texas)

This section selects two typical scenarios:

- Cold chain logistics park in New York;
- Interstate charging hub station in Texas;

Demonstrate the application ideas of 10-foot AC under different business models.

3.6.1 10-Foot AC Centralized Energy Storage Project in New York Cold Chain Logistics Park

a. Project Pain Points and Needs

- Location of the project: Large cold chain logistics park in the suburbs of New York State;
- Load Characteristics:
  - Large-capacity refrigeration compressors have heavy loads, running for long periods, and their start-stop operation causes impacts;
  - Cold storage has extremely high requirements for temperature stability; even a short power outage can lead to significant losses in goods value;
- Electricity Pricing Structure: The demand charge accounts for a high proportion; the maximum demand determines annual electricity expenses;
- Customer demands:
  - Reduce annual electricity costs (especially demand fees);
  - Improve power supply reliability and reduce cold chain risks caused by power outages;
  - Reserve capacity for the future increase in charging demand for EV refrigerated trucks in the park.

b. Project Objectives

- Reduce comprehensive electricity costs in the park by 10-20%;
- Provide 0.5-2 hours of support for critical refrigeration loads during short-term grid failures (depending on capacity design);
- Leave a certain power and capacity surplus for future charging stations;
- Build the brand of "Low Carbon Cold Chain Logistics Demonstration Park" for the industrial park.

c. Project Plan and Configuration

- Site Capacity and Grid Connection:
  - Utilize one 15kV connected 45MWh grade 10-foot AC site;
  - Standard configuration: 3 matrixes in parallel (each matrix has 3 cabinets, each cabinet contains 3 single cabinets).
- Access Structure:
  - The site is connected to the park's medium voltage / low voltage bus through a transformer;

  - Station-level EMS Access:
    - Cold storage compressor group control system;
    - Main power distribution system and energy metering of the park;
    - Possible EV refrigerated truck charging pile system (existing or reserved).
- Operating Strategy:
  - Normal operating conditions:
  - Peak shaving and valley filling + Demand control:
    - Charging during nighttime / valley period electricity pricing;
    - Discharging during daytime peak periods to control the peak electricity draw from the grid;
  - Cold chain specific strategy: moderate "precooling" within the permissible range of electricity prices and cold storage temperatures, optimizing electricity costs with energy storage;
  - Fault condition: providing support for critical cold storage loads during short-term power grid faults, ensuring temperature stability.

d. Business Model

- Investment entity: cold chain park operator or partnership with energy service companies;
- Model selection:
  - Self-investment and use (CAPEX + OPEX);
  - Or adopting a contract energy management (EMC) model, with ESCO investing and sharing savings on electricity costs.
- Renon Power role: providing 10-foot AC hardware platform, station-level EMS, cloud EMS access, as well as system integration and operation training.

e. Profit Model

- Direct Revenue:
  - Significant reduction in demand charges;
  - Savings on electricity bills brought by peak-and-valley price optimization.
- Indirect Revenue:
  - Reduction in cold chain incident risks, minimizing potential cargo loss and brand risk;
  - Improvement of the park's "green demonstration" image, aiding in attracting large clients and brand partners.

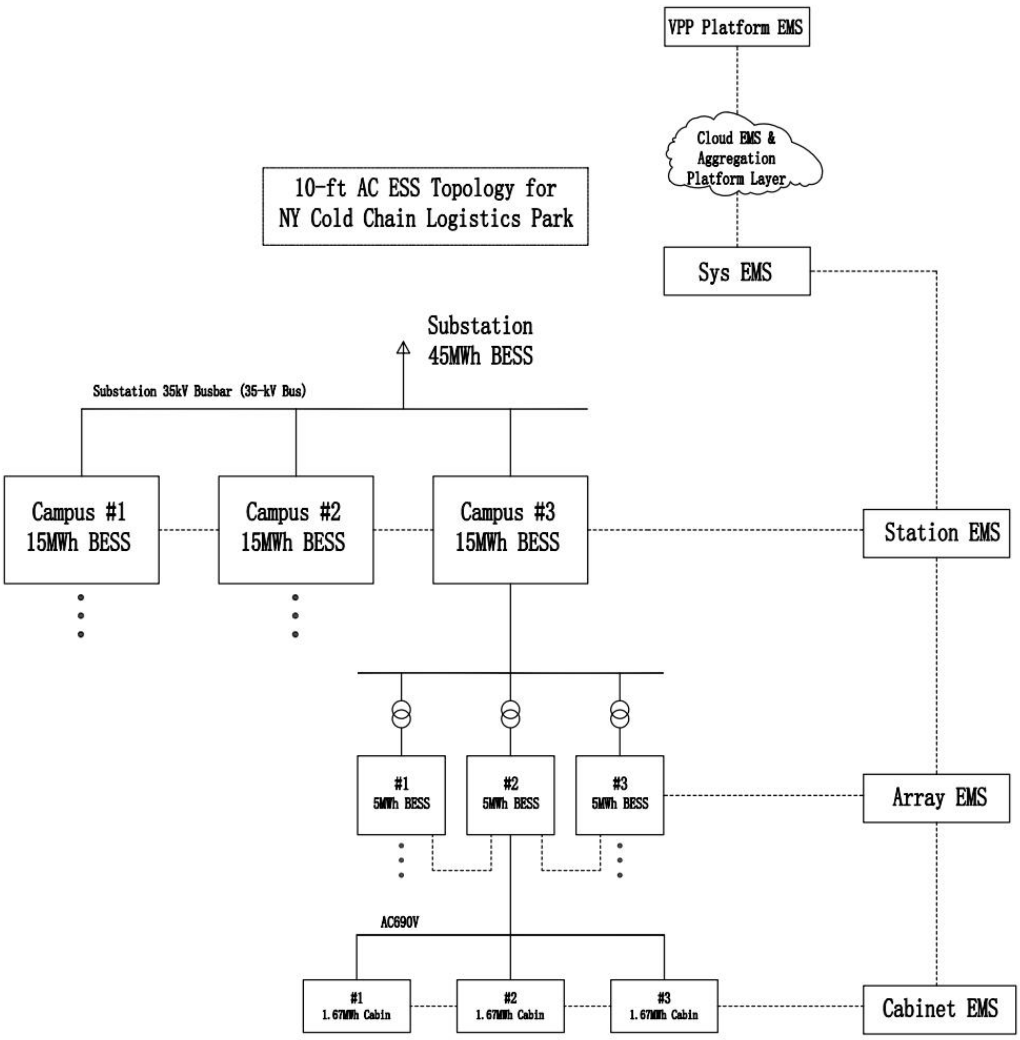
f. Investment Returns

- 45MWh Site investment: subject to equipment prices, civil engineering, and electrical modifications;
- Annual savings on electricity bills: common targets are 10–20%;
- Static payback period: approximately 5–7 years;
- If adopting an EMC model:
  - The park partner has no initial large capital investment, sharing saved electricity costs;
  - ESCO obtains a stable cash flow through long-term contracts.

g. Project Evaluation

- The 10-foot AC platform's high-capacity centralized features are very suitable for the scenario of cold chain parks, which require "high load + high demand + high reliability."
- The project simultaneously addresses the triple demands of "electricity cost + power supply reliability + brand image," making it a typical benchmark project for comprehensive value;
- providing a model for Renon Power to enter the "cold chain + energy storage" niche industry.

h. System Topology Diagram



i. Rendering Description

3.6.2 Texas Interstate High-Speed Charging Hub 10-Foot AC + Supercharging Project (Texas)

a. Project Pain Points and Needs

- Project location: Charging hub stations along major interstate highways in Texas (I-10/I-35/I-45, etc.);
- Scene features:
  - A large number of 250–350kW or even higher power DC supercharging piles;
  - High-speed traffic converges in a short time, resulting in "pulse-type" load changes;
- Distribution challenges:
  - If solely relying on grid power supply, large-scale expansion of station transformers and distribution facilities is needed, resulting in huge investments;
  - The grid company has strict requirements for maximum demand and power quality.
- Customer demands:
  - Achieve ultra-fast charging service capability for multiple parking spaces under limited distribution capacity;
  - Control infrastructure investment and electricity costs to ensure the sustainability of the business model;
  - Reserve space for future access to the ERCOT market/VPP model.

b. Project Objectives

- Build a 75MWh-level 10-foot AC energy storage station to provide strong energy storage support for the charging hub;
- Balance the three aspects of "electricity price optimization + demand control + ultra-charging experience."
- Create a standardized station model that can be replicated at other high-speed hubs in Texas.

c. Project Plan and Configuration

- Site Capacity and Grid Connection:
  - Use a 10-foot AC station with a 75MWh capacity connected at 35kV;
  - Standard configuration: 5 matrices in parallel, each matrix with 3 row cabinets, and each column with 3 individual cabinets.
- Charging hub structure:
  - The site includes 20–40 DC ultra-fast charging piles (which can be grouped into multiple clusters);
  - The charging load and energy storage are connected to the station's LV bus (connected through the transformer from 35kV).
- EMS Control Logic:
  - Normal operating conditions:
    - Charging at night / during low tariff periods to power 10-foot AC;
    - During peak daytime hours, energy storage and the grid jointly supply power to the supercharging stations, limiting peak electricity draw from the grid;
  - High load moments: The station-level EMS analyzes grid capacity, SOC within the station, and current vehicle queue status, dynamically allocating charging power and energy output;

- DR / VPP mode: When the grid issues a DR signal, the station can temporarily reduce power drawn from the grid and increase the proportion of energy storage discharge to obtain DR benefits.

d. Business Model

- Investment entities: Charging operators + energy investors + local infrastructure funds and other joint investments;
- Revenue sources:
  - Charging service fees (fast charging);
  - Difference in electricity costs (electricity price optimization + demand reduction);
  - DR / auxiliary service revenues (after connecting to the ERCOT market);
- Renon Power Role: Provides 10-foot AC energy storage platforms, EMS systems, overall solutions, and implementation services.

e. Profit Model

- Direct Revenue:
  - The charging service fee is the main source of cash flow;
  - The energy storage system reduces electricity costs through peak shaving and load control;
- Value-added income:
  - DR / auxiliary service income;
  - Brand and traffic value: Becoming an important charging hub in the region helps to bind automakers and platform resources.

f. Investment Returns

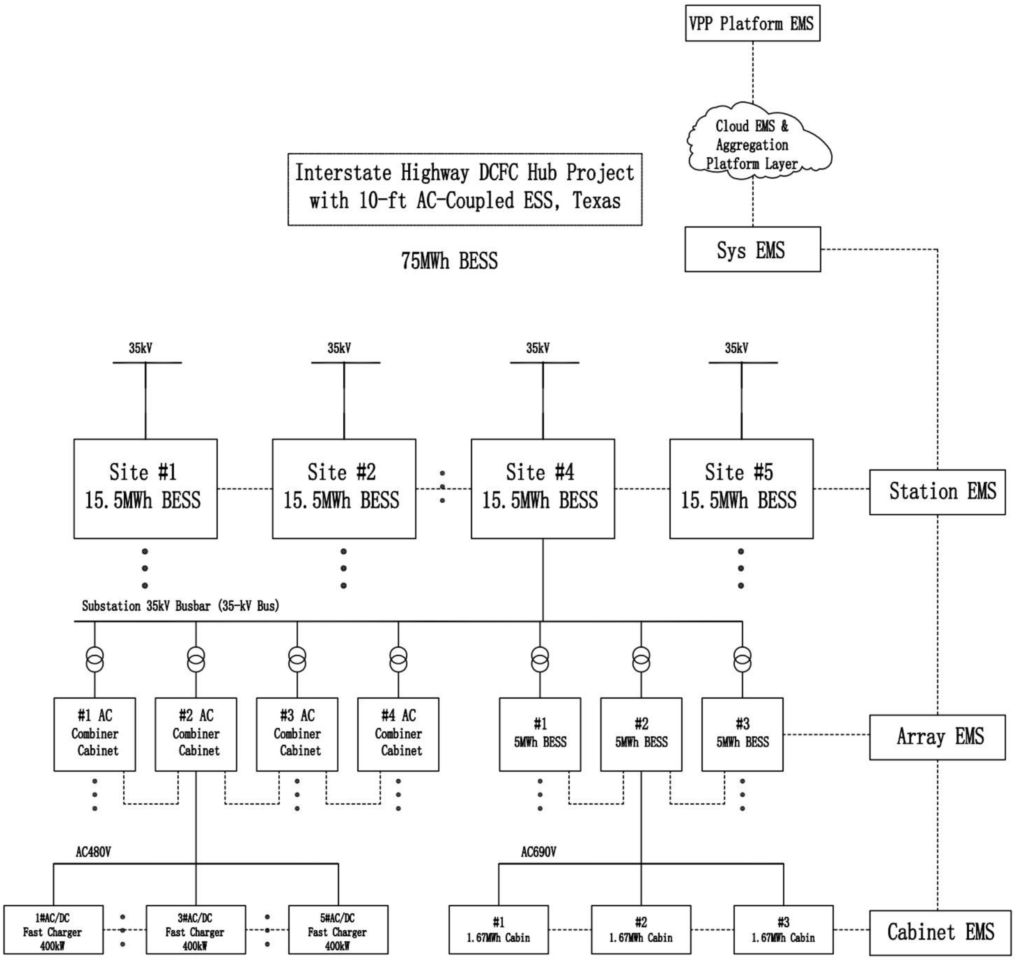
- 75MWh level stations are capital-intensive projects with large investment scales;
- Through a joint investment model and long-term operations, investment can be recovered within 8–12 years and achieve a reasonable IRR;
- If combined with policy incentives/IRA benefits and high utilization traffic, IRR is expected to increase significantly.

Note: Specific returns require detailed modeling based on traffic assumptions, utilization rates, charging prices, electricity price structures, and policy incentives.

g. Project Evaluation

- The large capacity and high power characteristics of the 10-foot AC platform are ideal for high-speed charging hubs in scenarios with extremely concentrated peak loads;
- The project combines "energy storage + ultra-fast charging + VPP," representing a typical form of future high-speed energy hubs;
- It holds significant strategic importance for Renon Power's establishment of the "high-speed hub benchmark" in Texas.

h. System Topology Diagram



i. Rendering Description

Technical Support

Email: support@renon-usa.com

Renon Power USA LLC

580 McIntyre Rd. McKinney, TX 75071

Renon Power Technology B.V.

Rietbaan 10, 2908 LP Capelle aan den IJssel

Renon Power Co., Ltd.

20-5, Hakozaki-cho, Nihonbashi, Chuo-ku, Tokyo VORT

Linkedin

Website