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ASE Response to RFI for Battery Energy Storage Systems FDAS

Additional submitted attachment is included below.

Response to Docket: 5-FDAS-01

RFI for Battery Energy Storage Systems

Flexible Demand Appliance Standards for Battery Storage Systems [FDAS] Compliance and Implementation Strategy

Submitted to: California Energy Commission (CEC)

Date: December 12, 2025

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1. Executive Summary and Strategic Alignment

1.1 The Imperative of Flexible Demand

The California Energy Commission's initiative to develop Flexible Demand Appliance Standards (FDAS) for Battery Energy Storage Systems (BESS) under Senate Bill 49 represents a pivotal shift in grid management. As the electrical grid transitions from a centralized, unidirectional delivery model to a distributed, bi-directional network, the role of residential BESS is evolving from passive backup assets to active, intelligent grid-edge resources. The integration of these distributed energy resources (DERs) is no longer a luxury but a necessity to address the "Energy Trilemma": providing affordable, clean, and reliable power in an era of rapid electrification and climate change.

This proposal outlines a robust, scalable, and secure technical framework for implementing FDAS for BESS. It leverages a **"Demand Flexibility Service Application"** architecture that bridges the gap between utility control centers and the heterogeneous landscape of behind-the-meter (BTM) assets. By shifting the "controllable node" from the cloud to the intelligent edges specifically utilizing Advanced Metering Infrastructure (AMI) 2.0 or dedicated DER gateways, this proposal addresses the critical challenges of latency, cybersecurity, and interoperability that have historically hindered Virtual Power Plant (VPP) deployments.

1.2 Proposed Architecture

Our response proposes a multi-tiered architecture that logically segregates functions across Utility, VPP/Aggregtor, and the Grid Edge constituting the consumer flexible demand assets. This architecture, validated in similar utility demand flexibility initiatives, separates the "Orchestration and Aggregation" layer from the mission-critical "Optimization and Control" layer.

- **Edge Layer:** The utilization of **AMI 2.0 meters or dedicated gateway device** with edge computing capabilities as the primary secure gateway, offering direct local Wi-Fi connectivity to flexible demand assets like BESS to ensure operation even during backhaul communication failures. Technical prerequisites include support for protocols like **IEEE 2030.5**, **SunSpec** to ensure interoperability, compliance, and secure control for demand flexibility programs
- **Orchestration Layer:** A cloud-native **DER Orchestration Platform** that handles high-volume, low-latency connectivity with thousands of diverse BTM assets.
- **Optimization Layer:** A secure, **"BTM Asset Optimization Engine"** that ingests real-time grid constraints from the ADMS/DERMS, Low Voltage network data (from Grid Edge Sensors), and market signals from the CEC's Market Informed Demand Automation Server (MIDAS) to generate optimal dispatch schedules.

1.3 Addressing the RFI

This document provides an exhaustive response to the 16 specific questions posed in the RFI. It goes beyond simple compliance to propose specific technical enhancements, such as the adoption of "Persistent Storage" and "Offline Behavior" logic derived from the CSIP/ CSIP-AUS (Australian) implementation of IEEE 2030.5. These enhancements are critical for ensuring that BESS assets can reliably perform load shifting and peak shaving functions even in the face of intermittent connectivity.

2. Regulatory Context and Technical Imperatives

2.1 Senate Bill 49 and the Shift to Active Management

Senate Bill 49 authorizes the CEC to adopt standards that enable appliances to schedule, shift, or curtail operations to align energy demand with clean energy production. For BESS, this mandate requires a fundamental change in control philosophy. Unlike a pool pump or water heater, which acts as a flexible *load*, a BESS is a flexible *resource* capable of both absorbing excess solar generation (mitigating the "Duck Curve" belly) and injecting power during the net-load ramp (mitigating the "Duck Curve" neck).

The current regulatory landscape, largely defined by CA Rule 21 and the Common Smart Inverter Profile (CSIP), focuses heavily on *interconnection* safety. The FDAS must extend this to *operational* flexibility. This requires standards that not only define how an inverter connects to the grid but how it receives, interprets, and executes complex economic and reliability dispatch commands over its lifetime.

2.2 The "Energy Trilemma" in California

The "Energy Trilemma"—balancing Sustainability, Reliability, and Affordability —is acutely felt in California.

1. Sustainability: The aggressive RPS goals require maximizing the self-consumption of rooftop solar. BESS is the only appliance capable of time-shifting this zero-carbon energy to the evening peak.
2. Reliability: As fossil-fuel baseloads retire, the grid lacks inertia. Aggregated BESS fleets can provide synthetic inertia and fast-frequency response, but only if the communication latency is low and the control loop is robust.
3. Affordability: Network upgrades to support electrification (EVs, Heat Pumps) are capital intensive. Non-Wires Alternatives (NWA) using BESS to shave local peaks can defer these investments, but this requires locational awareness that current "Bring Your Own Device" (BYOD) programs often lack.

2.3 De-Risking Future Investments

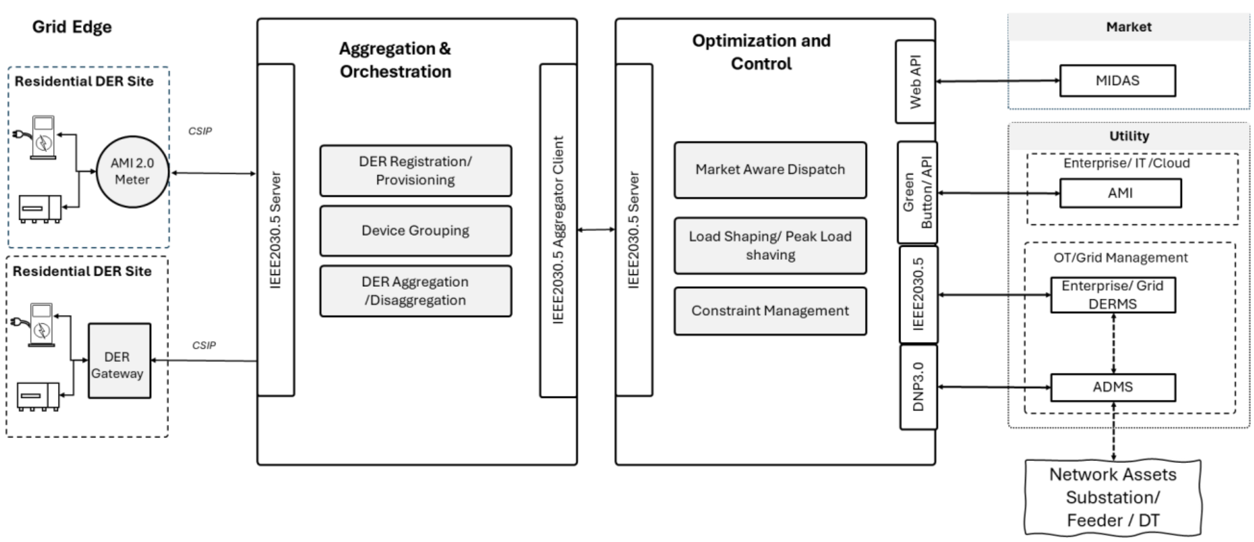
The proposed "Demand Flexibility Solution" acts as a foundational middleware layer. It solves the messy integration challenges—normalizing APIs, handling device dropouts, presenting the Enterprise DERMS with a clean, aggregated "Virtual Power Plant" resource. This allows the utility to focus its high-level optimization logic on a reliable resource pool rather than debugging individual residential internet connections.

3. Detailed Technical Architecture

The proposed solution architecture is designed to provide a comprehensive end-to-end framework for managing BTM BESS. It moves beyond simple cloud-to-cloud integrations by incorporating a robust edge computing layer and a segregated optimization engine.

3.1 Architecture Overview

The system is divided into three primary tiers: The Grid Edge, the Aggregator/VPP, and the Optimization Engine integrated with Utility and/or market.



Tier	Component	Functionality	Protocol/Standard
Grid Edge	**AMI 2.0 / Edge Gateway**	1. Local interface to BESS. 2. Protocol translation 3. Edge Analytics; Offline Logic	IEEE1547, IEEE 2030.5, IEEE1815/DNP3.0,

			Modbus, SunSpec, Wi-Fi
Aggregator	**Orchestration Platform/ VPP**	1. Device connectivity. 2. Device provisioning /registration 3. Grouping	IEEE 2030.5 (Server), REST API, MQTT
Optimizer	**Demand Flexibility Application**	1. Load Shaping 2. Peak Shaving 3. Constraint management 4. MIDAS integration	DNP3 (to ADMS), IEEE2030.5 (to DERMS), HTTPS (to MIDAS)

3.2 The DER Orchestration or VPP Application

This component, positioned in the aggregation tier, serves as the operational bridge. Its primary responsibility is **Secure DER Aggregation and Control**.

- **Multi-Modal Connectivity:** It supports direct integration with BESS directly through "Direct Control" using an edge gateway (Industrial Gateway or AMI meter).
- **Logical Grouping:** The application allows operators to group BESS assets based on electrical topology (Substation -> Feeder -> Transformer). This is essential for NWA to use cases where dispatch must be targeted to a specific congested node rather than the entire system.
- **Real-Time Monitoring:** It provides granular visibility into Active Power (kW), Reactive Power (kVAR), and State of Charge (SOC). This telemetry is aggregated up to the group level before being passed to the optimization engine and then to ADMS/DERMS, protecting the ADMS/DERMS from data floods.

3.3 The Asset Optimization & Control Engine

Optimization & Control engine is the "brain" of the system.

- **Optimization Logic:** It ingests high-level constraints (e.g., "Keep Feeder-A loading below 5 MW"), Low Voltage (LV) monitoring data (e.g., from sensors at DT level or AMI voltage alerts), and market signals (MIDAS prices). It solves a multi-objective optimization problem to generate individual dispatch schedules for the aggregated assets.
- **Security:** By keeping the optimization logic on-premises (or in a utility-controlled cloud), the utility retains sovereignty over the control algorithms that impact grid stability (as an option). The link to the aggregator shall be via a secure, outbound-initiated TLS tunnel over standard interface like IEEE2030.5, minimizing the attack surface.

3.4 AMI 2.0 and The Intelligent Edge Layer

A distinct feature of this proposal is the utilization of AMI 2.0 meters as the "Controllable Node." These meters, equipped with an application framework, fundamentally change the economics of BESS integration.

3.4.1 Edge Compute Capabilities

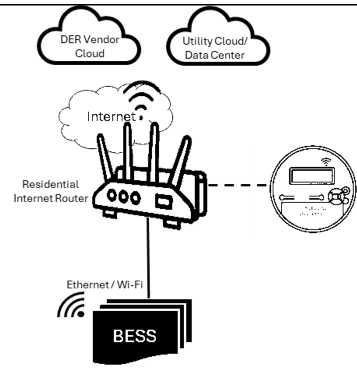
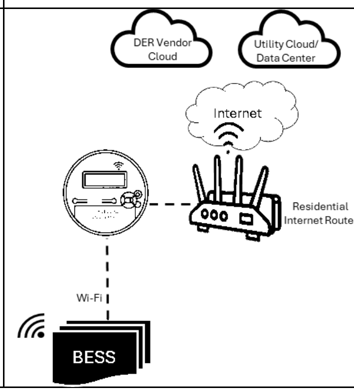
Advanced AMI 2.0 meters run operating systems capable of hosting containerized applications. The **Gateway App (GWA)** running on the meter acts as a local controller.

- **Local Discovery:** The GWA scans the local Home Area Network (HAN) to discover BESS assets (via SunSpec Modbus or IEEE 2030.5).
- **Data Processing:** Instead of sending raw, high-frequency voltage data to the cloud (incurring high backhaul costs), the GWA processes this data locally. It calculates 1-minute averages, detects voltage violations, and only transmits "Insights" or "Events" to the Aggregator/Utility.

3.4.2 Local Wi-Fi Communication Architectures

The RFI specifically inquiries about connectivity methods. Based on best-practice utility architecture, we propose two distinct models for local connectivity:

Options	A: Direct Connection to Customer Wi-Fi	B: Meter with Dual Mode & Routing Enabled
Mechanism	The AMI 2.0 meter is equipped with a Wi-Fi client radio. It connects to the homeowner's existing Wi-Fi router, just like the BESS and other smart home devices.	The AMI 2.0-meter acts as a Wi-Fi *Access Point* (AP) as well as a client. It broadcasts a dedicated, utility-managed SSID (e.g., "Utility-Secure-Link").
Data Flow	The Meter GWA communicates with the BESS over the local LAN.	The BESS is configured to connect specifically to this utility SSID. The meter routes this traffic securely to the utility network (via cellular or RF Mesh backhaul) or processes it locally.
Pros	Zero additional hardware cost; high bandwidth	High reliability; independent of the customer's home network changes; traffic segmentation separates grid control signals from household internet traffic.
Cons	Dependent on the customer's router reliability and password management. If the homeowner	Requires specific meter hardware support (Dual Radio), slightly more complex provisioning.

	changes their Wi-Fi password, the link is lost.	
Architecture		

Recommendation: We strongly recommend **Architecture B** for critical BESS assets participating in Firm Capacity or Emergency Load Reduction programs. Independence from consumer-grade networking gear is vital for reliability.

4. Protocols: Bridging the Gap with CSIP and CSIP-AUS

To ensure interoperability and resilience, the FDAS must mandate specific protocols. While CA Rule 21 specifies IEEE 2030.5 and the Common Smart Inverter Profile (CSIP), field experience suggests that standard CSIP is insufficient for robust BESS management. We propose adopting key enhancements from the **CSIP-AUS (Australian)** profile considering BESS use cases.

Note: CSIP v 3.0 is intended to bridge this gap.

4.1 IEEE 2030.5 Variations and Enhancements

The following table details specific protocol features that should be mandated in the FDAS. These definitions allow for more granular control of storage assets compared to generic DERs, ensuring that battery reserves are maintained for customer backup while maximizing grid participation.

Feature	Standard CSIP Status	Proposed FDAS Requirement	Rationale for BESS
Storage Ratings	Generic rtgW / rtgVA	**Split Charge/Discharge Ratings:** • rtgMaxChargeRateW: Sum of capabilities of all controllable storage assets (charge).	BESS often has asymmetric capabilities or grid constraints. Explicitly defining these ensures the aggregator knows the exact

		• rtgMaxDischargeRateW: Sum of capabilities of all controllable storage assets (discharge). • setMaxChargeRateW / setMaxDischargeRateW: Adjusted capabilities (less than total AC output).	bidirectional capacity available for dispatch.
Energy Capacity	rtgWh	**Operational Capacity Limits:** • rtgMaxWh: Sum of nameplate energy capacity. • setMaxWh: Maximum operational value for stored energy (system will not charge above this).	Allows the utility to respect battery health limits (e.g., not charging to 100% to prolong life) while knowing the total physical capacity.
Reserve Management	None.	**Minimum Storage Reserve:** • setMinWh (WattHour) [0..1]: Minimum operational value for stored energy. *Definition:* The value at which the battery will stop discharging to maintain state of charge above OEM- or installer-specified reserved minimums.	**Critical for Resilience.** This ensures that a VPP event does not drain the battery completely, preserving a "Backup Reserve" for the homeowner in case of a grid outage.
Dispatch Control	opModFixedW (Net Site Target)	**Storage-Specific Target:** • opModStorageTargetW (ActivePower) [0..1]: Target output at the aggregation of storage assets in Watts (signed value). *Definition:* This control only applies to EndDevices with storage components. It targets the storage assets specifically,	Allows "Storage-Only" dispatch. Standard opModFixedW targets the *net* meter point (Storage + Solar + Load), which can be unpredictable. opModStorageTargetW commands the battery directly (e.g., "Discharge 5kW") regardless of solar or load fluctuations.

		distinct from the net site load/generation.	
Offline Behavior	Default behavior only.	**Configurable Offline Logic:** 1. *Flex Connect:* Default curve active. 2. *DIDF: Execute last scheduled command.*	Resilience. If comms fails during a Peak Shaving event, the BESS must still discharge to meet the grid need.
Schedule Storage	Volatile (RAM).	**Persistent Storage:** Store schedules in Non-Volatile Memory (Flash).	Power Loss Recovery. If a BESS reboots after a blackout, it must immediately know its schedule without waiting to reconnect to the server.

4.2 The Role of the Gateway in Protocol Translation

The RFI asks about interoperability gaps. A major gap exists between the utility protocol (IEEE 2030.5) and the device protocol (Modbus/Proprietary). The "Intelligent Gateway" (software or hardware) bridges this.

- **Downstream Schedule Translation:** The gateway receives a DER Control event (e.g., "Start: 17:00, Duration: 3600s, Mode: opModFixedW, Value: 5000W") store the control and schedules.
- **Execution:** The gateway parses this and manages the local device. It might send a Modbus "Write Multiple Registers" command to the inverter. Crucially, if the inverter drifts (e.g., output drops to 4800W), the gateway's closed-loop control logic detects this via metering feedback and adjusts the command to ensure the 5000W target is met at the PCC (Point of Common Coupling).

5. Market Integration: MIDAS and Dynamic Optimization

This section describes how the proposed solution transforms a Battery Energy Storage System (BESS) from a simple backup device into an intelligent financial asset for the homeowner and a stability tool for the grid.

5.1 The Concept: "Set It and Forget It" Savings

The core intent of integrating with the Market Informed Demand Automation Server (MIDAS) is to automate complexity. Electricity rates in California can change based on the time of day, the season, and grid conditions. For a homeowner, manually tracking these changes to decide when to charge their battery is impossible.

Our solution automates this entirely. The "Optimization Engine" acts as a personal energy assistant that works in the background 24/7. It securely connects to the MIDAS database to "look ahead" at energy prices and environmental data for the next 24 hours.

5.2 How It Works in Practice

Instead of complex programming, the system operates on sophisticated, automated logic that benefits both the homeowner and the grid:

1. **Disaggregated Forecasting & Learning:** The system uses Machine Learning (ML) to train on historical data, such as the local load duration curve and weather conditions. This allows the utility to forecast the day-ahead expected active power load at a disaggregated level—specifically for the Distribution Transformer (DT) to which the residential battery is connected.

2. **Dynamic "Peakiest" Dispatch:** The battery is instructed to discharge specifically at the "peakiest" time for that local DT to relieve local transmission and distribution constraints. Unlike a static schedule, the battery set points change on a daily basis to match the unique needs of the grid for that specific day.

3. **Safety-First Operations:** This dynamic control happens alongside critical inputs from the Battery Management System (BMS). The system continuously monitors the State of Charge (SOC) to safeguard against deep discharge and monitors thermal conditions to prevent thermal runaway, ensuring the asset's health and safety are never compromised.

4. **Decentralized Ancillary Support:** The BESS functions as a provider of decentralized ancillary support at a local level. Beyond active power support, the battery and inverter can provide **Reactive Power Support (Volt-Var)** in the evening to mitigate voltage drops that often occur at the far end of a DT circuit.

5. **Incentivization & Evolution:** To ensure the battery is made available for these services, the orchestration is heavily incentivized, improving the payback period for the asset owner. The program is designed to evolve: starting as a regulatory incentive, gradually converting into a market-based price discovery model, and in the final stage, morphing into a fully realized Peer-to-Peer (P2P) energy trade ecosystem.

This approach ensures that the incentives created by the CEC—financial savings and environmental stewardship—are achieved automatically, maximizing the value of the BESS for every participant.

6. Comprehensive Response to RFI Questions

6.1 Scope

Question 1: *Should the CEC consider expanding the scope of FDAS to include commercial-scale, greater than 20kWh, BESS? What are the potential benefits, limitations, and challenges of including commercial BESS alongside residential systems in this regulation? Are there specific market segments, system sizes, or control capabilities that would make commercial BESS appropriate for inclusion?*

Response: Yes, the scope should unequivocally be expanded to include Light Commercial BESS up to 100 kWh. The distinction between a 20-kWh residential system and a 100-kWh small commercial system is purely regulatory, not technical. Both utilize similar inverter architectures (often string inverters) and identical communication interfaces (SunSpec Modbus, IEEE 2030.5).

Economic Rationale: While technical similarities justify inclusion, the economic drivers for commercial participation differ significantly from residential models. The Value of Lost Load (VOLL) is generally much higher for commercial users than for residential users, as power interruptions directly impact business operations, revenue, and productivity. Consequently, the marginal utility of a backup battery is higher for a commercial entity. To incentivize these users to participate in flexibility programs (and risk depleting their backup reserves for grid support), the FDAS regulation must encourage differentiated rate structures and compensation mechanisms. A simple residential-style rebate may be insufficient; commercial users require dynamic compensation that reflects their higher opportunity costs and the higher value they place on reliability.

Technical Justification: The DER Orchestration Platform is agnostic to battery size. It interacts with the "Site Controller." Whether that controller manages 20 kWh or 100 kWh, the control signals (Charge/Discharge) are identical. Excluding commercial systems leaves a significant volume of flexible capacity stranded. Small commercial loads often have load profiles that coincide perfectly with solar peaks, making them ideal candidates for "Solar Soaking" and evening discharge.

6.2 Control Point

Question 2: *Should the CEC consider defining the "controllable node" as the point of regulation for residential BESS instead of focusing on multimode inverters? The controllable node refers to the component within a system that manages battery charging and discharging in response to external signals and user preferences. Would this approach better reflect the diversity of system designs and control architectures currently in use? What benefits or challenges might this shift present?*

Response: Yes, the "Controllable Node" (Gateway) should be the superior regulatory point.

Focusing on the inverter limits flexibility. Inverters are power conversion devices; they are not inherently networking or security devices.

- **The Gateway Advantage:** A dedicated Gateway (like an Edge Gateway or AMI 2.0 Meter App) provides a layer of abstraction. It allows the asset owner to swap out the inverter hardware without changing the communications interface.
- **Aggregation:** A single Gateway can manage multiple downstream devices (e.g., 2 Powerwalls + 1 EV Charger). Regulating Gateway allows the CEC to treat the entire home as a single "Flexible Resource," which simplifies the topology for the FDAS.

6.3 Capabilities

Question 3: *What software and hardware capabilities could enable residential BESS to relieve/eliminate grid congestion? How can control software be configured to respond to automated and/or manual override signals from the customer's BESS?*

Response: To relieve congestion, the BESS must move beyond "set-and-forget" TOU modes.

- **Hardware:** Must support **Reactive Power Support (Volt-Var)**. Congestion is often a voltage problem, not just a thermal one. Injecting VARs can support voltage at the end of a feeder, allowing more active power to flow. These smart inverter functions are defined in the IEEE 1547-2018 standard and verified through UL 1741 SB certification, which should be a mandatory requirement for all eligible BESS assets.
- **Software:** Must support Locational Dispatch. The Orchestration Application must be able to map every BESS to its specific Distribution Transformer and Feeder. This allows the ADMS to issue a "Feeder Relief" command that targets *only* the batteries on the congested circuit, rather than a system-wide broadcast.

6.4 Technology

Question 4: *How can a standard that integrates battery operation with grid conditions account for different BESS (AC coupled versus DC coupled) and use cases (self-consumption, backup power, and DR events)? What technical constraints could limit a BESS's ability to participate in flexible demand programs? What are the various operational modes (ex. backup, self-consumption, etc.) used for BESS, and how does BESS software prioritize between modes? What hardware and software are needed to enable BESS to provide grid services and optimize costs for customers? What percentage of residential BESSs currently receive grid signals (e.g., electricity prices, GHG emissions, and*

California Independent System Operator Flex Alerts) to schedule load shifting, demand response?

Response: The standard (IEEE 2030.5) handles AC vs. DC coupling via the DER Information Model.

- **Abstraction:** The standard defines the capability in terms of "Active Power at the Point of Common Coupling (PCC)." Whether the electrons come from a DC-coupled hybrid inverter or an AC-coupled retrofit battery is irrelevant to the grid signal.
- **Operational Modes:** The FDAS must mandate support for the following modes
  1. Peak Shaving: Discharge based on a schedule.
  2. Emergency Load Reduction: Immediate discharge upon command.
  3. Import Limiting: Discharge battery to limit import from grid
  4. Export Limiting: Dynamic curtailment of solar/battery export to prevent reverse power flow issues.
  5. Island Mode: The ability to seamlessly disconnect and form a microgrid (for resilience), while reporting this status change to the utility.

6.5 Connectivity

Question 5: *What are the most common methods for communicating grid signals to BESSs (e.g., Ethernet, Wi-Fi, Cellular)? What are the costs and benefits of these methods that are identified? What are the strategies and technologies employed to enhance communication and connectivity for BESS in areas with limited infrastructure, poor communication, and connectivity?*

Response: We propose a hierarchy of connectivity methods to balance cost and reliability.

Method	Reliability	Cost	Latency	Use Case
AMI 2.0 (RF Mesh)	High (Utility Owned)	Low (Embedded)	Medium	Primary path for verification and billing data.
Customer Wi-Fi	Low (Password churn)	Lowest	Low	High-frequency telemetry; Consumer App data.
Cellular (LTE/5G)	High	High (Data plans)	Low	Critical dispatch; Backup for Wi-Fi failure.

Strategies for Limited Infrastructure:

In areas with poor connectivity, the "Persistent Storage" requirement becomes vital. The gateway should download a 7-day schedule whenever it has a connection. If the connection drops, it continues to operate autonomously based on that active and passive schedules set and local Volt-var, Volt-Watt curves.

6.6 Protocols and Interoperability

Question 6: *What are the communication protocols or components of existing communication protocols that are used to enable load shifting capabilities for residential BESSs? What are the advantages and disadvantages of each of the communication protocols? What is the implementation status of these communication protocols? What are the industry-wide standard communications protocols currently in use or planned for BESS? What are the gaps and challenges to implementing load shifting capabilities? How can the standard ensure interoperability between BESS and other flexible demand appliances (e.g. EVSE, space conditioning and electric water heating), and various control systems (such as home management systems)?*

Response: IEEE 2030.5 (CSIP) is the undisputed standard for the Utility-to-DER link.

- **Gaps:** The "Last Inch" communication (Gateway to Inverter) is non-standard. It relies on communication interface defined in IEEE1547 such as Modbus (SunSpec).
- **Gap Resolution:** The FDAS should not try to standardize the "Last Inch" (which stifles innovation) but **should mandate communication interface** defined in **IEEE1547** and **UL1741 SB**. Every BESS manufacturer must provide documentation that allows third-party Gateway to read/write control signals.

6.7 Cost Optimization and MIDAS

Question 7: How *can a residential BESS best minimize customers' electricity costs both with and without self-generation (such as solar PV)? How can residential BESSs best utilize the CEC's Market Informed Demand Automation Server (MIDAS), which provides free access to utilities' time-varying rates, GHG emission signals, and California Independent System Operator (California ISO) Flex Alerts? More details can be found here: Market Informed Demand Automation Server (MIDAS) (ca.gov).*

a. Are there options for BESS systems to leverage signals from CEC MIDAS? What are the key functionalities that are required for BESS to respond to CEC MIDAS signals? Are there changes to MIDAS that would better support BESS load flexibility than the existing configuration?

b. Are there any strategies to best utilize BESS with Demand Response events? What is the role of BESS charging and discharging from the grid?

Response: BESS minimizes costs by arbitraging the differential between Peak and Off-Peak rates.

- **MIDAS Role:** MIDAS automates this. Instead of a static TOU table programmed once a year, the BESS polls MIDAS daily. If the utility changes the rates (e.g., introduces a "Critical Peak Pricing" day), the BESS adapts automatically.
- **Key Functionality:** The system must have a "Price-Responsive" mode where Charge_Trigger is set to Price < X and Discharge_Trigger is set to Price > Y.

6.8 Cybersecurity

Question 8: *What are the cybersecurity challenges and needs associated with communicating signals from the grid or a third-party, and interacting with BESS? How would these cybersecurity protocol challenges be used to address the risks to both customer data and grid reliability? What are the risks and benefits of enabling remote software updates to incorporate new standards, and what processes can be used to mitigate these risks?*

Response: The primary risk is a **"botnet" attack** where thousands of batteries are commanded to discharge simultaneously, causing a frequency excursion or local thermal overloads. Additionally, the reliance on remote updates introduces supply chain vulnerabilities. We propose a defense-in-depth strategy comprising technical controls and organizational compliance requirements.

Technical Mitigations:

1. Mutual Authentication (mTLS): Every gateway must be issued a unique X.509 digital certificate. This ensures that the Aggregator verifies the device and the device verifies the Aggregator before any command is processed.
2. Rate Limiting & Traffic Shaping: The "DER Orchestration Platform" must implement strict rate limiting on API calls to prevent Denial of Service (DDoS) attacks.
3. Edge-Based Command Validation: The "Edge Gateway" (or AMI App) must host local "sanity check" logic. If it receives a command (e.g., "Discharge 100%") that contradicts local grid safety limits (such as high local voltage), the gateway must autonomously block the command to protect the grid physics.
4. Secure Boot & Firmware Signing: To mitigate the risk of malicious remote updates, all devices must enforce Secure Boot mechanisms. Firmware updates must be cryptographically signed by the manufacturer; the device should reject any update that lacks a valid signature, preventing attackers from flashing malicious code.

Organizational Compliance: Technical controls must be supported by rigorous organizational security standards to protect customer data and system integrity.

1. ISO/IEC 27001: We recommend the FDAS mandate that any Cloud Aggregator connecting to the utility grid must maintain current ISO/IEC 27001 certification. This ensures a systematic approach to managing sensitive company and customer information.
2. SOC 2 Type II: Aggregators should also be required to provide annual System and Organization Controls (SOC) 2 Type II attestation reports. This verifies that the service provider's internal controls regarding security, availability, processing integrity, confidentiality, and privacy are not only designed correctly but are operating effectively over time.

6.9 Resilience

Question 9: *In the event of a loss of communication and/or connectivity, how should the residential BESS function? What are the potential risks and benefits of each approach, especially in terms of grid reliability, user experience, and long-term sustainability? What is the current status of interoperability standards that would allow previously installed BESS to point to a different cloud-software control layer if the original control layer is disbanded for business reasons?*

Response: Offline Behavior is the critical resilience feature.

- **Requirement:** The FDAS must mandate that BESS devices support "Schedule Persistence."
- **Logic:** Upon loss of comms, the BESS does *not* revert to idle. It continues to execute the last known valid schedule (e.g., the MIDAS-optimized plan downloaded that morning).
- **Cloud Agnostic:** The standard must support "Re-Registration." If a cloud provider is not available, the BESS gateway must be re-configurable (via local interface) to point to a new generic aggregator URL.

6.10 Valuation Tools

Question 10: *Staff is considering using the California Public Utilities Commission's (CPUC) Avoided Cost Calculator (ACC) for internal data evaluation while CEC continues to draft a standard for residential BESS. To what extent is the ACC a reliable and valuable tool for forecasting hourly value for electricity import or export to the grid? Are there specific strengths or limitations in the ACC's methodology or assumptions that should be considered when valuing Net Billing Tariff for BESS? Are there other sources that CEC staff should consider in valuing or forecasting hourly value for electricity imports or exports to the grid?*

Response: The ACC is a planning tool, not an operational one. It is useful for designing the FDAS incentives (e.g., determining the value of a rebate). However, for daily operations, the MIDAS signal (which reflects real-time grid conditions) is the superior valuation tool. Reliance solely on the ACC for operational dispatch leads to suboptimal outcomes because it uses historical averages rather than today's weather/load reality.

6.11 Customer Experience

Question 11: *What types of information or awareness campaign do the Load Serving Entities (LSE) or other entities provide participants in the BESS installation program to help customers understand the benefits BESS provides? What percentage of customers have a residential BESS? What reasons do customers give for installing BESS at their residence? Do customers with residential BESSs have options for more than one rate structure? What tariff structure or options are utilized by the installed stock of BESS? Do customers with a residential BESS prefer a specific rate structure that LSEs or other entities provide? Do customers who add a BESS to their residence stay with their previous rate structure? What financial incentives or rate structures are most effective in encouraging customers to adopt and use for BESS? What are the estimated costs and benefits for customers of participating in the flexible demand program for BESS, including potential bill savings and the impact on BESS lifespan?*

Response: Trust is built through transparency. The customer app must show:

1. **"VPP State":** Clearly indicate when the battery is under utility control ("Grid Event Active").
2. **"Earnings Tracker":** Show the cumulative dollar value earned from flexibility events.
3. **"Opt-Out":** A simple slider to "Opt-Out" of an event for comfort or anxiety reasons. Note: Frequent opt-outs may degrade financial incentives, which should be clearly communicated.

6.12 System Design

Question 12: *When developing policy for residential BESS, should the CEC define all-in-one battery, controls, and inverter systems as distinct from systems where these components are housed separately? What are the benefits and challenges of each configuration in terms of installation flexibility, system scalability, maintenance, and overall cost-effectiveness, and should all-in-one systems be handled differently in regulation?*

Response: No. Distinguishing them creates regulatory loopholes. The standard should define the "System" as the functional block of Storage + Inverter + Controller. Whether these are in one box or three is irrelevant to the grid. The compliance obligation lies with the entity requesting interconnection (the installer/integrator) to ensure the system meets the FDAS.

6.13 Data Sources

Question 13: *CEC staff based their California residential BESS stock estimates, growth rates, and load shapes on data provided by the CEC 2024 Integrated Energy Policy Report. Are there other California-specific information sources that staff should consider?*

Response: We recommend incorporating AMI Data (via the Green Button Connect My Data standard) as a primary data source for load shaping. Using the customer's actual historical load profile (rather than a generic class profile) allows the "Optimization Engine" to size the backup reserve and discharge schedule far more accurately. Additionally, integration with Low Voltage (LV) Network Monitors (such as DT sensors) can provide granular visibility into transformer loading and voltage constraints, refining the available flexibility.

6.14 Multifamily Access

Question 14: *What options are available for tenants and occupants in multifamily buildings to access financial benefits from BESS? How would the control software need to change to support load flexibility in this configuration? What, if any, BESS software options exist to allow building owners or operators to manage demand as well as provide grid services? Are there examples of tenant-or resident-owned BESS that could provide these services and could be cost-effectively moved with residents to future residences?*

Response: The solution is Virtual Allocation.

- **MUP (Mirror Usage Points):** As detailed in the CSIP research, a single gateway can support multiple MUPs (mirror usage points) to send telemetry. A large BESS in the basement can be virtually split into multiple "slices" representing each consumer.
- **Billing:** The utility receives metering data for each MUP (slice). The tenant sees a "Battery Credit" on their bill as if they owned a small unit in their apartment, even though the hardware is communal.

6.15 Equity

Question 15: What *are the equity considerations for BESS, and how can FDAS address these issues in regulation? For example, are there concerns that flexible demand will be disproportionately accessible based on income level? Are there other factors or impacts that should be considered if there were to be disproportionate accessibility?*

Response: Standardization is an equity enabler. By mandating open standards (IEEE 2030.5/CSIP), the CEC prevents vendor lock-in, driving down hardware costs and OEM cloud subscription cost. This makes BESS more accessible. Furthermore, the "Multifamily Virtual Allocation" model described above allows renters and low-income residents to participate in the flexibility market without the capital cost of buying a home or a battery.

6.16 Miscellaneous

Question 16: *After reviewing the scope and questions posed in this request for information, are there additional issues or considerations that should be addressed by CEC staff?*

7. Implementation of Roadmap and Pilot Strategy

Drawing from industry best practices, we propose a phased implementation roadmap to validate this architecture before full-scale enforcement.

Phase 1: Foundational Capability

Goal: Establish data pipelines and connectivity.

- **Deployment:** Deploy the **DER Orchestration Platform**.
- **Integration:** Integrate the top 3 BESS OEMs in CA
- **Pilot:** Install **AMI 2.0 meters with Edge Apps** or Gateway at 50 diverse residential sites (including low-income/multifamily).
- **Testing:** Validate "Direct Gateway Control" and telemetry data quality.

Phase 2: Advanced Optimization

Goal: Activate the "brain" and market signals.

- **MIDAS:** Integrate the live MIDAS API feed into the Optimization Engine.
- **Automation:** Enable automated "Price-Responsive" dispatch logic.
- **Resilience Testing:** Conduct "unplugged" tests to validate the CSIP-AUS "Offline Behavior" and "Persistent Storage" capabilities.
- **ADMS Link:** Establish the DNP3 link to the utility control room for emergency override testing.

8. Conclusion

The California Energy Commission stands at the precipice of a new era in grid management. By adopting the recommendations in this proposal—specifically the shift to **AMI 2.0 as an intelligent edge**, the rigorous enforcement of **CSIP with resilience enhancements**, and the market-driven automation via **MIDAS**—California can unlock gigawatts of flexible capacity currently locked inside residential garages.

This architecture offers a "No Regrets" path forward. It aligns with the best global practices (CSIP/CSIP-AUS), leverages existing investments in smart metering, and provides a scalable, secure foundation for the virtual power plants of the future. Technology is mature; the standards are defined; the task now is simply to integrate them into a cohesive regulatory framework.