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Quarterly ADER Update

Tesla Energy

Agenda

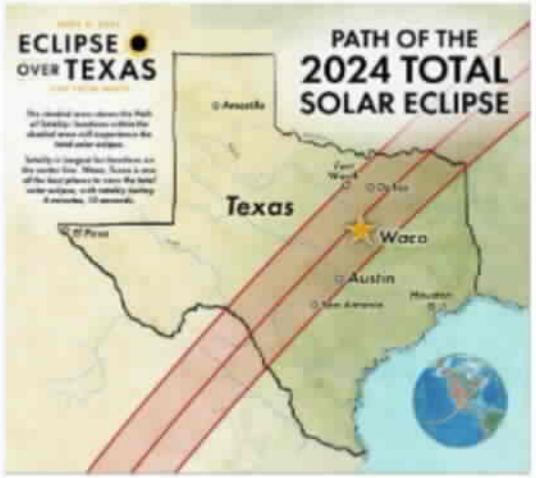
- Lessons learned: Solar Eclipse Non-spin Deployment

- Introducing RRS from ADERs
  - Use case
  - Potential qualification methods

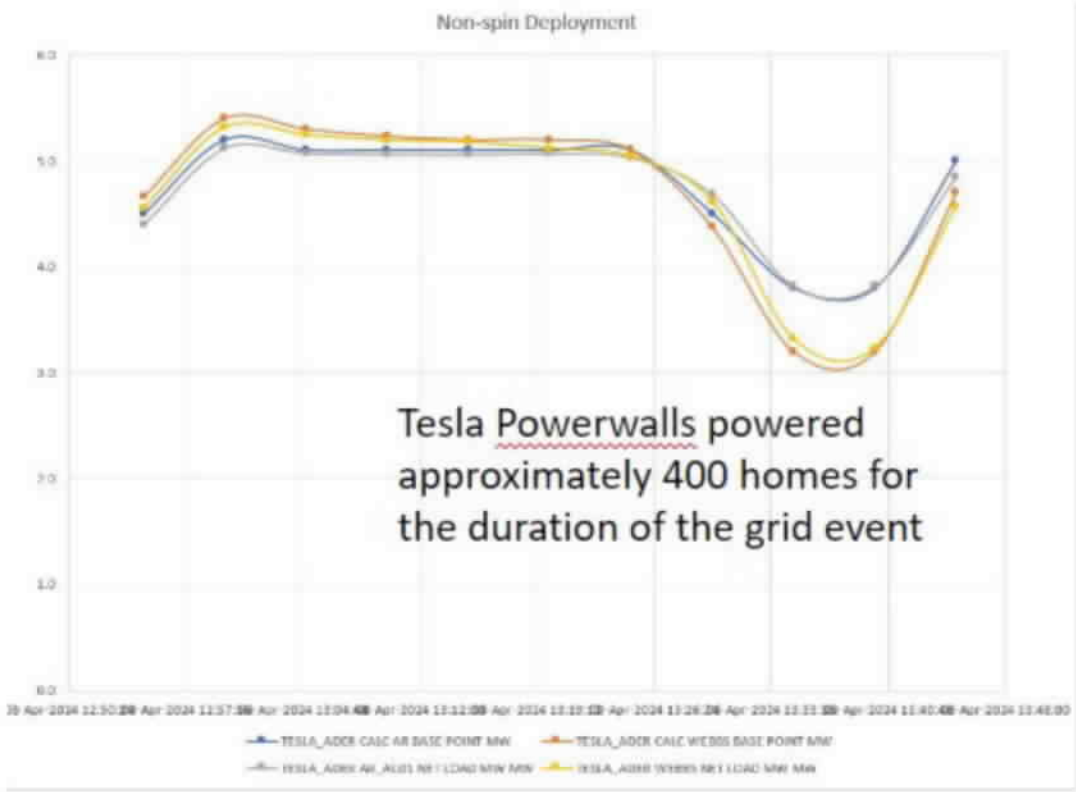
- Developing Aggregations of devices built by multiple OEMs
  - Economies of scale
  - Telemetry requirements
  - Exemption from SCED dispatch and rationale

Solar Eclipse Deployment

Tesla's ADERs were deployed for Non-spinning Reserve Service



As the solar eclipse extinguished solar generation across Texas, Tesla Electric's Aggregations of distributed residential storage responded in seconds, precisely when called upon by the System operator.



Introducing RRS from ADERs

Use Case

- Batteries can respond to frequency events based upon site-specific observed measurements with a simulated governor response

- Wholesale batteries in ERCOT routinely provide this service by charging (for high frequency events) and discharging (for low frequency events)

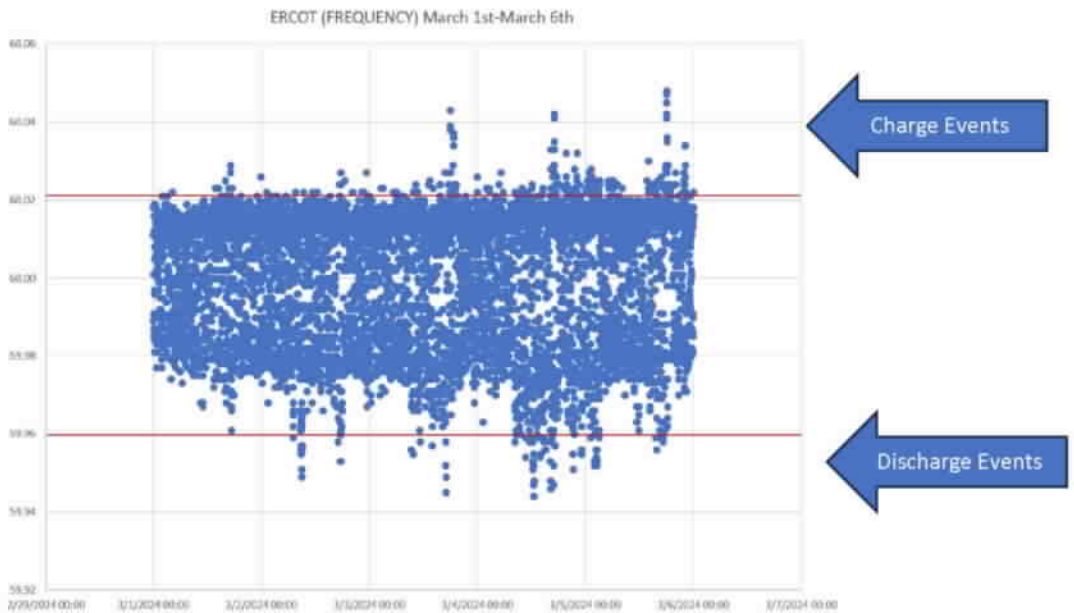
- Distributed storage, by virtue of their inverter technology and on-board data recording can
  - Respond in less than a second (comparable or better than the response time of traditional generation)
  - Capture event data, with sub-second granularity, to demonstrate compliance

- RRS is a gentle use case for batteries, and compliments residential customer use cases (Extend the use of solar, reduce consumption from the grid)

- Tesla Electric's ADERs are RRS-PFR and SCED dispatchable, though relaxing the requirement to respond to SCED could enable mixed aggregations to participate with less costs
  - OEMs could telemeter participating devices and capability individually to a QSE
  - SCED dispatch over disparate OEM networks are not currently acheivable

Introducing RRS from ADERs

Use Case



In 1 Week:
1Min Charge, 10Min of Discharge
119 Hours, 50Min within Deadband
750WHr discharged per participating PW

- Responsive Reserve Service (RRS), after the introduction of ECRS is
  - Primary Frequency Response (self-dispatched based upon site specific frequency observations)
  - SCED dispatchable after release in EEA
- Gentle use case for batteries
  - Can be provided while charging or discharging
  - Limited to frequency dead band (60Hz +/- .036Hz)
  - Constantly deployed, but for small charge/discharge events
- Maximum compatibility with owner investment thesis
  - Storm Watch Mode, Back-up Reserve, Consumption constraints (extend use o solar / minimize grid usage)

Introducing RRS from ADERs
Potential Qualification methods

Device Certification

1. Demonstrate PFR capability for each device, certify from independent engineering organization

2. Validate on-board data recording

Pros:
Mirrors certification process for RRSNC (RRS provided by load behind under frequency relays (UFRS). Frequency event can be controlled in a lab

Cons:
Time intensive, may require a new certification for each device

Field Demonstration

1. Demonstrate PFR capability for each device by capturing Frequency Measurable Event (FME) with onboard recording

2. Validate on-board data recording (select sites)

Pros:
Consistent with traditional resource validation process. Expedient. Validates performance routinely.

Cons:
Requires PFR activation prior to qualification. Qualification could be delayed waiting for an FME to occur

Introducing ADERs with multiple devices

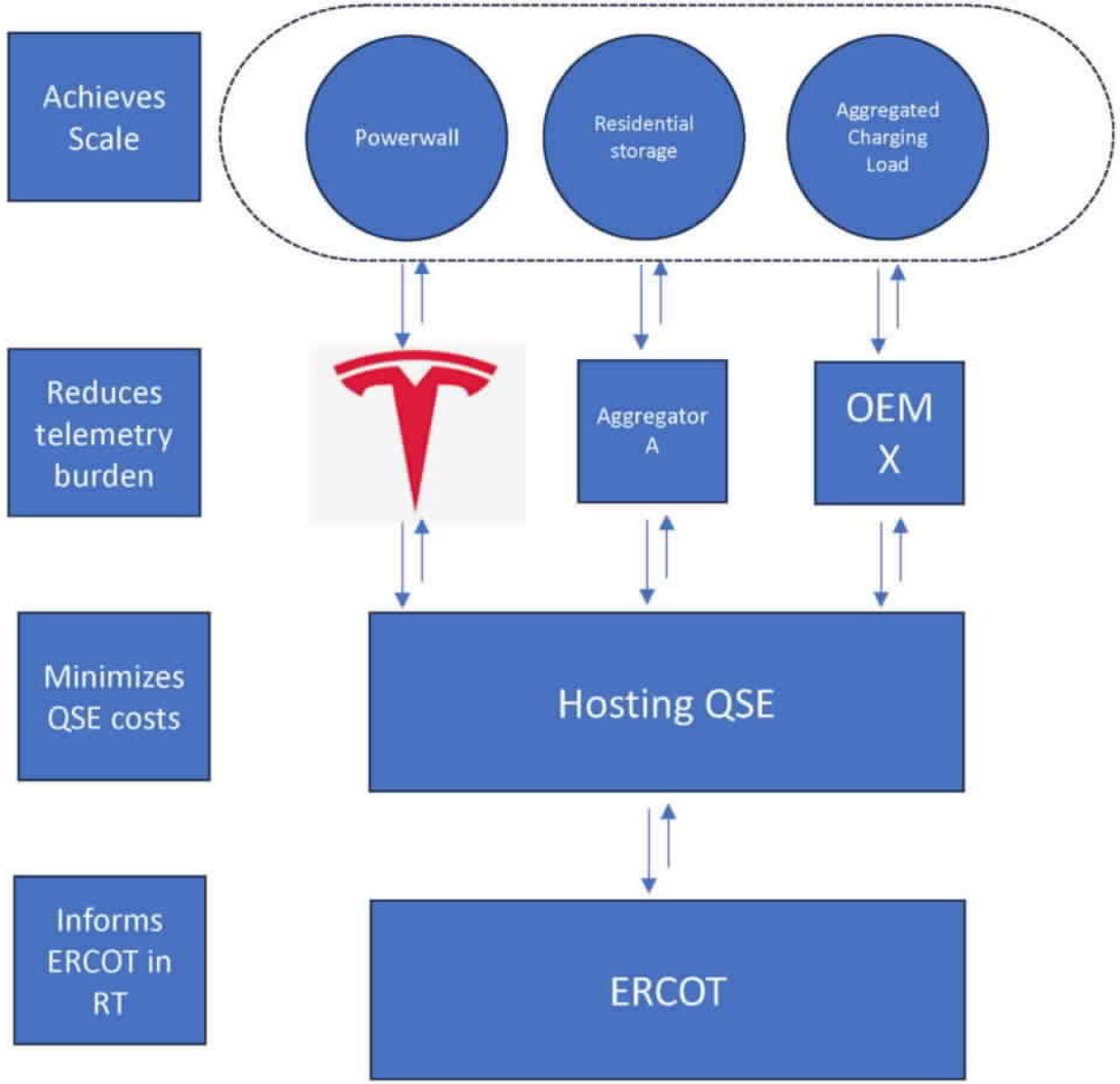
RRS from ADERs could remove impediments to entry

Tesla learned minimum economic scale for an ADER is approximately 10MW. 10MW of scale is challenged given all capacity must be within the same TDSP/Load Zone/REP portfolio.

SCED dispatch requires extensive telemetry over proprietary networks, further limiting scale to devices manufactured by the same OEM.

Comparatively, PFR is dispatched by system frequency, as observed at the site. Devices produced by different OEMs could join the same ADER if they can (1) provide PFR, (2) Record a PFR event, (3) store and send the PFR event to the OEM.

The OEM or aggregator could telemeter real-time participating capacity to the QSE managing the ADER.



Introducing ADERs with multiple devices
Rationale for SCED exemption

ERCOT procures between 2300 and 3178MW of RRS each hour of the year. Up to 60% of the total can be from Load, or Non-Controllable Load Resources (not SCED dispatchable.) The remaining 40% can be dispatched by SCED to recover other spent reserves, though these reserves typically provide PFR.

ERCOT must always retain at least some PFR, and can shed load to mitigate the risk of uncontrolled load shed (which is imminent without PFR.) ADERs providing PFR could be withheld to provide PFR through the progression of an EEA, and exempt from SCED dispatch.

Tesla Electric ADERs will provide RRS with SCED dispatchability (uniform aggregation with existing SCED dispatch capability.

To explore ADERs with mixed OEM devices, reduced QSE/telemetry costs, and attainable efficient scale, Tesla suggests that ERCOT impose:

1. A total RRS from ADER limit

2. A subset of that limit to be provided as PFR only, with SCED dispatch excused.