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Filing Date - 2024-09-27 01:52:57 PM

Control Number - 53911

Item Number - 117

MEMORANDUM

FROM: Jason M. Ryan, ADER Task Force Chair
Joel Yu, ADER Task Force Vice-Chair

RE: Project No. 53911, *Aggregate Distributed Energy Resource (ADER) ERCOT Pilot Project*

DATE: September 27, 2024

Attached are the materials presented at the task force workshop earlier today.

ADER Task Force Workshop

September 27, 2024

Agenda

- Opening Remarks (Chair)
- Introductions from new Task Force members (5 min)
- ERCOT Update (30 min)
- Bandera/Tesla Lessons Learned Presentation (30 min)
- Cmsr Glotfelty Memo Item #3 Discussion
  - *Roadmap to get to 80 MWs and beyond, i.e., ADERs as "permanent fixture in the ERCOT software"*
- Recap action items and discuss next workshop scheduling and agenda

Aggregated Distributed Energy Resource (ADER) Task Force – ERCOT Update

Ryan King
Manager, Market Design

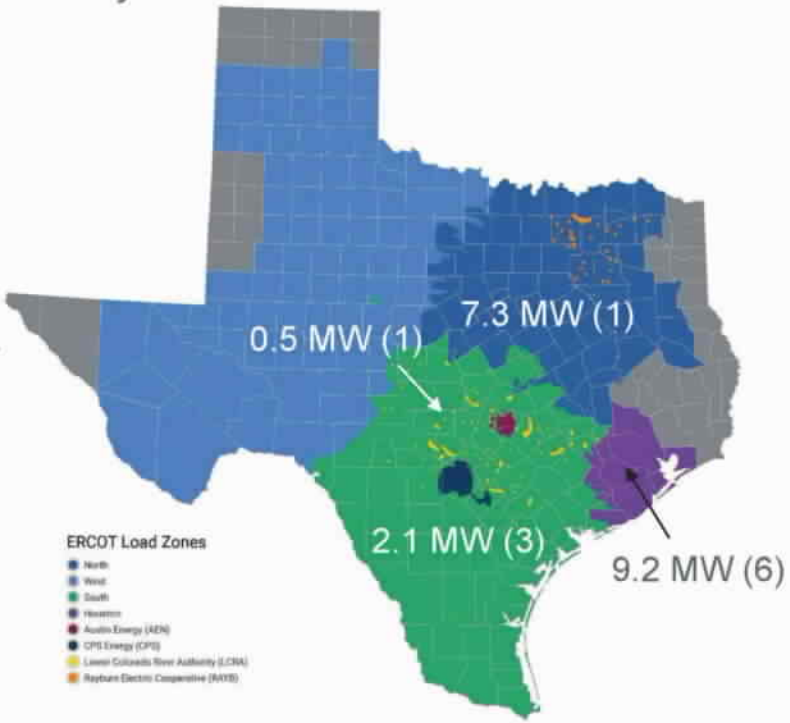
Mark Patterson
Manager, Demand Integration

ADER Task Force Meeting
September 27, 2024

Pilot Participation as of September '24

- 2 ADERs fully participating in the wholesale electric market:
  - 14.5 MW for energy
  - 8.6 MW for Non-Spin
  - 8.6 MW for ECRS
- 9 additional ADERs have ERCOT-accepted Details of the Aggregation (DOTA) forms in place:
  - ERCOT-wide energy: 4.6 MW
  - ERCOT-wide Non-Spin: 1.1 MW
  - ERCOT-wide ECRS: 0.1 MW
- Seeing actual activity on 4 of these 9 ADERs (e.g., updating DOTAs, telemetry validation, qualification testing, etc.)
  - 2.2 MW of 4.6 MW total

MWs for energy and count of ADERs by Load Zone for all 11 ADERs



Pilot Participation as of September ‘24

		LZ_AEN	LZ_CPS	LZ_HOUSTON	LZ_LCRA	LZ_NORTH	LZ_RAYBN	LZ_SOUTH	LZ_WEST	ERCOT-WIDE
Energy	Limit (MW)	2.8	5.3	20.3	3.1	28.7	1.2	10.3	8.2	80.0
	Approved (MW)	0.0	0.0	9.2	0.5	7.3	0.0	2.1	0.0	19.1
	Unused (MW)	2.8	5.3	11.1	2.6	21.4	1.2	8.2	8.2	60.9
	% Full	0%	0%	45%	16%	25%	0%	20%	0%	24%
Non-Spin	Limit (MW)	1.4	2.7	10.1	1.6	14.3	0.6	5.2	4.1	40.0
	Approved (MW)	0.0	0.0	4.7	0.0	4.6	0.0	0.4	0.0	9.7
	Unused (MW)	1.4	2.7	5.4	1.6	9.7	0.6	4.8	4.1	30.3
	% Full	0%	0%	46%	0%	32%	0%	8%	0%	24%
ECRS	Limit (MW)	1.4	2.7	10.1	1.6	14.3	0.6	5.2	4.1	40.0
	Approved (MW)	0.0	0.0	4.0	0.1	4.6	0.0	0.0	0.0	8.7
	Unused (MW)	1.4	2.7	6.1	1.4	9.7	0.6	5.2	4.1	31.3
	% Full	0%	0%	39%	8%	32%	0%	0%	0%	22%

Recent Discussions on Active ADERs

- ERCOT staff has been having several discussions with individual pilot participants and other interested parties, with topics including:
  - Details on how to provide telemetry and other market submissions to ERCOT;
  - Updates to DOTA forms;
  - Telemetry validation;
  - Ancillary Service qualification and testing; and
  - Other general questions about the pilot and how to participate.

ERCOT's Focus for Phase 3 of the Pilot

- In thinking about how to best expand participation in the pilot, the primary focus of ERCOT staff has been an additional participation model that allows "blocky" response (more details on the next slides).
  - "Blocky" generally refers to a participation model where a Resource can participate in the Ancillary Services market without having to following 5-minute Real-Time Market dispatch.
  - This already exists for Load Resources today.
  - With additional time and review, there is a way to accomplish this mode of participation without changes to ERCOT systems.
- While the primary goal for ERCOT is looking for ways to expand participation in the pilot in a fair and reliable way, this type of participation could have a relationship to multiple points raised by Commissioner Glotfelty in his memo on August 14th.
  - Specifically, under today's rules for Load Resources under the "blocky" participation model, the Qualified Scheduling Entity (QSE) representing the Resource does not have to be the QSE representing the premise/electric provider as the Load Serving Entity (LSE).

Additional Details on the "Blocky" Participation Model Approach

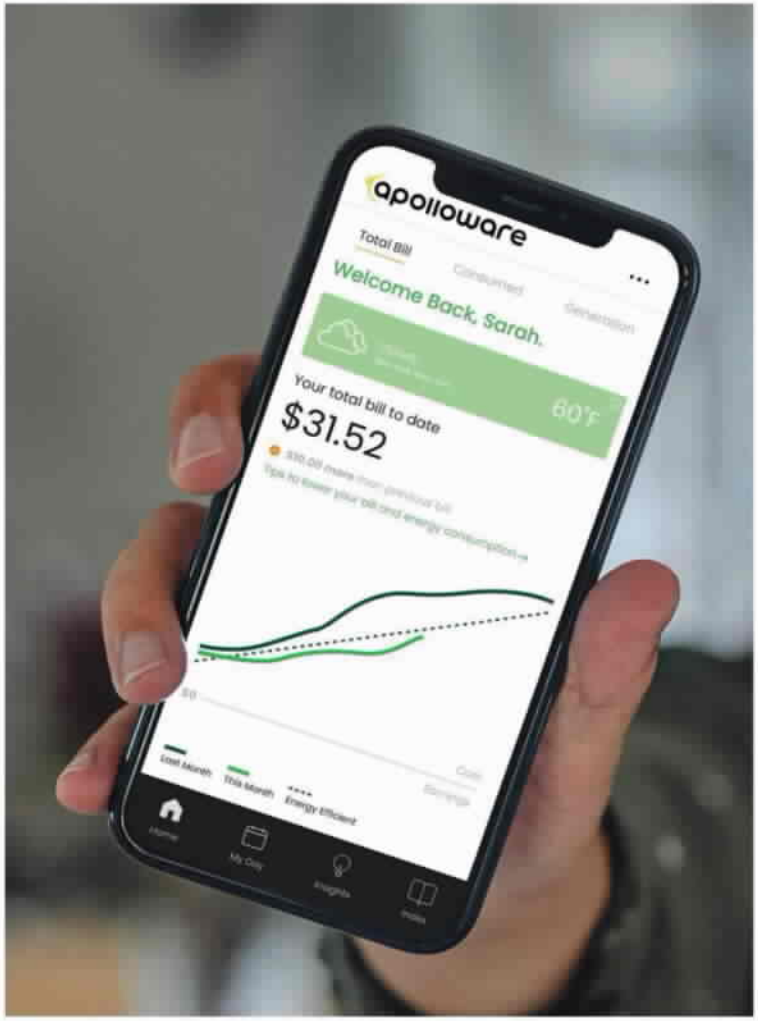
- Aggregations of "blocky" devices/premises would participate as Non-Controllable Load Resources (NCLRs).
- Aggregation will be registered and modeled like other ADERs but using NCLR categories for Resource parameters in ERCOT's Resource Integration an Ongoing Operations (RIOO) system.
- Real-time 2-second telemetry would still be required from the QSE to ERCOT using all NCLR attributes.
- These ADERs would be dispatched by the Ancillary Service Deployment Manager like other NCLRs.
- Since these Resources would be registered and participating as NCLRs, Section 3.6.1 (4) of the Protocols would not apply and the QSE representing the ADER could be a QSE who is different than the one who represents the LSE serving the Load of all sites within the aggregation.
  - The Protocol would not apply unless otherwise stated in the governing document.

Additional Details on the "Blocky" Participation Model Approach

- Telemetry changes for "blocky" ADERs:
  - For device-level telemetry validation, we would require 5-minute interval data from each device (1-minute data will still be required for SCED dispatchable ADERs)
  - Validation Metric change: Of these intervals being evaluated, the telemetered value must be within 50% of the aggregate premise-level data averaged over each 15-minute Settlement interval when the Total Expected Registered Capacity is less or equal to 1 MW, or within 10% of the aggregate device-level data averaged over each 15-minute Settlement interval when the Total Expected Registered Capacity is greater than 1 MW.
- Deployment performance will use meter before – meter after, like other NCLRs. The 5-minute meter before baseline is similar to existing NCLR requirements.

Next Steps

- ERCOT staff will continue engaging with the current, active pilot participants on submissions, validations, and qualifications.
- A review of the current governing document for the pilot has been started to identify the types of changes that would be needed for the concept that has been laid out in this presentation.
  - The changes to the governing document will be substantial as compared to the changes that were required between phases 1 and 2.
  - While this is likely to be beneficial and the feedback has been positive, the degree to which this additional participation model will increase the number of MWs in the pilot is unknown.

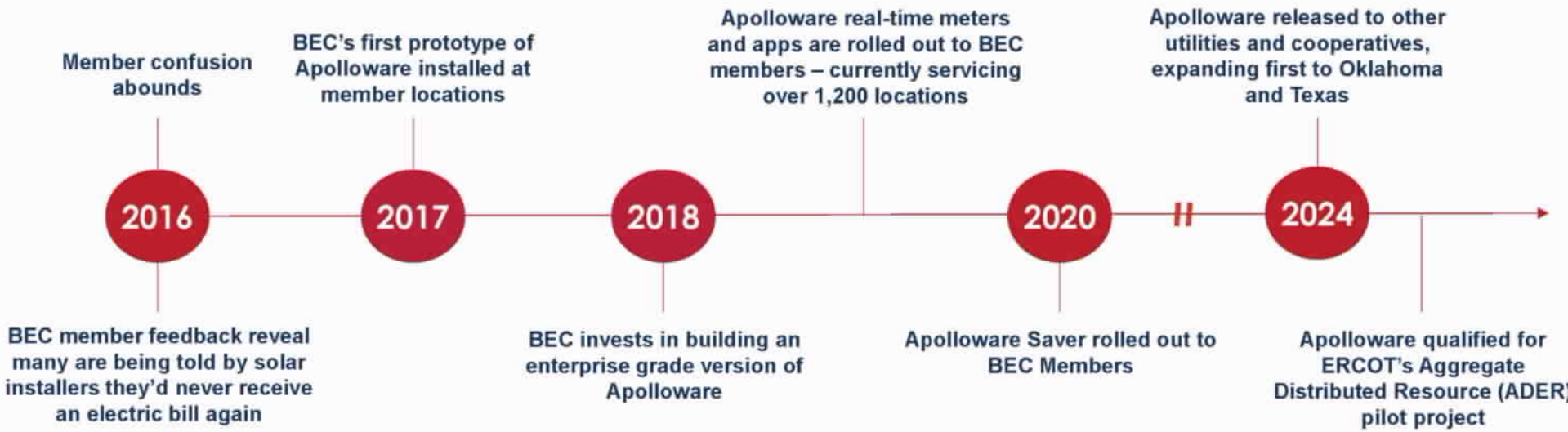


ADER Qualification Experiences & Lessons Learned

September 2024

Apolloware Background

The desire to better service BEC's members evolved into the enterprise-grade software platform Apolloware is today. Every feature in Apolloware has been incubated and market-tested at Bandera Electric.



Headlines

- **BEC, using Apolloware, passed ADER SCED qualification on the first attempt.** This portion of the test is technically more difficult compared to Telemetry.
- **ADER Telemetry testing required multiple iterations to pass.** We picked up key learnings that were incorporated to the test process and will be invaluable when operating in the market.
- **BEC is now fully qualified for SCED and Telemetry to participate in the market, and provisionally qualified for Non-Spin and ECRS.**
- **Qualification under the current ERCOT Protocols is possible with:**
  - Device-level, real-time energy feedback
  - Tight integration and understanding of third-party equipment, APIs, servers, and communications
  - Advanced programming to manage edge cases
  - Comprehensive testing at every point of potential failure (there are many)
  - Operational reporting to monitor events

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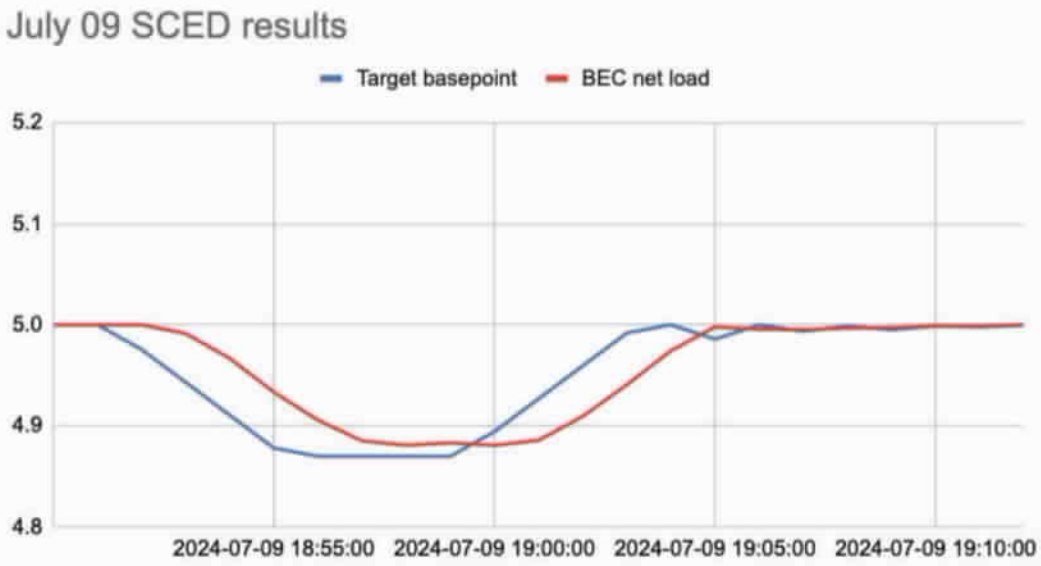
Security-Constrained Economic Dispatch (SCED) Testing

Ability to **receive ERCOT dispatch instructions to ramp up or down smoothly within a 5-minute interval** following an Updated Desired Base Point (UDBP).

BEC passed on the first attempt using Apolloware's highly performant cloud infrastructure that is capable of elastic scaling to large ADERs



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Telemetry Qualification Requirements

ADERs must provide real-time telemetry data to ERCOT, including power output, status and operational parameters. BEC conducted telemetry qualification on device-level data (vs. premise-level).

Qualification Requirements At-A-Glance:

1. ERCOT aggregates device-level averaged for 15-minute intervals during an 8-hour test period. We provide 1-minute interval energy (Net Power) data for each device (kWh) upon completion of testing for ERCOT evaluation and data aggregation
2. The ADER Net Power Consumption of the aggregated device-level sub-meter data must meet the following conditions:
    a. Only intervals where aggregate device-level data, averaged over each 15-minute window, are greater than 10% of the Maximum Injection Capability OR Maximum Withdrawal Capability will be evaluated.
    b. Of the intervals evaluated, the telemetered value must be within 10% of the aggregate device-level data averaged over each 15-minute interval
    c. During the 8-hour test period, at least 50% of the intervals must meet the above conditions.

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Telemetry Test Results – Aug 19: Passed!

Time	NPF	Device	Error
8/19/24 12:00	-0.07296	-0.073926814	1.31%
8/19/24 12:15	-0.07258	-0.074189687	2.17%
8/19/24 12:30	-0.071933333	-0.073905717	2.67%
8/19/24 12:45	-0.07236	-0.073972414	2.18%
8/19/24 13:00	-0.07248	-0.074125832	2.22%
8/19/24 13:15	-0.0723	-0.074260209	2.64%
8/19/24 13:30	-0.072153333	-0.074208902	2.77%
8/19/24 13:45	-0.067146667	-0.067423034	0.41%
8/19/24 14:00	0.073313333	0.074731394	1.90%
8/19/24 14:15	0.073366667	0.074996381	2.17%
8/19/24 14:30	0.073086667	0.074872631	2.39%
8/19/24 14:45	0.073666667	0.074993963	1.77%
8/19/24 15:00	0.07356	0.075171909	2.14%
8/19/24 15:15	0.07278	0.074986941	2.94%
8/19/24 15:30	0.07332	0.074634638	1.76%
8/19/24 15:45	0.071826667	0.072861624	1.42%

2.05% Avg. Error Rate –
97.95% Accuracy

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Lessons Learned & Improvements

- ADER Qualification Notes
- Site Reliability is Key
- Road to 80 MW
- Value of Independent Telemetry

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Qualification Notes

- **ERCOT Requirements Require Interpretation** – even with proactive engagement with ERCOT, translating the requirements into a viable architecture is difficult.
  - **ACTION**: We proactively engaged with ERCOT for multiple sessions, sharing preliminary test results and patterns to refine the technical architecture. These were invaluable.

- **ADER Capacity Matters** – initial capacity submitted in the ERCOT DOTA was small, making the margin of error incredibly tight. Yet, testing at such a low capacity helped identify issues and risks that allowed us to "tighten" every connection streaming data via QSE to ERCOT.
  - **ACTION**: Updated the DOTA with additional ADER sites to increase the margin of error. Other utilities should consider starting with a larger ADER.

- **Member Awareness** – proactively communicate with participating members prior to ADER testing
  - **ACTION**: Outreach to members via phone and email in advance of subsequent test cycles.

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Site Reliability is Key

The ADER sites used BEC-owned batteries and most were in BEC Fiber territory. We could control as many variables related to installation, configuration, and communications, but still, micro-failures occurred.

Multiply the scenario at scale, add more DERs across multiple OEMs, throw in extreme temperatures, allow customers to BYO batteries…the outcome is predictable: devices and sites ***WILL*** have issues that impact the precision ERCOT requires.

- **Site Reliability & Capacity Factor** – edge cases for sites must be accounted for. Comms outages should be expected at the device-level and need to be managed systematically to trigger battery idle commands and adjust LPC/MPC calculations during an ADER event.
  - **ACTION**: Introduce new code and logic into Apolloware to identify comms outages and adjust programmatically to ensure telemetry values match device level data. Identify edge cases that may require updates to the OEM's API or Apolloware's integration.
  - **ACTION**: Set and test standards for keeping capacity in reserve to be able to meet bid requirements, i.e. if a site drops out, an alternate reserve site can be activated. Introduce a capacity factor, controlled algorithmically, that uses machine learning to forecast and optimize capacity in reserve (and therefore bids in the market) based on historic site performance, weather and other variables.

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Value of Independent Telemetry & Monitoring

OEM Agnostic Device Level Telemetry offers distinct advantages as we consider scaling to 80 MW and beyond.

Every DER OEM will have its own unique limitations, including device reliability, data accuracy, data granularity, device responsiveness and performance attributes (e.g. batteries get hot and fail to discharge at instructed levels).

We solved for these limitations by:

- Monitoring DER circuits independent of the OEM
- Using real-time telemetry feedback to calibrate signals to the batteries. We found in development and testing that the OEM could not provide the level of telemetry needed to qualify.

Independent real-time circuit monitoring provides accurate and reliable data on the *actual* performance of the DERs. This enables prediction of aggregate commands needed to reach a target discharge levels. Apolloware dynamically adjusts to calibrate the overall load response across a diverse array of DERs - critical to incorporating other storage OEMs and thermostats.

We consider this independent telemetry solution to be a key strategic enabler for scaling.

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The Road to 80 MW

BEC has identified strategic areas of focus to begin scaling:

- **Target Households with Smart Thermostats**: Focus on the 1.3 million homes with existing smart thermostats. Aim to convert at least 40,000 thermostats into registered ADER participants to achieve the 80 MW goal.
- **Expand DER Integration Beyond Smart Thermostats**: Encourage OEMs to join the Task Force and collaborate on integrating devices like home batteries, EV chargers, and smart water heaters.
- **Leverage Apolloware's Capabilities**: Use Apolloware's infrastructure to manage these devices, ensuring compliance with ERCOT requirements and maximizing integration potential.
- **Incentive Rollout**: Develop a robust incentive structure to encourage participation, informed by consumer behavior and market trends.

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Up Next

- Initiated Market Participation on Sep 16, 2024
- ADER "Operationalization" enhancements to the Apolloware platform as part of the DERMS features in development
- Tighter integration with Enphase API / roadmap (pushing towards "real time")
- "ADER as a Service" → Apolloware as a secured, enterprise grade open access platform
- Site Reliability automation and control algorithm

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Roadmap to 80 MWs and Beyond

- Issues Inventory

Action Items and Next Steps

- Recap action items
- Workshop #2 Scheduling and Agenda