ESDER – Load Shift Product

Stakeholder Workshop – November 6, 2017

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Solution components

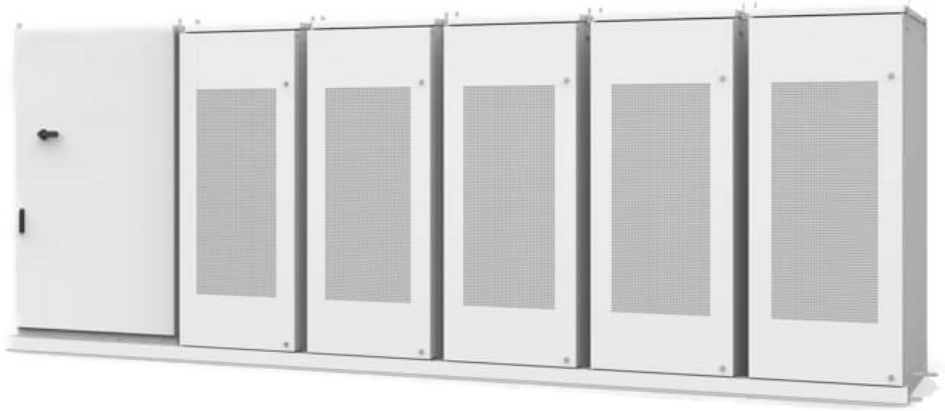
Energy Storage Systems

Modular options for all facility sizes and locations.
Batteries from leading global manufacturers.

Medium indoor
132 kW modules
(server rack size)

Small indoor
18 kW modules
(gym locker size)

Large outdoor
Scalable from 100 kW to 5+ MW



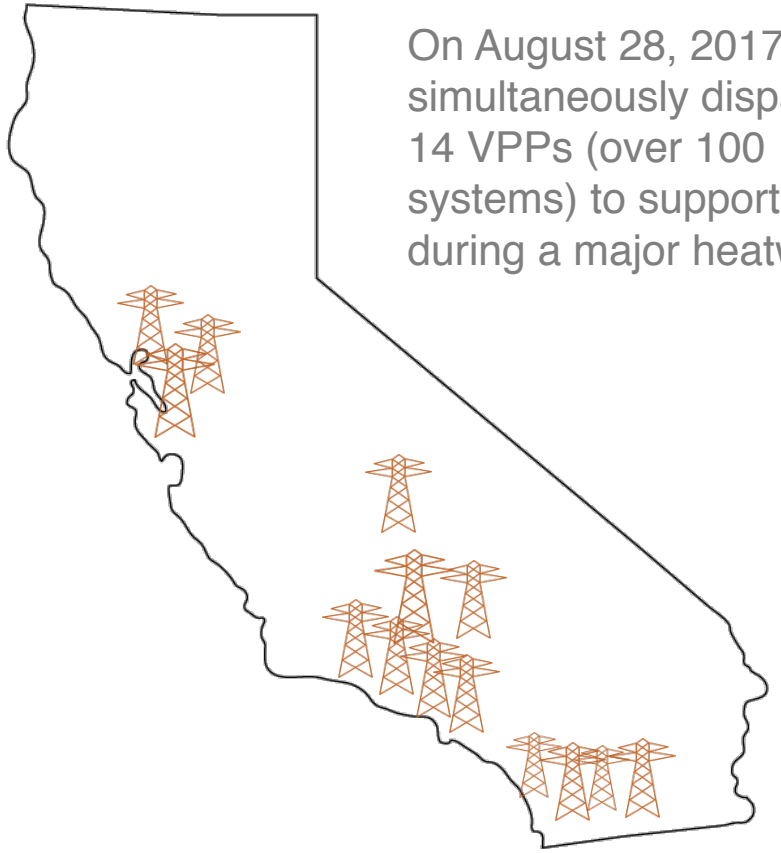
Athena™ Artificial Intelligence

Automatically controls when energy storage charges and discharges to optimize timing, maximize savings, and create virtual power plants.

Virtual Power Plants are working today

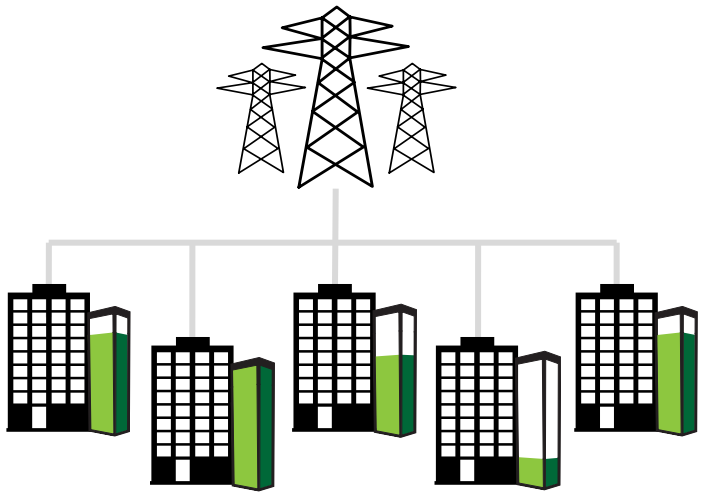
CAISO PDR or SCE LCR aggregations

- Stem's network, powered by Athena™, has responded to over 500 grid dispatch requests
- Supported the grid during heatwaves on June 19 and August 28
- No manual intervention
- Delivered on-time and more than promised
- Customers enjoyed helping California avoid blackouts



On August 28, 2017 Stem simultaneously dispatched 14 VPPs (over 100 systems) to support the grid during a major heatwave.

Load Shift: Overview



Early 2016: Need recognized – duck belly deeper and wider than anticipated. Front-of-meter NGR can help but BTM can't

2016: In ESDER Phase 2 as Load Consumption Working Group (LCWG)

- Can we just flip the sign on PDR?
- Stalled: primary concern is retail rate impact

July 2017: CAISO Board directs staff to consider again.

Aug-Sep 2017: Small group works with Staff to scope and plan for ESDER 3

Goal: A way for current and future BTM resources to bid for negatively priced energy

- Implemented Quickly; Minimize work at the CPUC or IOUs
- Minimum Viable Product: Don't boil the ocean now. Evolve over time.

Stem's Latest Thinking: A sub-type of PDR, "shift PDR" or "Proxy Shift Resource",

- PDR rules plus the ability to bid and dispatch to increase load during negative pricing
- For Now – Only available to resources that are shifting electricity demand on the grid

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Evolution of Thinking (stage 1)

"Demand" to "Shift"

- Retail rate impact is a problem for Demand resources
- Do not want to incentivize wasteful load increase
- Move concept from PDR to NGR

Need to modify NGR (why doesn't NGR work for BTM?)

- 24x7 Settlement – scoped in to ESDER Phase 3
- Wholesale treatment of charging – ok if non-exporting
- WDAT interconnection / CAISO New Resource Imp – ok if non-exporting?
- DERP not eligible for RA – not a big problem?
- Non-exporting NGR could work. All charging pays retail. No impacts on retail bill

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Evolution of Thinking (stage 2)

Metering

- Typical Use (PDR has MGO Baseline)
- NGR 24x7 issue resolution may adopt something similar?

Continuity

- Resources allowed to participate in existing PDR markets (e.g. DRAM)
- Registrations work with existing programs and contracts (e.g. all still reference PDR)

Bid and Dispatch from Charge to Discharge

- NGR allows seamless movement with bid curve
- Load shift doesn't need this and BTM may not want it

Minimum Size

- NGR is 500 KW, PDR is 100 KW
- May be more significant for EV or residential aggregations

Above argues for PDR-subtype, only shift resources, rather than modified NGR

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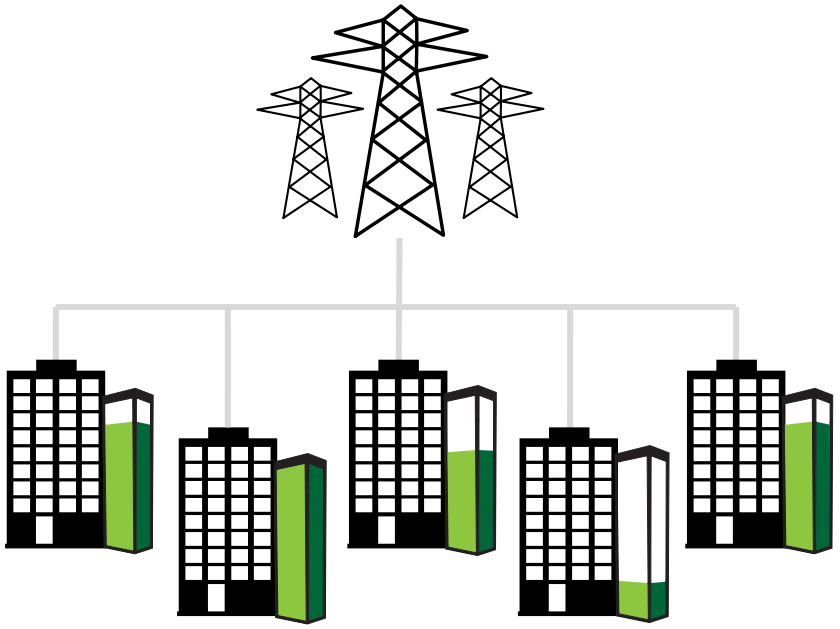
Shift-PDR Concept



Register as a sub-type of PDR:

- Must qualify as a shift resource
- Min size is 100 KW

Bidding: As PDR today

- Positive bid for discharge
- Negative bid for charge
- No must-offer obligations for negative bids (not capacity)
- No bid curve – no transitions within interval

MGO-Metered: MGO Baseline does not apply to charging direction

Net Benefits Test: Does not apply to charging direction

Default Load Adjustment: Does not apply for now?

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Open Questions

Qualifying as ”shift resource”

- Thermal “shift”; Electric vehicles; Beneficial uses

Net Benefits Test

- Threshold Question: Since customer is paying for energy on retail bill, is NBT necessary?
- Same NBT math can apply in reverse; but discharge could offset net cost?

Default Load Adjustment

Tariff Changes: which would be easier to change NGR or PDR?

MGO Baseline

- Threshold Question: No double compensation risk, so is Baseline needed?
- Current MGO Baseline doesn’t account for charging; treats as zero

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