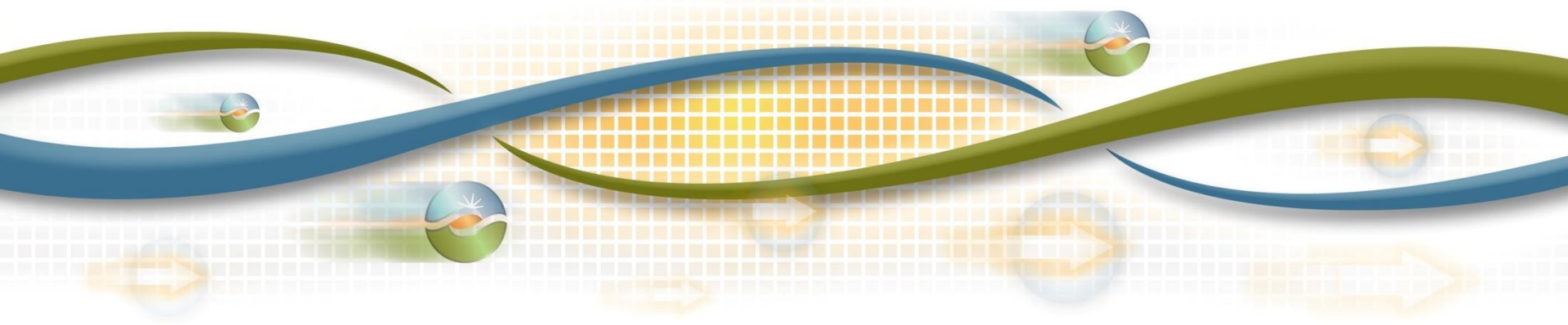
Energy Storage and Distributed Energy Resources Phase 2 ("ESDER 2")

Third Revised Straw Proposal

Stakeholder Conference Call
May 4, 2017
9:00 a.m. – 12:00 p.m. (Pacific Time)

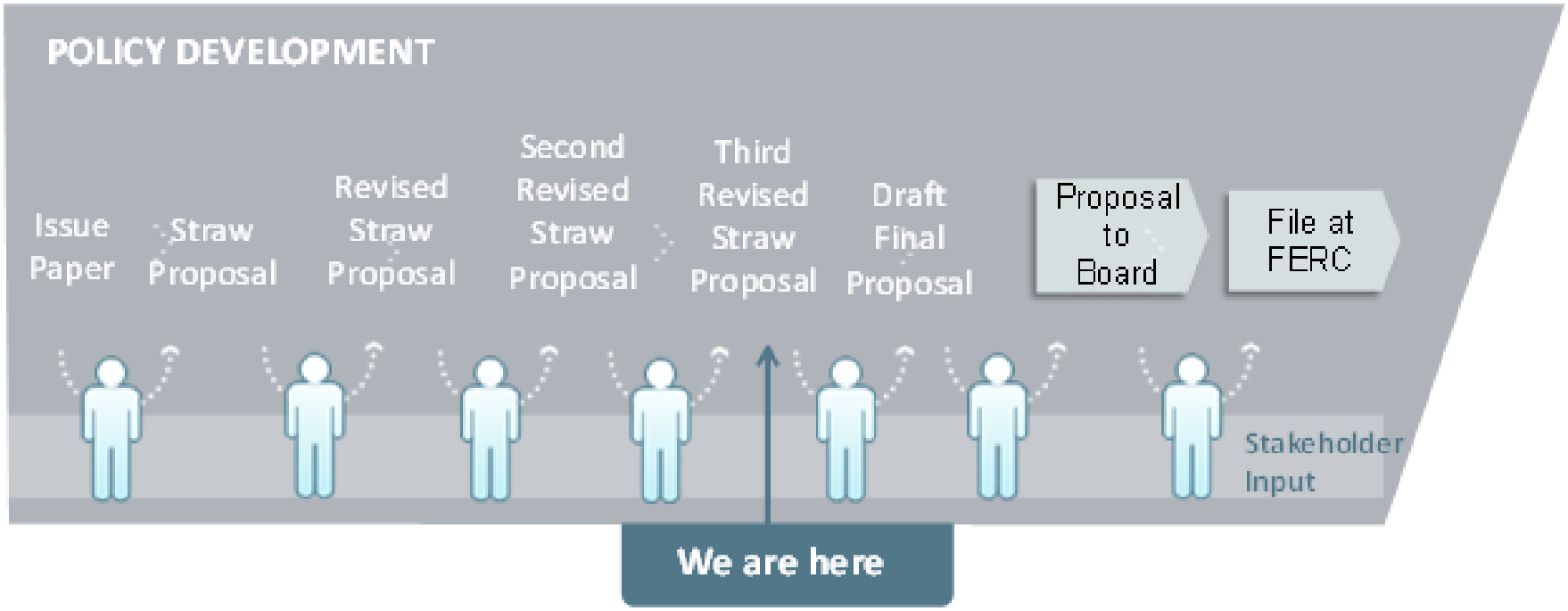


Agenda

Time	Item	Speaker
9:00-9:10	Stakeholder Process and Schedule	James Bishara
9:10-9:15	Changes from Previous Proposal	Keith Johnson
9:15-9:45	Alternative Baselines to Enhance Demand Response	Working Group Representatives
9:45-10:15	Distinguishing between Charging Energy and Station Power	Bill Weaver
10:15-10:45	Net Benefits Test for Demand Response	Eric Kim
10:45-11:00	Increase Load Consumption as Demand Response Enhancement	John Goodin
11:00-11:20	Non-Generating Resource Enhancements	Peter Klauer
11:20-11:40	Multiple-Use Applications	Lorenzo Kristov
11:40-11:55	ESDER Phase 3	Eric Kim
11:55-12:00	Next Steps	James Bishara

STAKEHOLDER PROCESS AND SCHEDULE

ESDER 2 Stakeholder Process



ESDER 2 Stakeholder Process Schedule

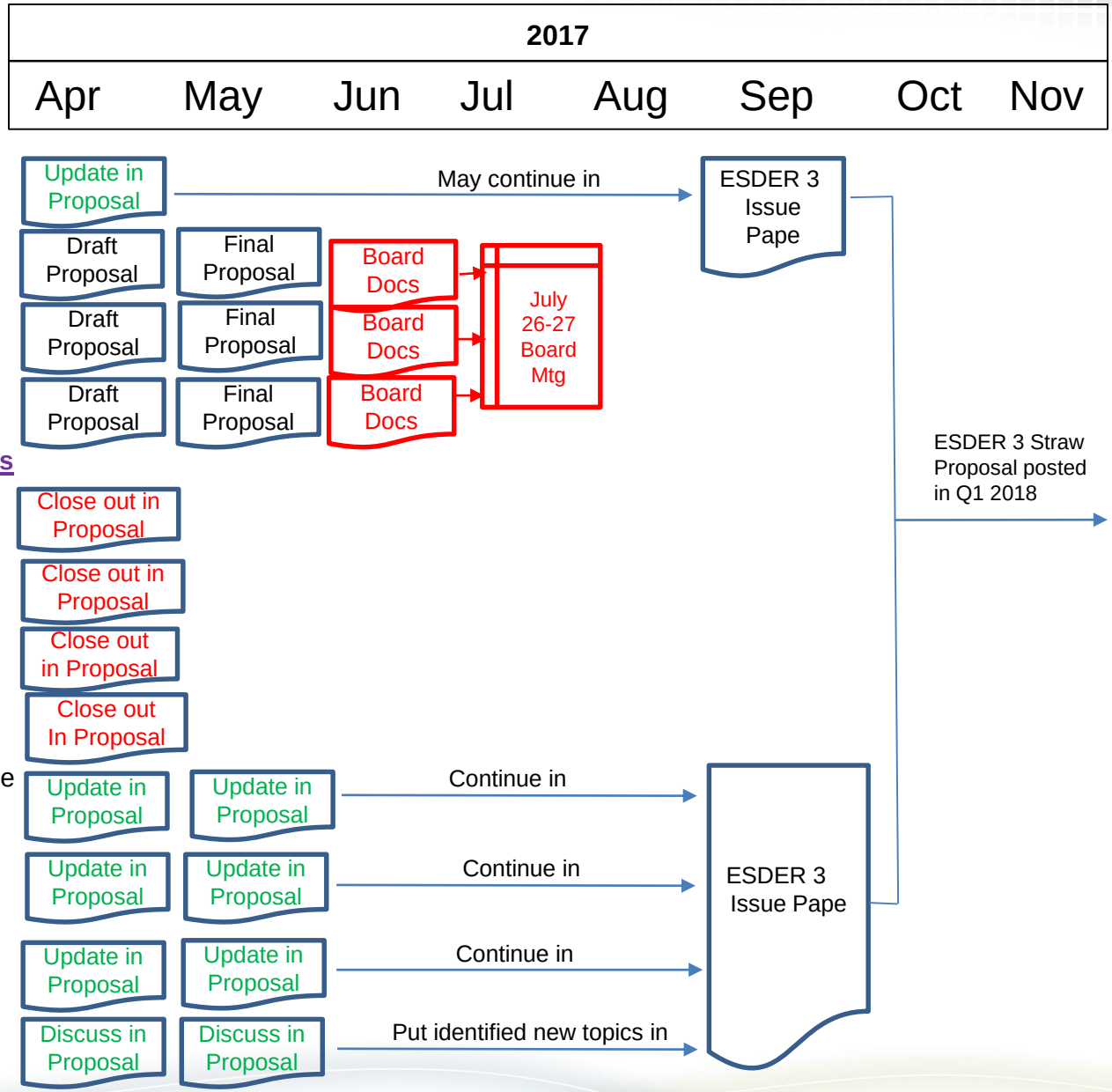
Milestone	Date	Activity
Third Revised Straw Proposal	April 17	Post ESDER 2 third revised straw proposal
	May 4	Hold stakeholder conference call
	May 18	Stakeholder written comments due
Draft Final Proposal	June 8	Post ESDER 2 draft final proposal
	June 15	Hold stakeholder meeting or conference call
	June 23	Stakeholder written comments due
Presentation to EIM Governing Body	July 13	Present ESDER 2 proposal at Energy Imbalance Market Governing Body meeting
Presentation to Board for Approval	July 26-27	Present ESDER proposal for approval at CAISO Board meeting
ESDER 3 Issue Paper	September 29	Post ESDER 3 issue paper

CHANGES FROM PREVIOUS PROPOSAL

There are several key changes from the previous ESDER 2 proposal

1. Broke out topics for Board approval this year and topics that require additional discussion in ESDER 2 and ESDER 3
2. For approval at July 26-27 Board meeting
   a) Updated Baseline Analysis Working Group ("BAWG) proposal on alternative baselines demand Response ("DR") enhancement
   b) Updated proposal on distinguishing between charging energy and station power
   c) New proposal for threshold price for DR determined by net benefits test to account for Energy Imbalance Market ("EIM") participant bidding
3. Not planned for Board approval this year
   a) Updated report on increased load consumption DR enhancement
   b) Updated report on non-generating resources ("NGR") enhancements
   c) Updated report on multiple-use applications ("MUA")
4. Discuss plan for ESDER 3 initiative and request stakeholder input on topics

Scope Breakout - ESDER 2 and ESDER 3



ALTERNATIVE BASELINES TO ENHANCE DEMAND RESPONSE

BAWG analyzed hundreds of different baselines within three types of classes

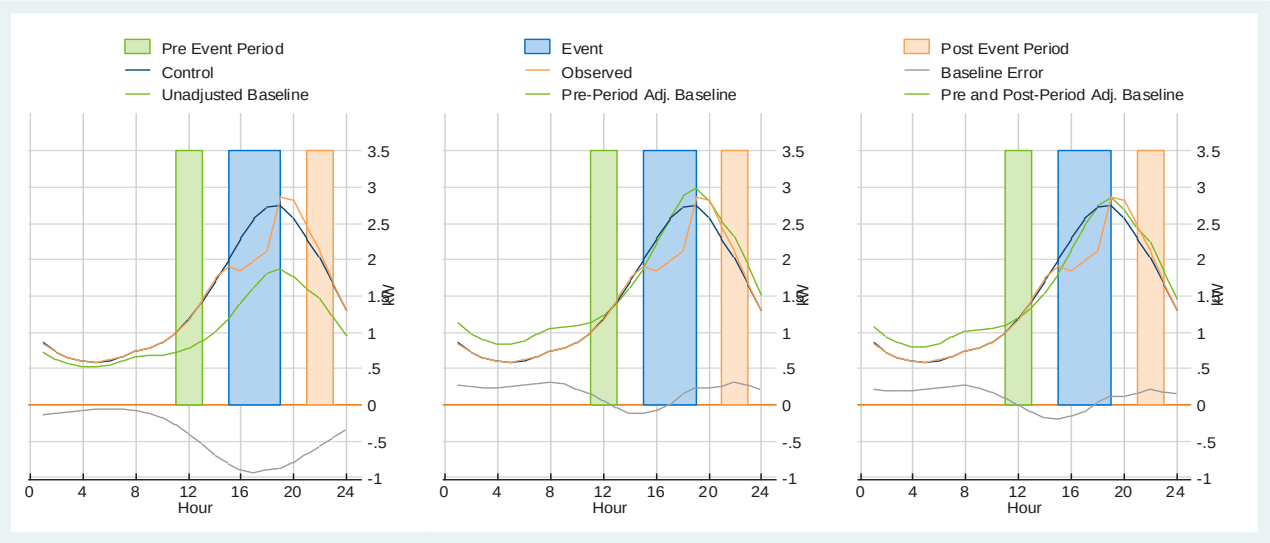
1. **Control Groups** – Establishes baseline of load patterns during curtailment event using non-dispatched customers with similar profiles
2. **Day Matching** – Estimates what electricity use would have been in absence of DR dispatch, using electricity use data on non-event but similar days
3. **Weather Matching** – Estimates what electricity use would have been in absence of dispatch during non-event days with most similar weather conditions

Baseline Performance Analysis

- Randomized control groups with a large sample size (200-400 participants) were more than twice as precise as day or weather matching baselines
- Day or weather matching baselines provides alternative for Demand Response Providers (“DRPs”) that do not have proposed minimum size of 150 participants

BAWG analyzed and proposed the use of pre- and post- event adjusted baselines

- All of the recommended baselines have an adjustment period that includes two pre-event and two post-event hours (4 hours total), each with a two hour buffer from the event



Recommended Baselines

Customer Segment	Weekday	Baselines Recommended	Adjustment Caps
Residential	Weekday	Control group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		Highest 5/10 day matching	+/- 40%
	Weekend	Control group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		Highest 3/5 weighted day matching	+/- 40%
Non-residential	Weekday	Control Group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		10/10 day matching	+/- 20%
	Weekend	Control group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		4 eligible days immediately prior (4/4)	+/-20%

A method for deriving SQMD in intervals of five minutes when a PDR or RDRR offers real-time or ancillary services is proposed

- The ISO proposes that the new Customer Load Baseline methodology (CLB) calculations utilize the current methodology, employed by the ISO calculated 10 in 10 CLB, to derive 5-minute interval results
  - An hourly baseline is pro-rated to create a 5-minute baseline from which the 5-minute interval load, measured during the event, is subtracted
- Current requirements for load data interval size used in developing the CLB will not change
  - Hourly interval when participating in day ahead only
  - A 15-minute interval maximum when participating in real time or ancillary services (non-spinning and spinning reserve)

The ISO is proposing to have all CLB calculations, including the current 10 in 10, performed and submitted by the DRP or its SC

- Provides greater flexibility and a timely implementation of the alternative baselines

- Accelerates the retirement of the ISO's legacy Demand Response System
  - Settlement quality meter data SQMD submission will utilize the ISO's Market Results Interface Settlements (MRIS) system consistent with all other resources

Additional benefits due to Performance Methodologies being calculated by DRP or its SC

- SQMD submitted will represent the pre-calculated Demand Response Energy Measurement for an event and will, therefore, be submitted for the Event Day only.
  - Submittal of pre-event load SQMD, 45 days required for the 10 in 10 CBL, would no longer be necessary
- ISO will use a pre-approval process and leverage auditing provisions to ensure accurate development and submission of SQMD.
  - Processes implemented by DRP or SC to perform CBL calculations can be leveraged for use by any new resource using the same CBL

DISTINGUISHING BETWEEN CHARGING ENERGY AND STATION POWER

This topic will distinguish between energy used to charge a storage device and energy used to supply station power.

- Energy for resale is considered wholesale under Federal Power Act
  - Means charging a storage device is a wholesale FERC jurisdictional activity
- Station power is energy consumed to operate a generating resource, a retail state jurisdictional activity
- For station power purposes, storage resources should be treated similar to generating resources
- CAISO believes energy used to charge a battery for later resale should be subject to wholesale rate

This topic is being addressed in this initiative and in a California Public Utility Commission proceeding.

- On February 24, CPUC issued its Proposed Decision on Track 2 storage issues, which affect station power
  - Describes energy use considered retail
  - Describes energy use considered wholesale
  - Describes components included in wholesale
  - Consumption should be able to be netted against response to dispatch, within 15-minute settlement period
- CAISO requests feedback on what changes should be made to CAISO tariff in light of potential changes to retail tariffs

The CAISO's latest proposal is summarized below.

- Modify CAISO tariff definition of station power to exclude energy used to charge batteries for later resale
- Modify definition of station power to exclude certain agreed-upon wholesale uses, including*
  - Charging energy
  - Resistive losses
  - Pumps
  - Power conversion system
  - Transformer
  - Battery management system
  - Thermal regulation for batteries
  - Vacuums

* View these loads as sales for resale under Federal Power Act

CAISO believes it may be prudent to reduce verbiage in CAISO tariff's definition of station power.

- Simpler approach could be to
  - Define station power as energy to serve load located on a generating unit site and jurisdictional to local regulatory authority
  - Settled pursuant to a retail tariff
- CAISO requests stakeholder feedback on this subject
- Whatever definition is adopted should focus on jurisdictional lines between wholesale and retail uses

There is concern that storage resources could use wholesale CAISO-metered charging energy to serve their station power load.

- Could have one of two negative consequences
  - Either retail energy provider will not be able to charge resource for serving its station power load, or
  - Resource will be charged twice for same energy
- CAISO requests feedback on what tariff revisions could ensure issue does not arise
- Could require wholesale and retail load be metered separately
  - Interested in other solutions that would not require separate metering and clear bifurcation of loads

NET BENEFITS TEST FOR DEMAND RESPONSE

FERC Order 745 required DR be compensated at full locational market price (“ LMP”) if LMP is above a threshold price.

- Net Benefits Test (“ NBT”) is performed monthly and establishes this threshold price
- Threshold price = net benefits of dispatching DR exceeds marginal cost of DR
- Net benefit of dispatching DR is based on representative aggregated supply curve for trade month

The NBT is based on the construction of an aggregated supply curve.

- One key aspect of supply curve is adjusting for fuel prices
- Currently, supply curve adjusts for gas price differences based on reference month (previous year) and trade month
  - Using simple average of PG&E Citygate and Southern California Citygate

With expansion of EIM participants and further integration of DR programs, CAISO proposes to include additional gas prices.

- Proposing to
  - Remove language in CAISO tariff that explicitly states California gas price indices
  - Adjust supply curve based on a simple average of all gas price indices within EIM regions

NON-GENERATOR RESOURCE ENHANCEMENTS

Scope: Understanding physical use limitations and applicability for CAISO use-limitation designation for storage resources

- Modeling physical MW Limits based on time of day
- Modeling physical MW limits based on depth of cycling
- Model reduced MW throughput based on state of charge ("SOC")
- Model annual or monthly MWh charge and discharge limitations
- Define rules for storage resources modeled as NGR to qualify as a use-limited resource ("ULR")
- Metering, settlement, and market optimization consideration for storage under multiple use applications

Current modeling capabilities within NGR to address physical limitations

- Modeling physical MW limits based on depth of cycling
- Modeling physical MW Limits based on time of day
- Modeling reduced MW throughput based on SOC

Existing tools to address:

- Resource implementation characterization
- Bidding practices
- Representing physical capacity constraints through CAISO outage management system

Proposal: These topics are being closed out in ESDER 2 but will be followed as SCs and CAISO gain more experience and knowledge with participating storage resources

Addressing battery manufacturer performance guarantees

- Model cumulative MWh charge and discharge limitations at resource level to help adhere to resource contractual stipulations or resource limitations

Existing tools to address:

- No explicit NGR modeling capability exists today for cumulative MWh resource tracking

Proposal: Advance topic to ESDER 3 to further discuss if this is best treated as a physical market optimization constraint or through costs reflected in economic bids.

Maximizing storage value as grid resources under ULR status or multi-use application scenarios

- Defining rules for storage resources modeled as NGR to qualify as a ULR
- Metering, settlement, and market optimization consideration for storage under multiple use applications

Current Status:

- Progress was made in two use-limited working group meetings on defining potential opportunity and commitment costs for NGR modeled storage
- Current ULR definition is evolving
- What is most favorable way to represent use limitations? Through explicit costs and constraints or implicitly through economic bids?

Maximizing storage value as grid resources under ULR status or multi-use application scenarios

Proposal: Advance ULR topic to ESDER 3 for further discussion and development

ESDER 3 will seek to leverage efforts of RSI and CCE3 stakeholder processes which are evolving the definition of ULR, the ULR application process, and market treatment of such defined resources

The related complexities of optimizing a wholesale market resource for grid reliability verses specific resource opportunities to maximize value across multiple-use applications will need to be further discussed in both CAISO and CPUC forums

INCREASE LOAD CONSUMPTION AS DEMAND RESPONSE ENHANCEMENT

Load Consumption Working Group Update

Purpose:

Explore ability for Proxy Demand Response resources (“PDR”) to consume load based on an ISO dispatch instruction, including ability for PDR to provide regulation service

Must address priority concerns before CAISO can develop a wholesale load consumption capability

- Identify and resolve retail and wholesale settlement interactions
  - Address regulatory, technical, and financial impacts of directed load consumption on rate structures/demand charges from investor-owned utilities and customer perspective
- Resolve value of load consumption capability if provided through retail rate relief mechanisms or direct incentives
- Design accurate and precise performance evaluation methods under different use case scenarios
- Address Southern California Edison's concern about wholesale market double compensation
  - Need for net benefits test or default load adjustment application?

MULTIPLE-USE APPLICATIONS

Multiple-Use Applications

- MUA are those where an energy resource or facility provides services to and receives compensation from more than one entity
- Distributed Energy Resources could potentially provide and be compensated for services to end-use customers, distribution system and wholesale markets

Multiple-Use Applications (cont.)

- In context of CPUC Energy Storage Track 2 proceeding (R. 15-03-011) CAISO has collaborated with CPUC staff to
  - Review comments received after 2016 joint workshop and develop framework for addressing MUA issues
  - Prepare joint report offering preliminary findings, principles, recommendations and questions for further discussion
  - Plan joint workshop to be held later this month to discuss report and obtain additional stakeholder input
- Thus far CAISO has not identified MUA issues or topics that require separate treatment in a CAISO initiative
- If upcoming workshop and stakeholder comments identify an issue that should be addressed in a CAISO initiative, CAISO will consider it in scope of ESDER 3

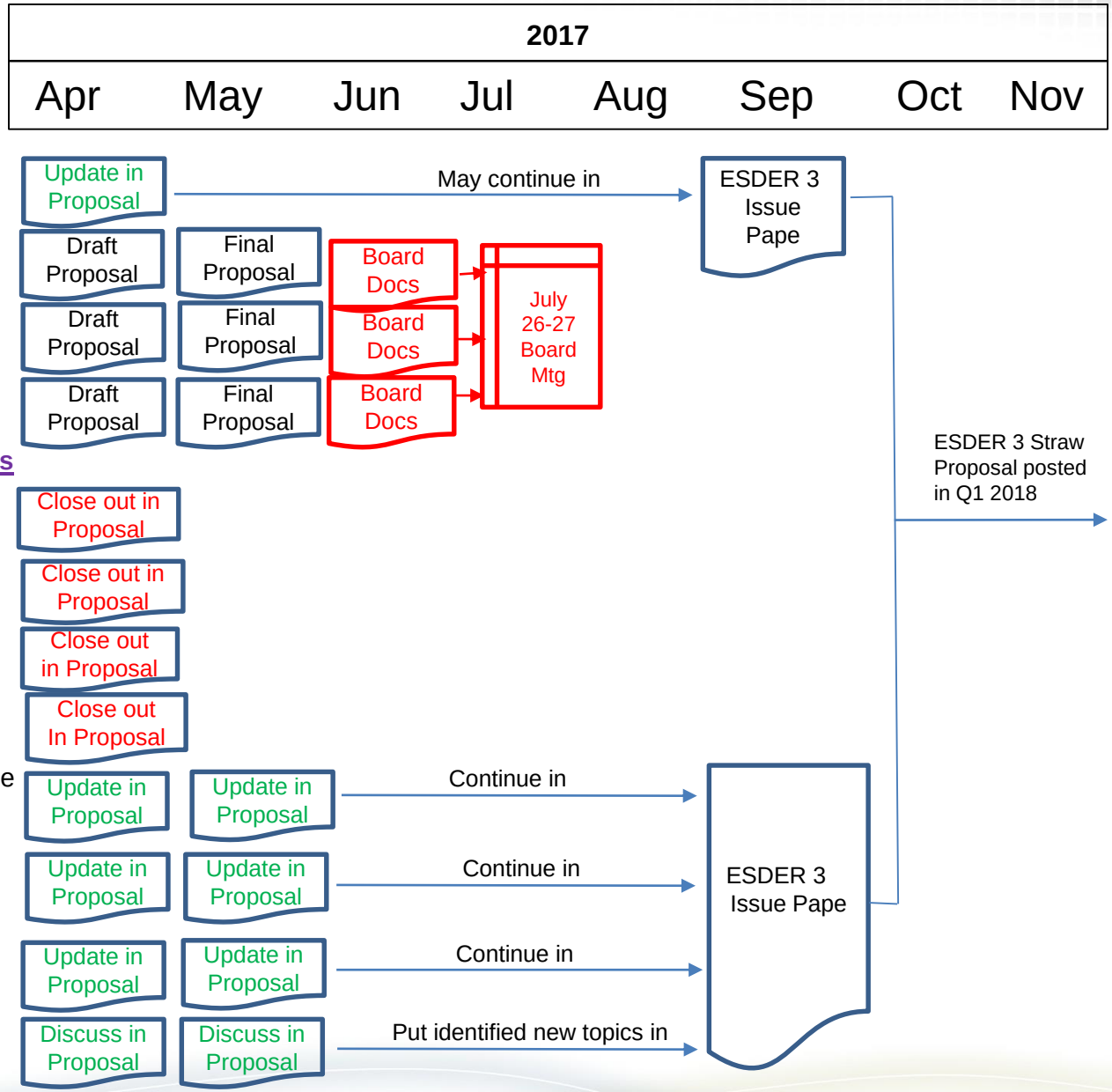
ESDER PHASE 3

ESDER will continue in phase 3 and an issue paper will be released in September 2017.

- CAISO will continue to address following topics
  - Increase load consumption
  - NGR enhancements
  - MUA

- Stakeholders are encouraged to submit potential scope topics

Scope Breakout - ESDER 2 and ESDER 3



NEXT STEPS

Next Steps

- Request stakeholders to submit written comments by close of business on May 18
- Use comments template provided on website at: http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResourcesPhase2.aspx
- Submit to comments mailbox: initiativecomments@caiso.com

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Thank you!