



California ISO

Gestion de Recursos Distribuidos por los DSO y su Relacion con el Operador Central del Sistema

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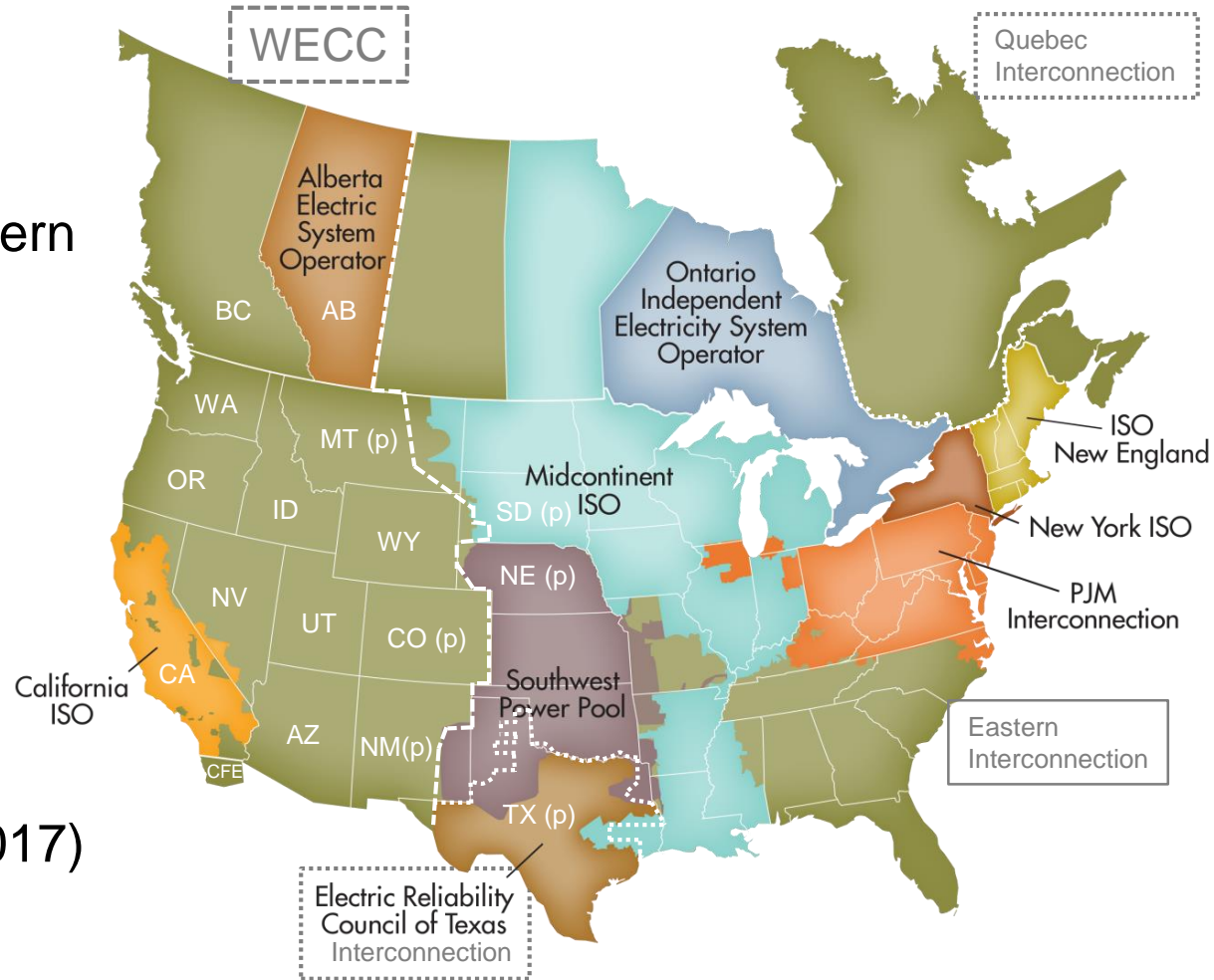
ASOCODIS-USAID

Bogota Colombia

Diciembre 2018

The California ISO

- 2/3 of the U.S. is supported by an ISO
- One of 38 balancing authorities in the western interconnection
- Serves 80% of CA & small portion of NV
- 26,000 miles of wires
- 27,000 market transactions per day
- \$9.4 billion market (2017)



Key functions of an ISO

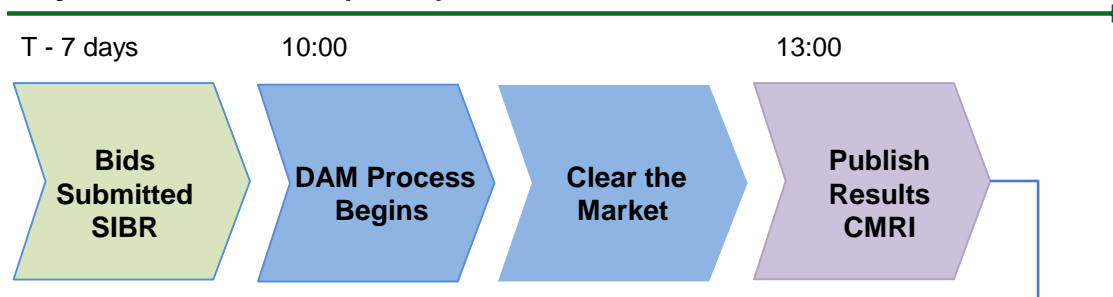
- Uses advanced technology to balance supply and demand every 4 seconds
- Operate markets for wholesale electricity and reserves
- Manage new power plant interconnections
- Plan grid expansions



CAISO operates both day-ahead and real-time markets

Market Timeline:

Day Ahead Market (DAM)

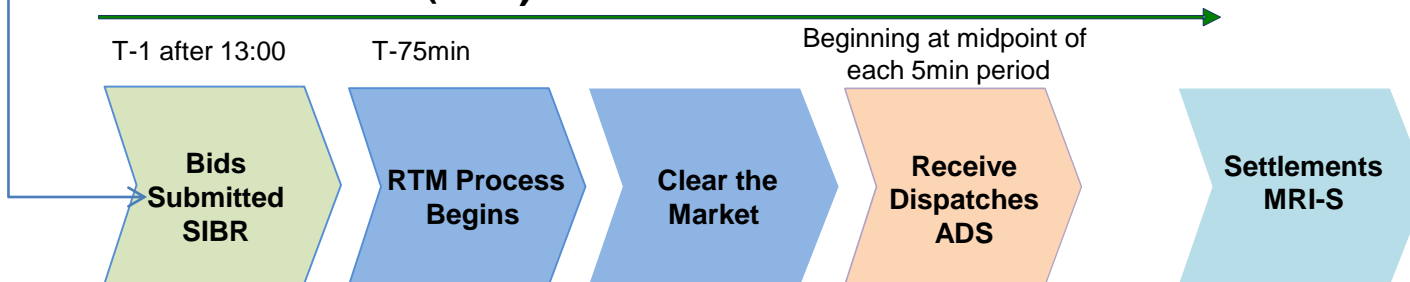


Triggers the
Real Time
Market

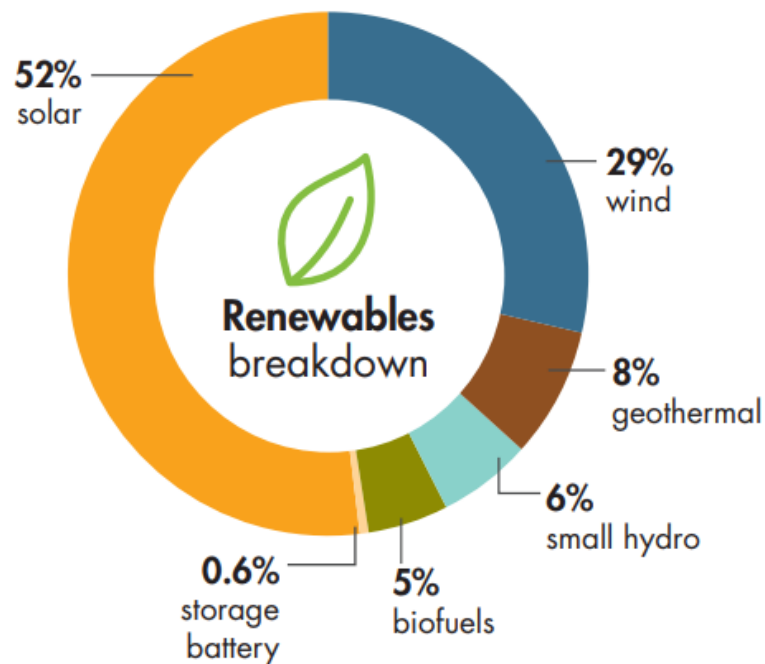
Applications:


- SIBR - Scheduling and Infrastructure Business Rules
- CMRI – California ISO Market Results Interface
- ADS – Automated Dispatch System
- SLIC – Scheduling and Logging for ISO of California – Outages
- MRI-S – Market Results Interface - Settlements







Real Time Market (RTM)




ISO renewable resource mix




 Renewables served demand
73.9% - May 26, 2018 at 2:12 p.m.

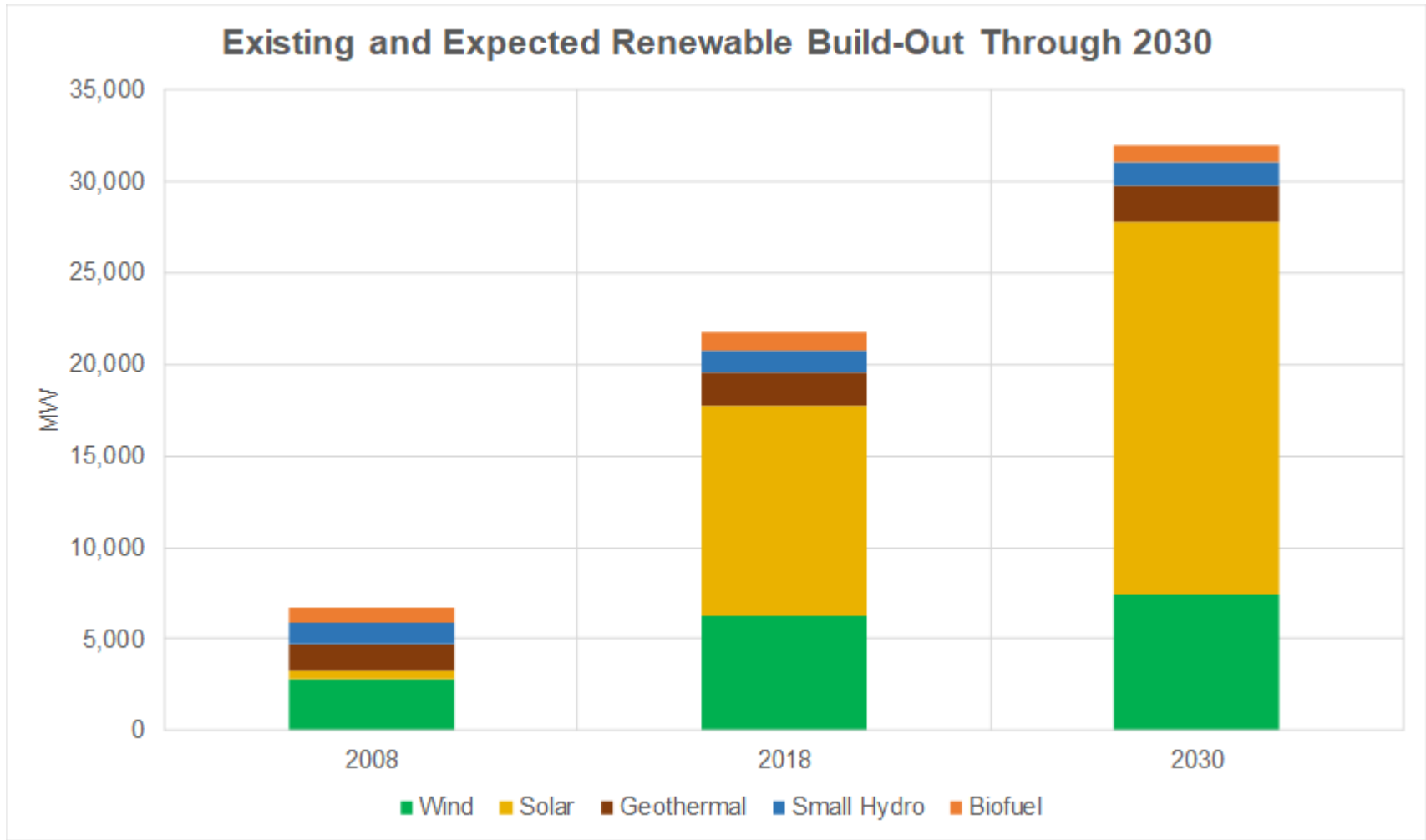
		Megawatts
	Solar	11,482
	Wind	6,295
	Small hydro	1,238
	Geothermal	1,790
	Biofuels	1,013
	Storage battery	134*
TOTAL		21,952

Record peaks

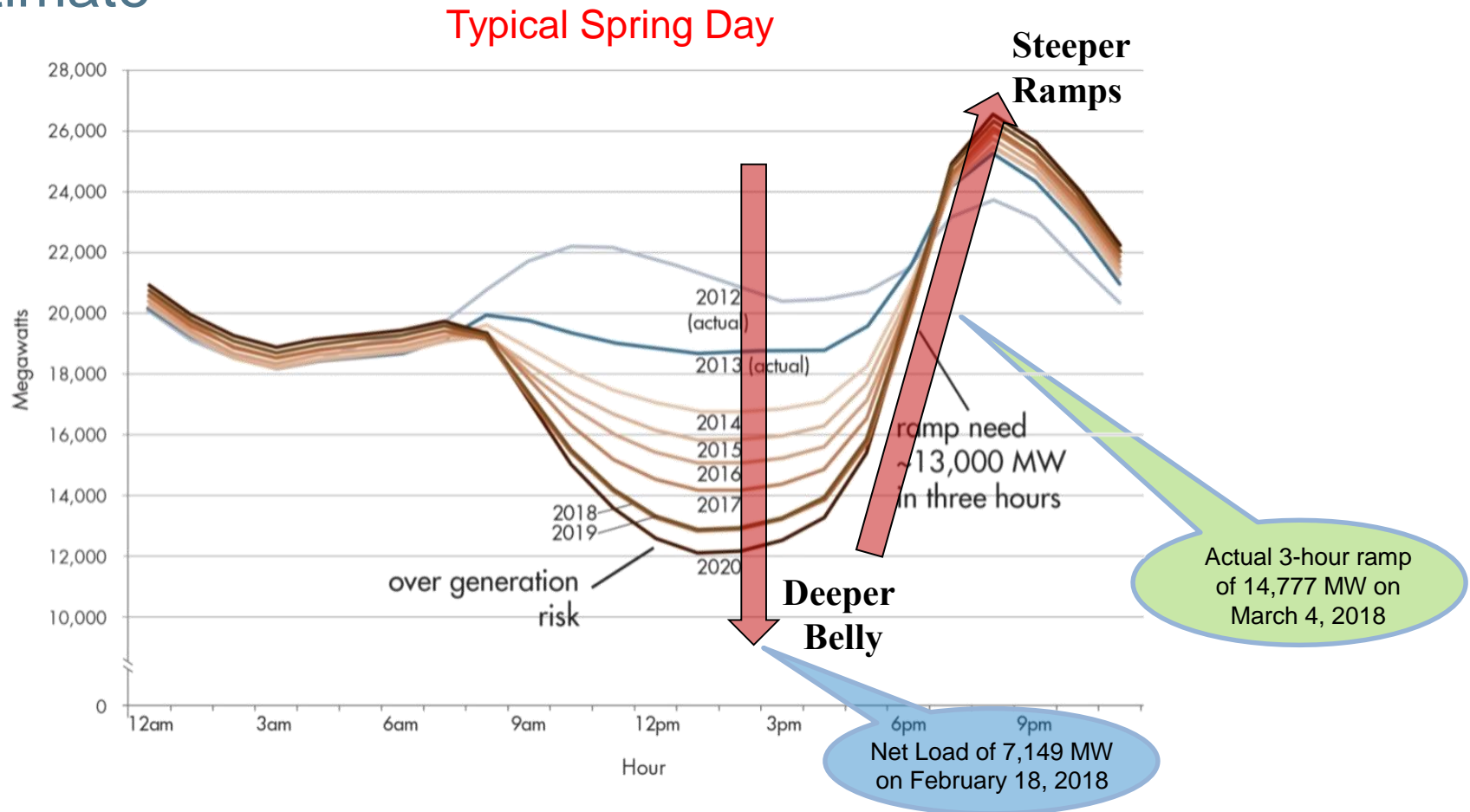
 **SOLAR (NEW)**
10,735 MW - June 8, 2018, 12:33 p.m.

 **WIND (NEW)**
5,193 MW - June 8, 2018, 9:04 p.m.

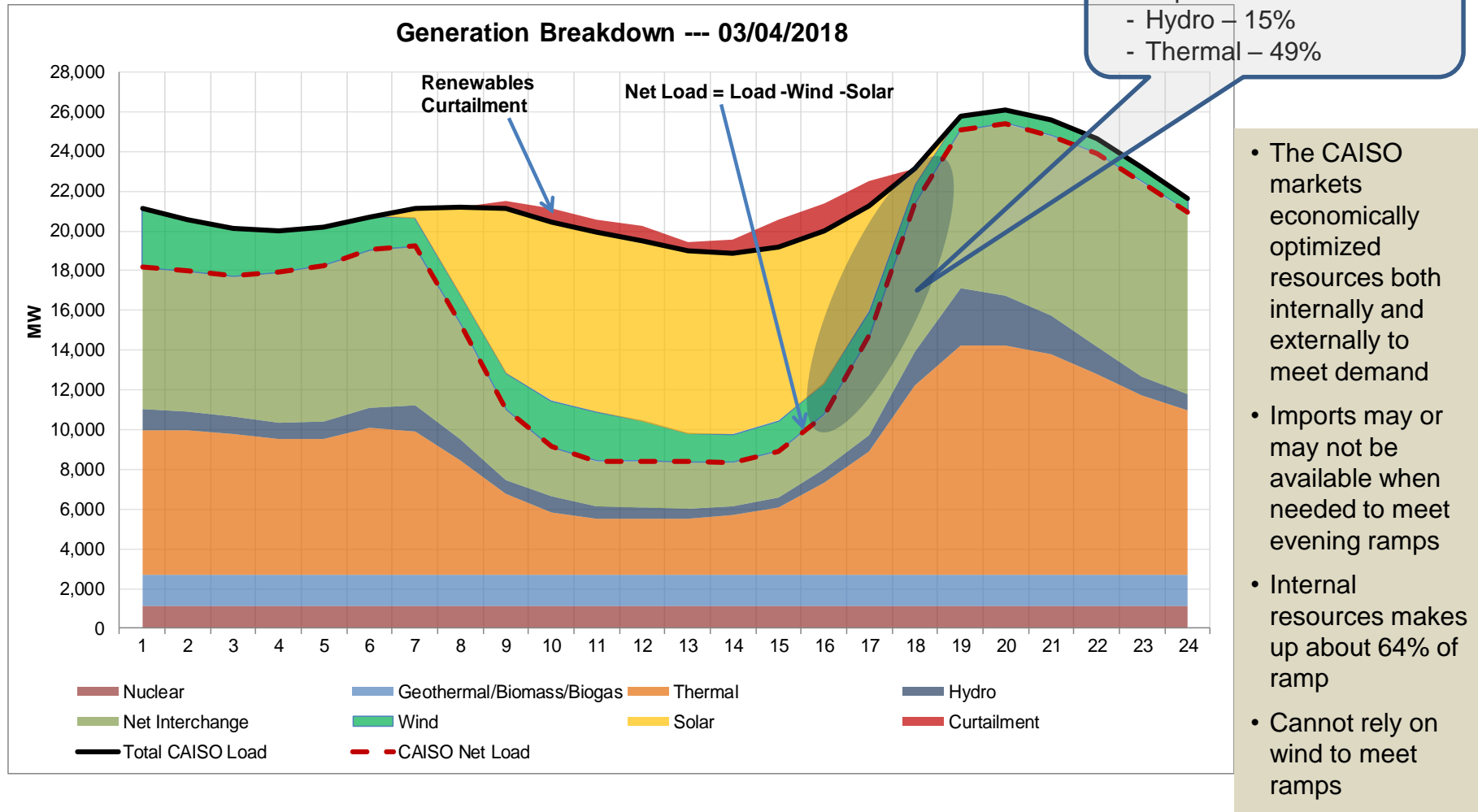
Growth of renewables to achieve 60% by 2030 is expected to be largely solar



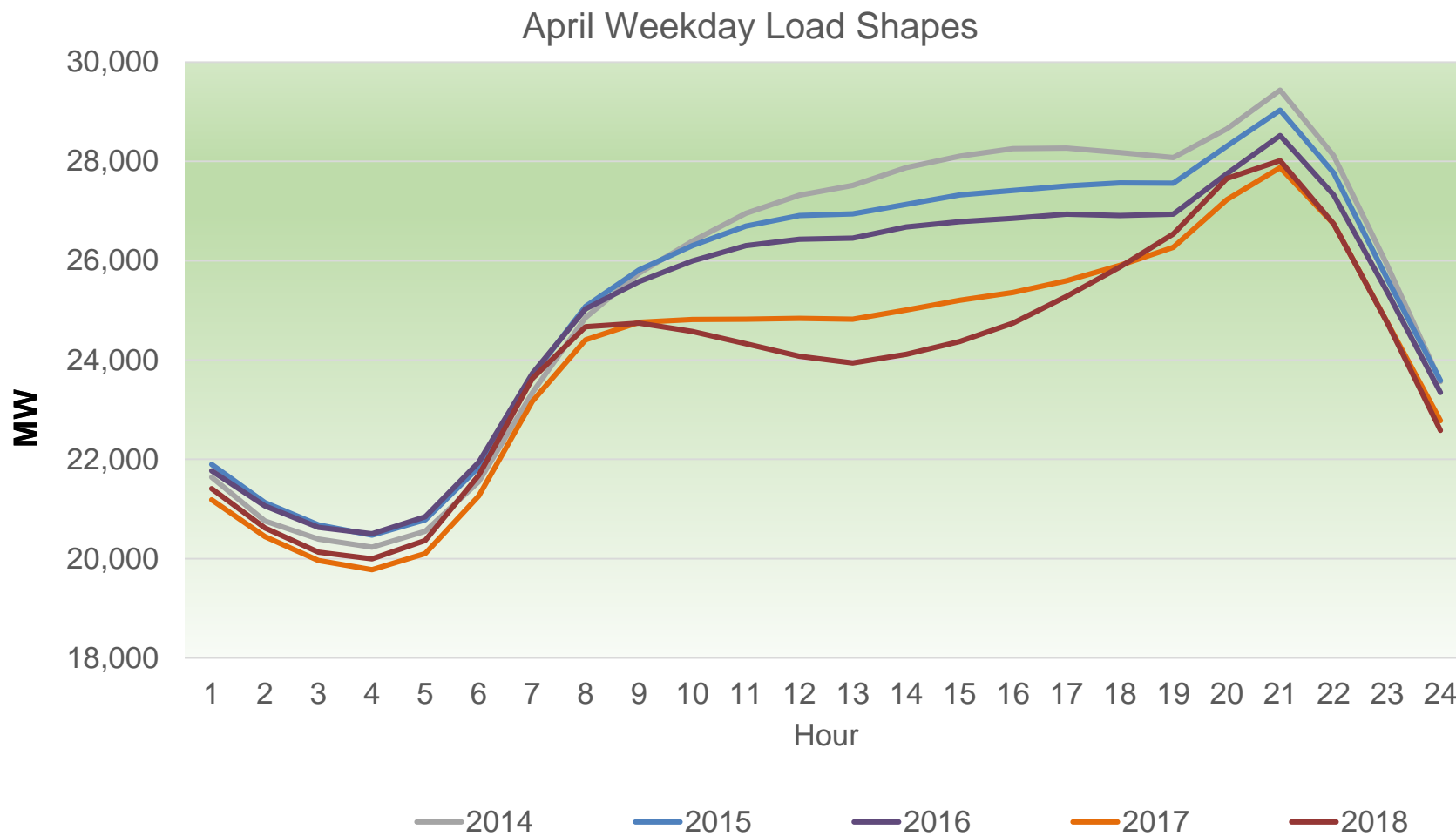
The duck turns 10 years old: Actual net-load and 3-hour ramps are about four years ahead of the CAISO's original estimate



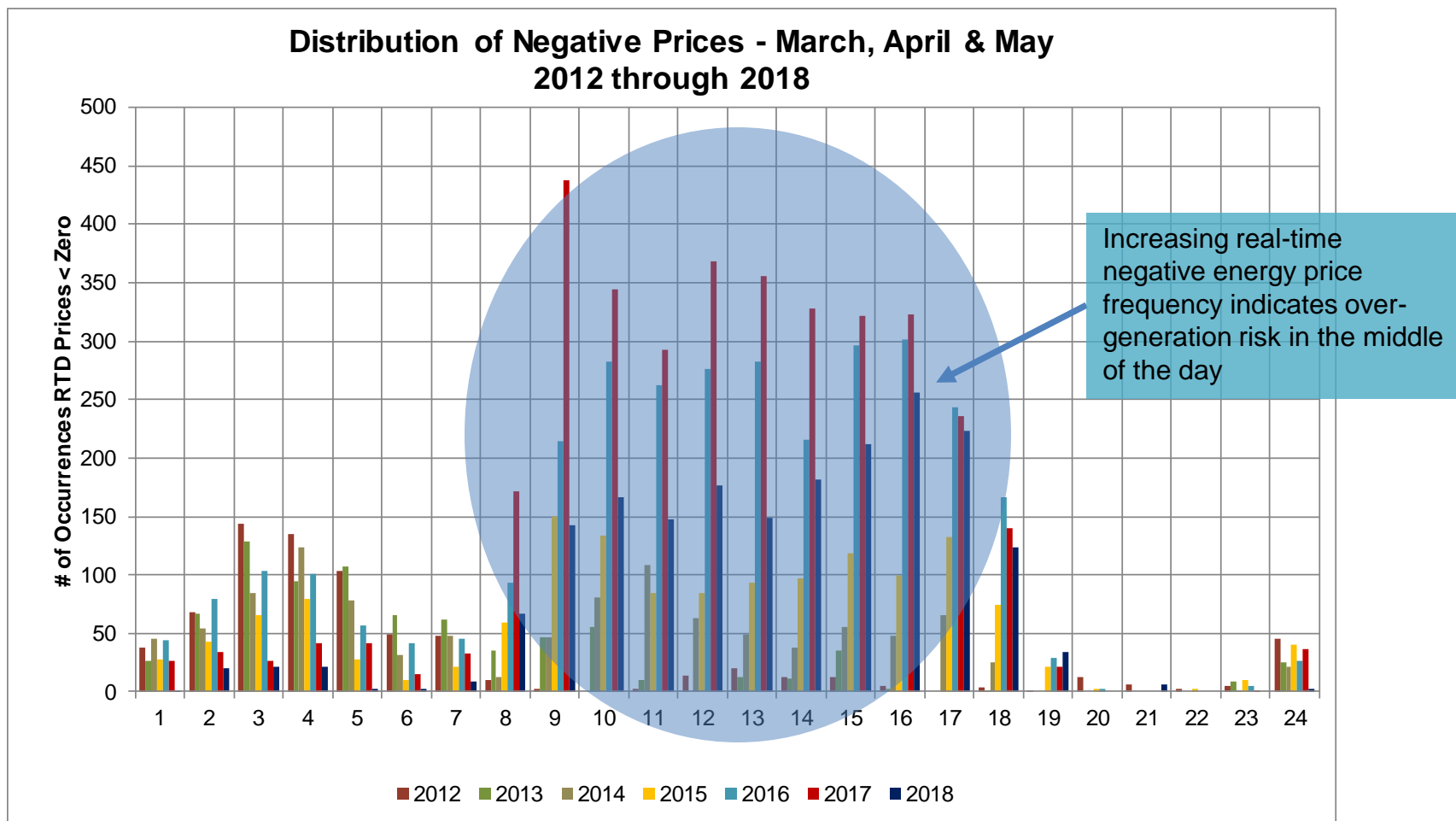
On Sunday, March 4, 2018 the maximum 3-hour upward ramp was 14,777 MW



Historical Load Shapes



New price patterns incentivize innovation in responsive demand and storage



A suite of solutions are necessary



Storage – increase the effective participation by energy storage resources.



Western EIM expansion – expand the western Energy Imbalance Market.



Demand response – enable adjustments in consumer demand, both up and down, when warranted by grid conditions.



Regional coordination – offers more diversified set of clean energy resources through a cost effective and reliable regional market.



Time-of-use rates – implement time-of-use rates that match consumption with efficient use of clean energy supplies.



Electric vehicles – incorporate electric vehicle charging systems that are responsive to changing grid conditions.



Renewable portfolio diversity – explore procurement strategies to achieve a more diverse renewable portfolio.



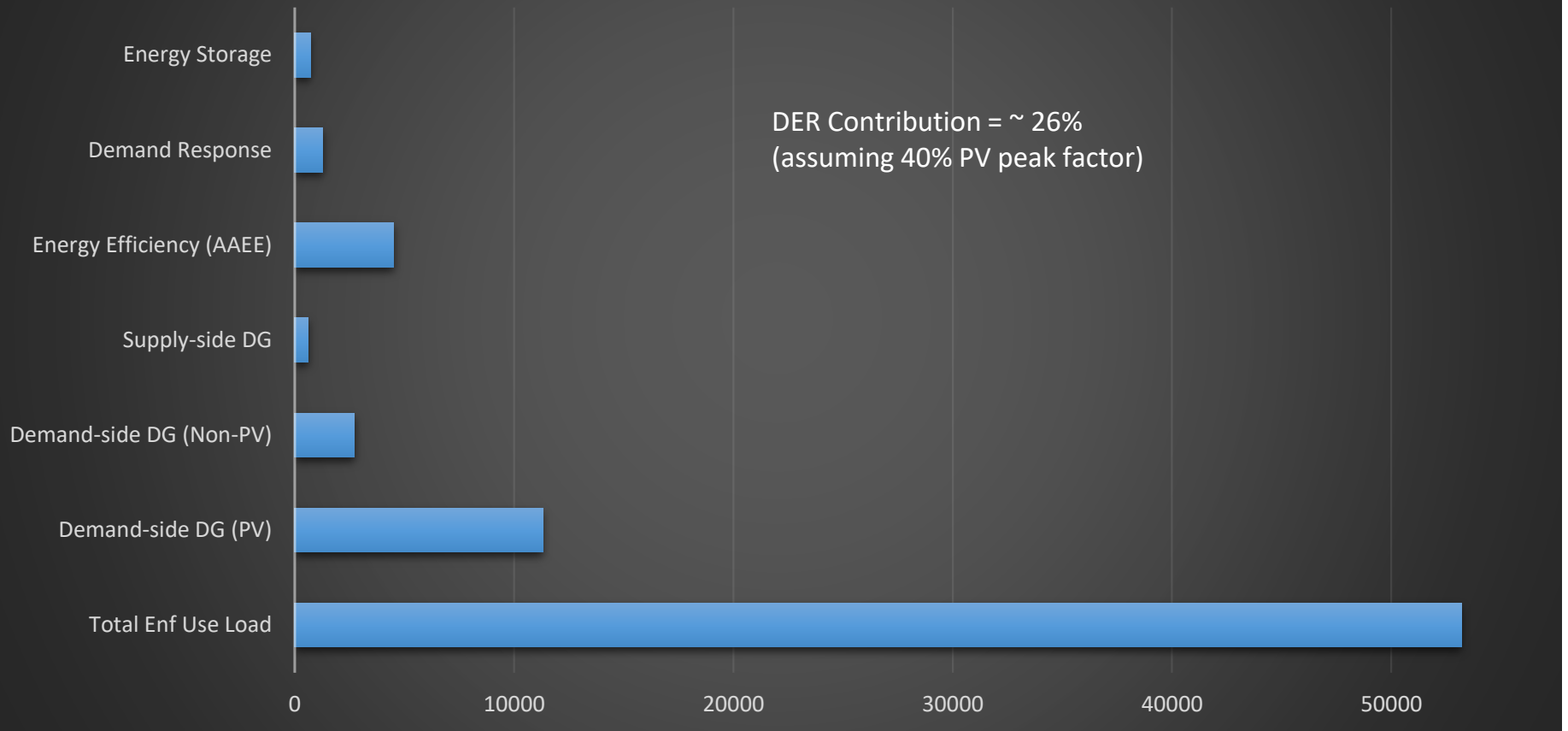
Flexible resources – invest in fast-responding resources that can follow sudden increases and decreases in demand.

DER Types (NERC Reliability Guideline)

- **Utility-Scale Distributed Energy Resources (U-DER):**
directly connected to the distribution bus or through a dedicated, non-load serving feeder.
- **Retail-Scale Distributed Energy Resources (R-DER):**
Offset customer load. Include residential, commercial, and industrial customers.
- Distributed Energy Resources may include:
 - Distributed Generation – in front or behind the meter
 - Energy Efficiency – load modifier embedded in load forecast
 - Demand Response – demand or supply side
 - Energy Storage – can be modeled as supply or demand side
 - Electric Vehicles

DER in numbers

Approximate CAISO 2026 Demand and DER Forecast (MW)



CAISO's markets are supporting the growth of distributed generation

- When supported by markets, it presents an opportunity for California technology companies
- DER can offer benefits/services to customers, distribution system, and transmission grid:
 - Energy storage can help mitigate oversupply and add flexibility
 - Demand response can reduce the need for conventional resources
 - Micro grids allows participation in ancillary services markets
- Our markets support:
 - Charging and discharging of storage
 - Distributed generation aggregations
 - Distribution-side heterogeneous aggregations of demand and other assets

The four corners to a successful integration of Distributed Resources

Load Shaping

Reliable Operations

Economical feasibility

Resource Adequacy

Distribution connected resources are becoming an increasingly important part of the resource mix

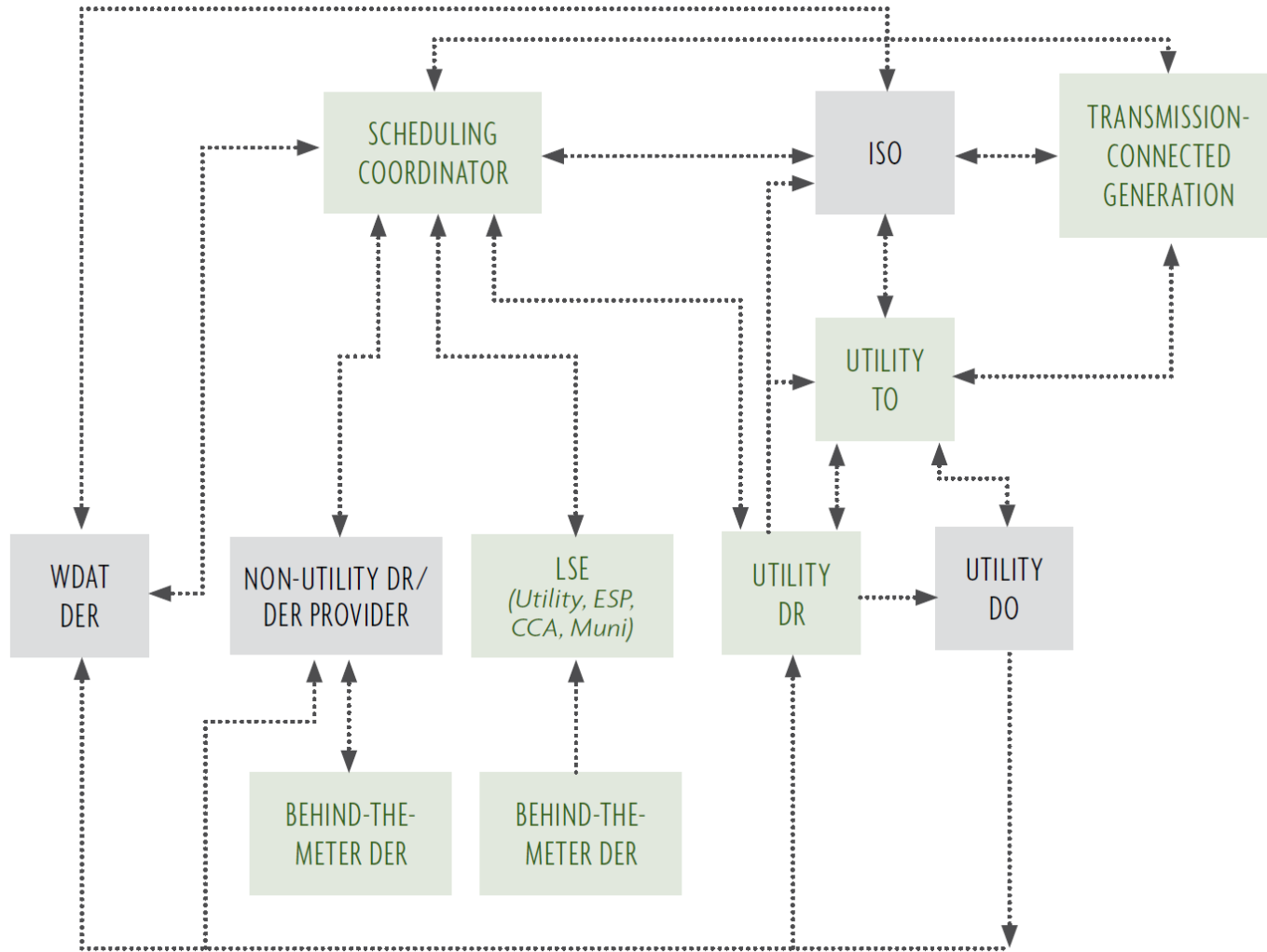
- Significant growth driven by state policies, emerging cost-effective distributed technologies and evolving customer preferences
- Opportunities for DER are expanding: DER can offer benefits/services to customers, distribution system, and transmission grid
- Integrating DER into CAISO markets will:
 - Help lower carbon emissions
 - Provide operational benefits

Multiple
Use
Applications

CAISO has several models for participation of distributed energy resource (DER)

- Proxy Demand Resource, 2010 (PDR) – Distribution
 - Leverages on standard model of generating resources
 - Supplier can aggregate multiple end-use customers to create a virtual supply resource
- Non Generator Resource, 2012 (NGR) – Transmission & Distribution
 - Designed for a resource that can vary between consuming & producing energy (e.g., storage, V2G)
 - The non-generator resource (NGR) participation model recognizes a seamless operation between generation and load
- DER Provider, 2016 (DERP) - Distribution
 - Create a pathway for DERs to be aggregated and meet .5 MW minimum participation requirement
 - Allows aggregations from resources in front of and behind the end-use customer meter

Typical flow of Demand Response Programs*



Demand Response process in the ISO's markets

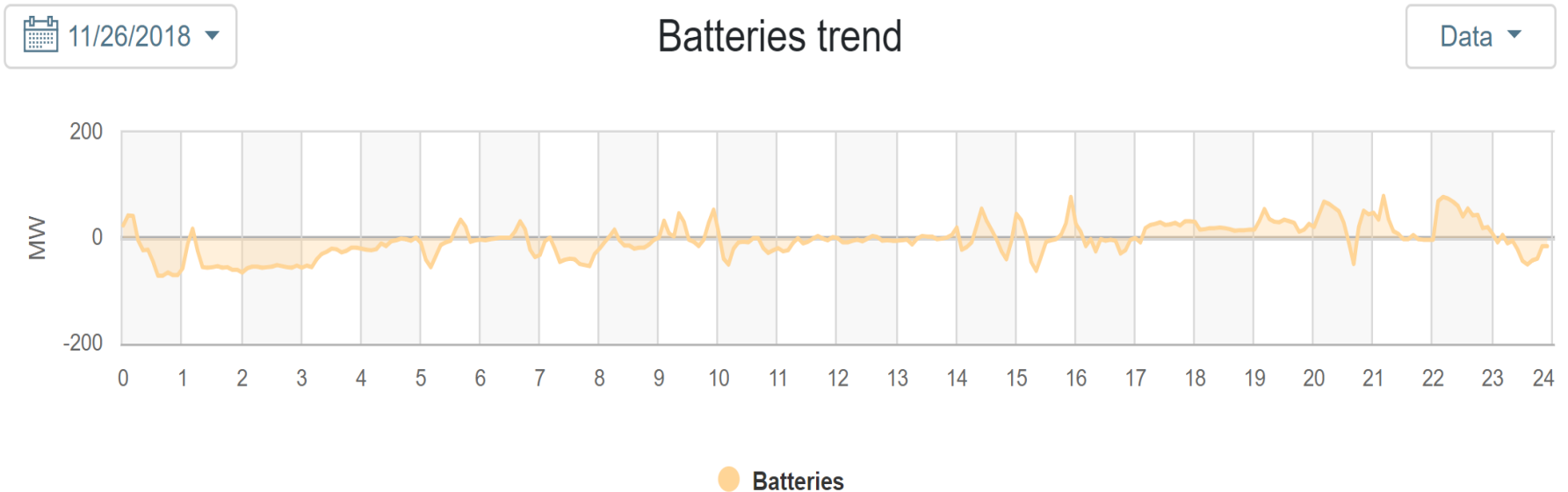
Process Overview

	Pre-Market Activities			Market	Post-Market Activities		
Activities	<p><u>Secure Agreements</u></p> <p><u>Access DRRS</u> -Registration</p> <p><u>Access DRS</u> -Not needed for registrations with a 10/1/2018 and forward effective date</p> <p><u>Access MRI-S</u> -Data Submittal</p> <p><u>Access CMRI</u> -Identify TEE</p>	<p><u>Performance Methodology Approval</u></p> <p>-Submit templates to PDR@caiso.com</p> <p>*A minimum of 1 Performance Methodology must be approved to begin registration</p>	<p><u>Registration Process</u></p> <p><u>Begin</u> -Provide End Use Load Location Information</p> <p><u>End</u> -Receive Market Resource ID</p>	<p><u>Day-Ahead Real-Time Markets</u></p> <p>-Bidding -Dispatch -Outage Management</p>	<p><u>Meter Data Submission</u></p> <p><u>For TD Prior to 10/1/2018</u> -Historic -Day Of Event</p> <p><u>For TD 10/1/2018 and Forward</u> -Performance Data -Baseline Data</p>	<p><u>Baseline Calculation</u></p> <p>-Performance Measurement -For TD prior to 10/1/2018</p>	<p><u>Settlement</u></p> <p><u>SC DRP</u> -PDR/RDRR Performance</p> <p><u>SC LSE</u> -Default Load Adjustment</p>
Timeline	Approx. 30 BD	10 BD	7 BD Minimum 265 BD Maximum		T+8 BD T+48 BD T+172 BD		T+3 BD T+12 BD T+55 BD T+9 Month

2018 Enhancements contain four proposal elements recently approved by the Board of Governors

1. New bidding and real-time dispatch options for proxy demand resources (PDR)
2. Removal of the single load serving entity (LSE) aggregation requirement
3. New load shift product for behind the meter (BTM) storage
4. Measurement of behind the meter electric vehicle supply equipment (EVSE) load curtailment

Batteries provide great flexibility to the operation of the system



Brewing challenges for the integration of Distributed Resources

- Limited projection and forecasting of conditions
- Lack of situational awareness, observability and controllability
- Coordination between the Transmission and Distribution sides