



March 6, 2019

Power Procurement Board Retreat

Agenda

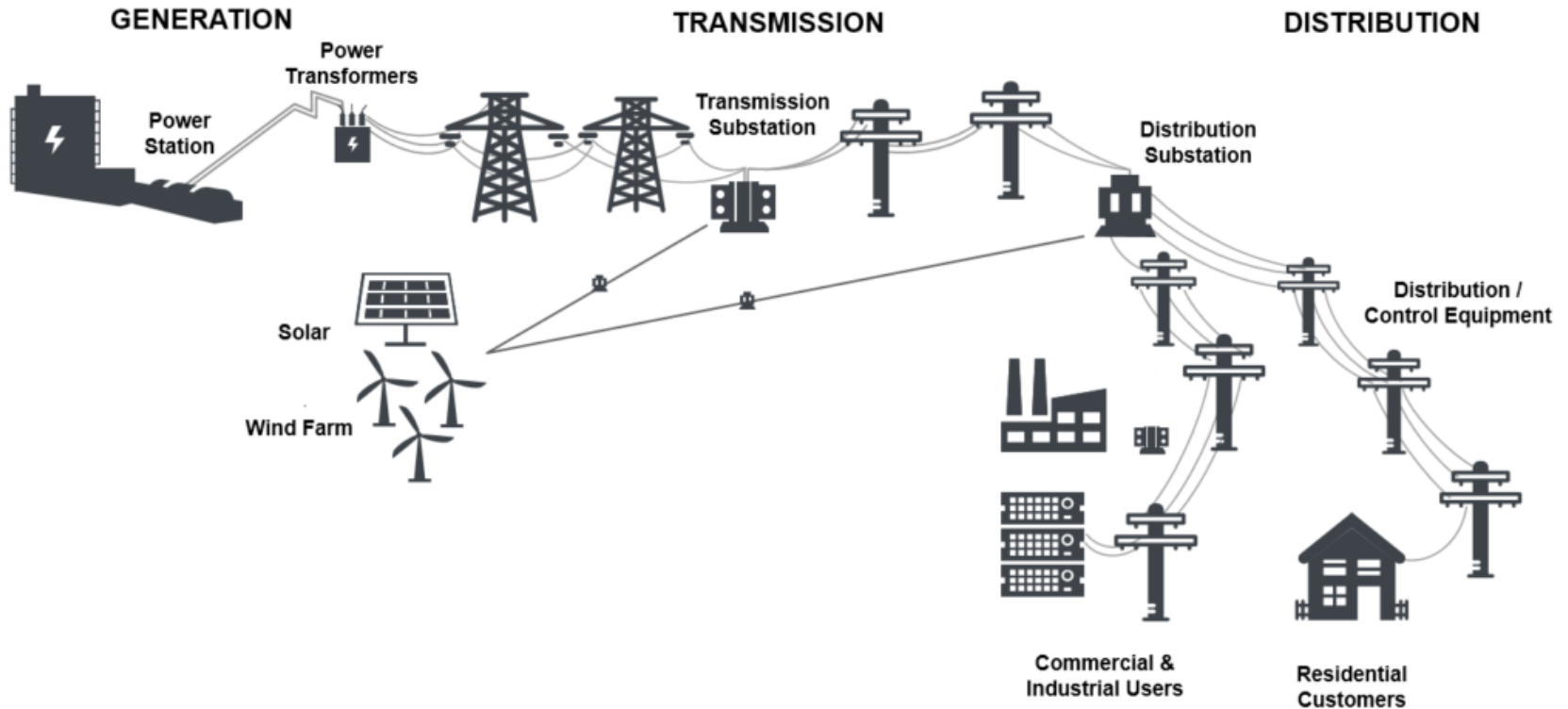
- Energy Market Overview
- Energy Risk Management
- Resource Adequacy
- Renewable Energy Products
- Long-Term Renewable Planning





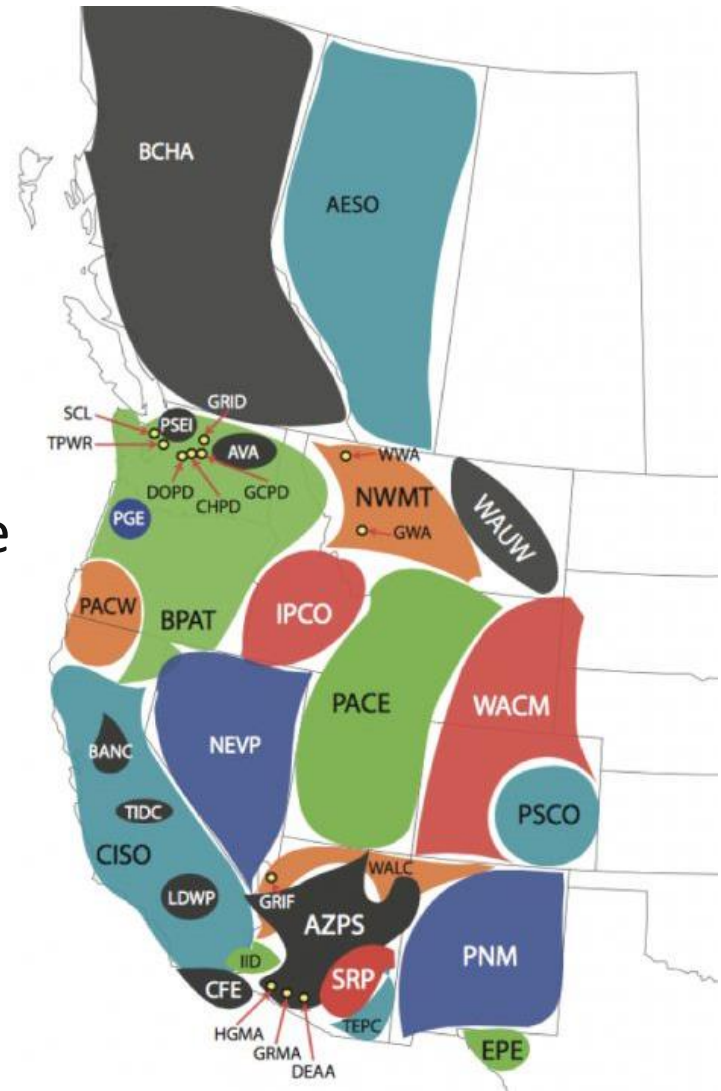
Energy Market Overview

Power Industry



WECC

- Western Interconnection
 - Multiple BAAs
- Balancing Authority Area
 - Maintain Supply/Demand Balance
 - Demand = Supply + Imported Energy
 - Manage Inter-Tie Tagging
 - Manage System Frequency
 - Manage Coordinated Dispatch of Generation



California Balancing Authority Areas

- CAISO BAA
 - Avg. Peak Load 45,000 MW
 - 26,000 circuit miles of transmission
- Role of CAISO
 - Competitive Wholesale Power Market
 - Reliable Operations
 - Grid Planning and Development



Wholesale Energy Market Products

- **Energy**
- **Transmission**
- **Capacity**
 - Resource Adequacy
 - Ancillary Services
 - Operating Reserves
 - Regulation Services
- **Natural Gas**
- **Congestion Revenue Rights**
- **Renewable Energy Products**



Energy

- Transacting Energy
 - Bilateral Wholesale Markets
 - Long / Short Term
 - CAISO Day-Ahead Market
 - CAISO Real-Time Market
 - Fifteen Min. Market (FMM)
 - Five Min. Market (RTM)
- Physical / Financial Transactions
- Inter-SC Transactions

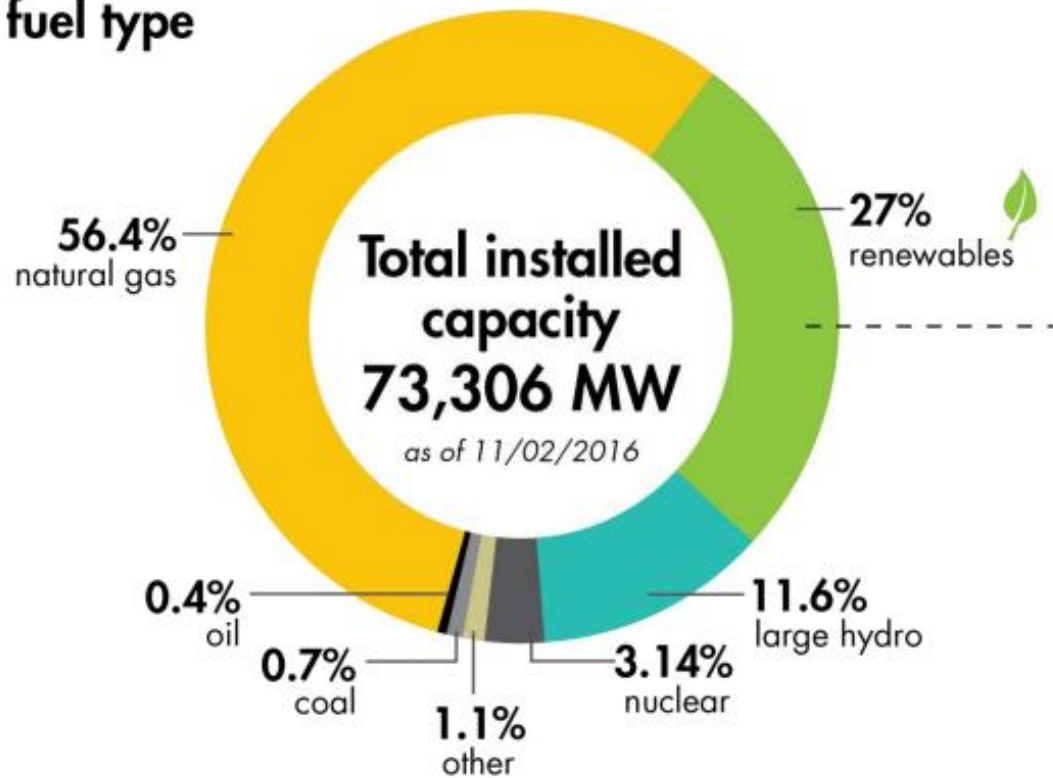


Energy Market Price Volatility

- Key Drivers of Energy Market Prices
 - Natural Gas
 - Storage
 - Transport
 - Demand
 - Weather
 - Local and Regional
 - Hydrology
 - Policy and Changing Supply Composition
 - RPS
 - GHG Free Objectives

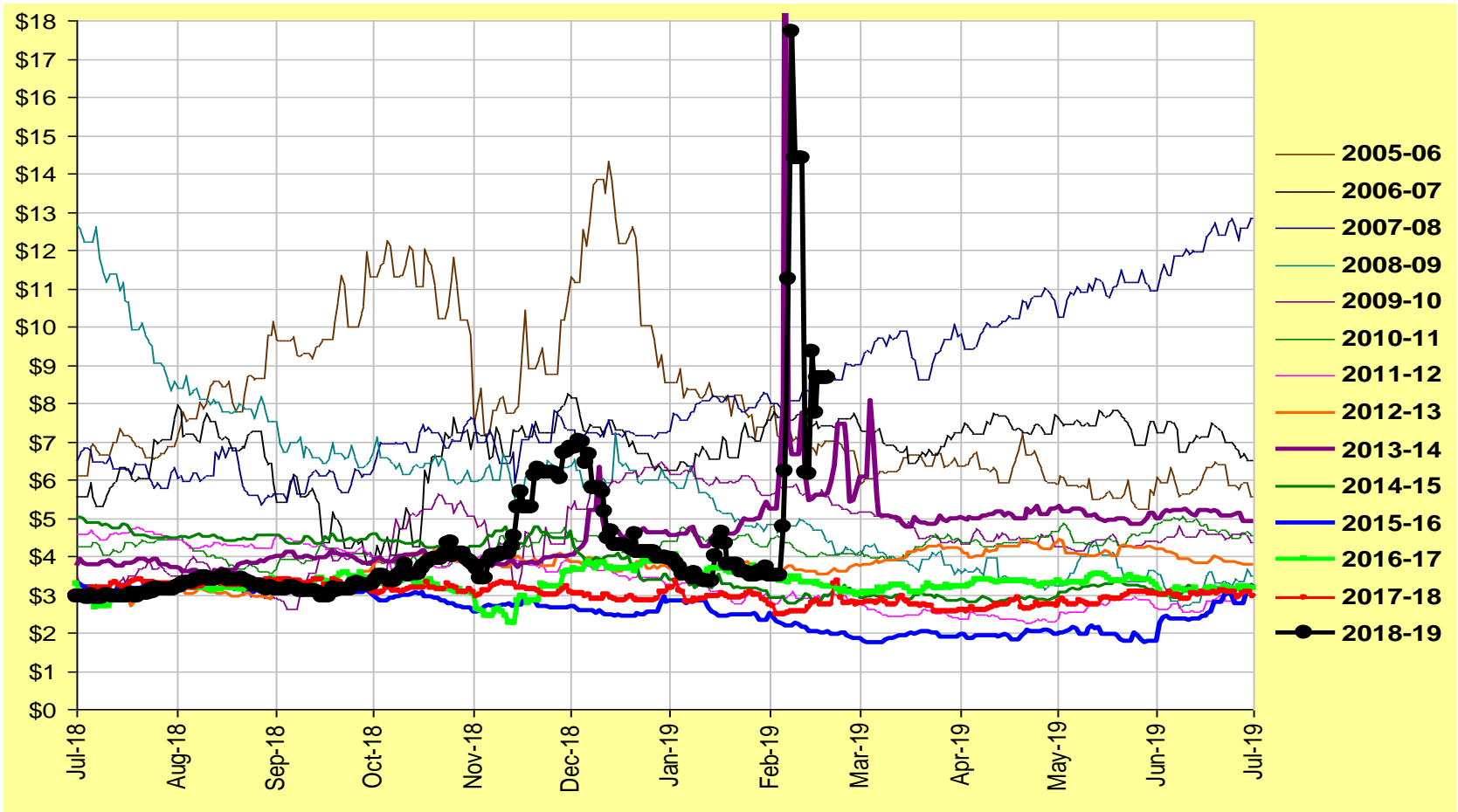


Power mix by fuel type

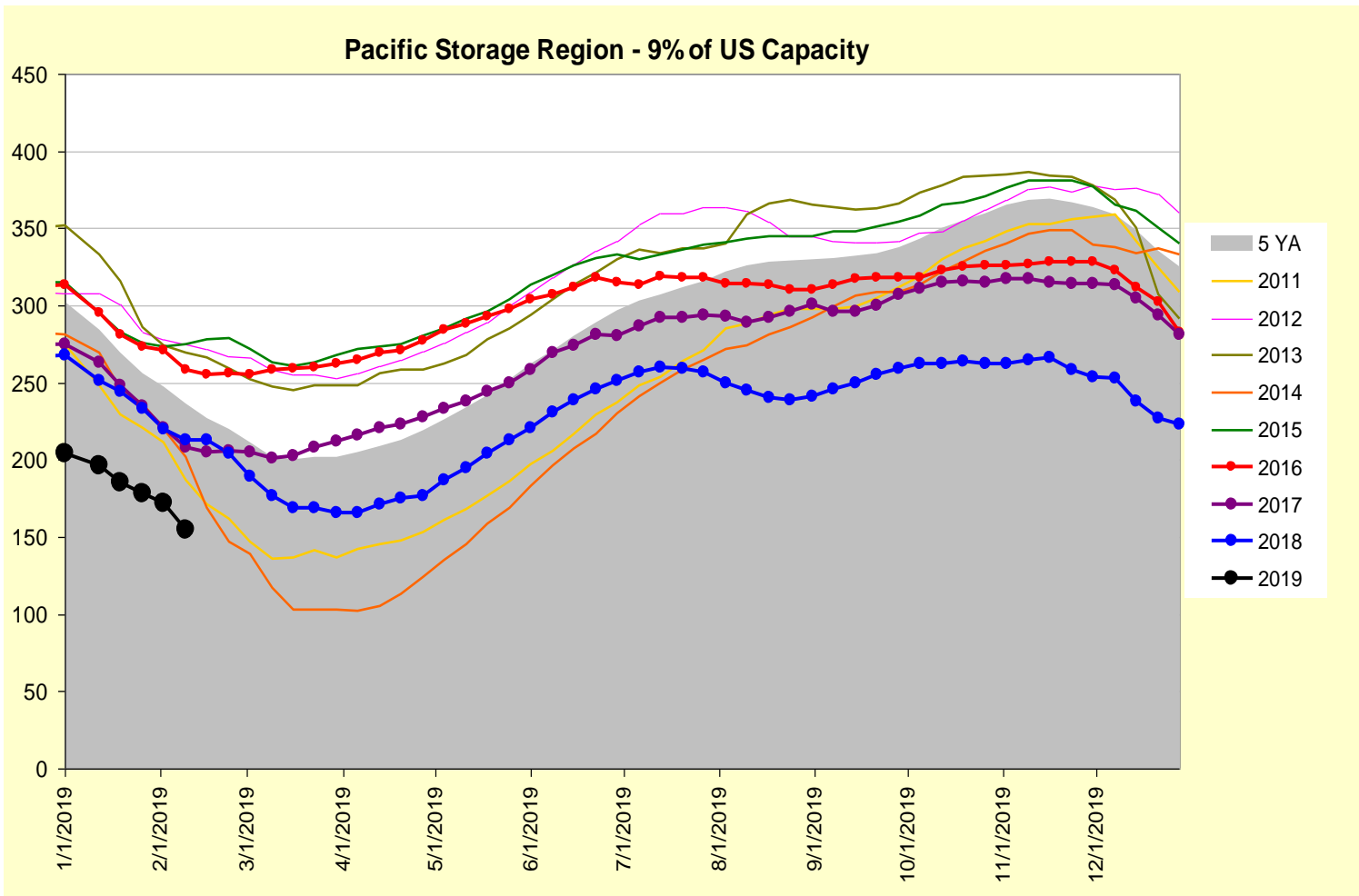


15,755 MW = Maximum import capacity at summer peak for the ISO

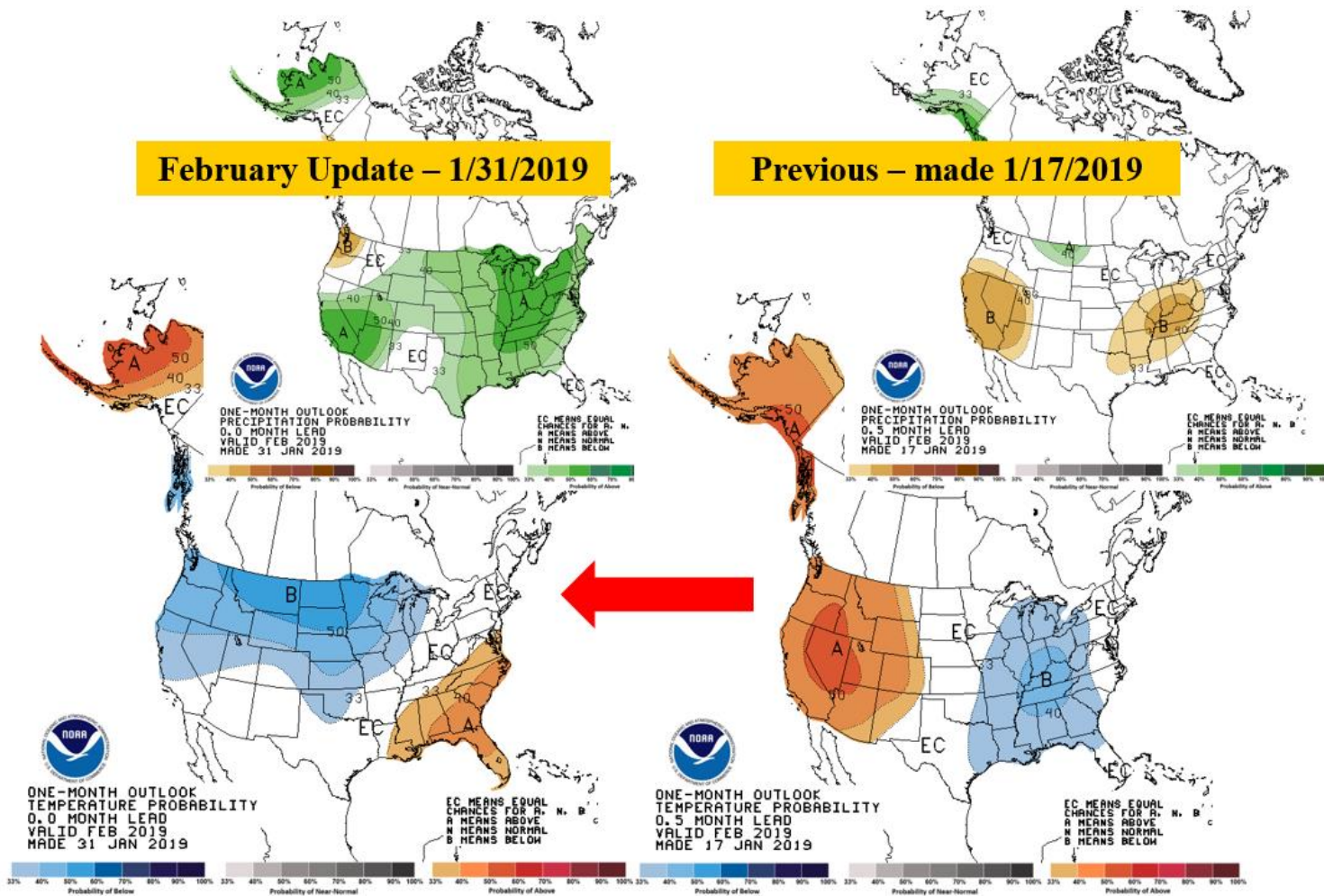
Daily Natural Gas Spot Prices (PG&E Citygate)



Natural Gas Storage Levels - Pacific

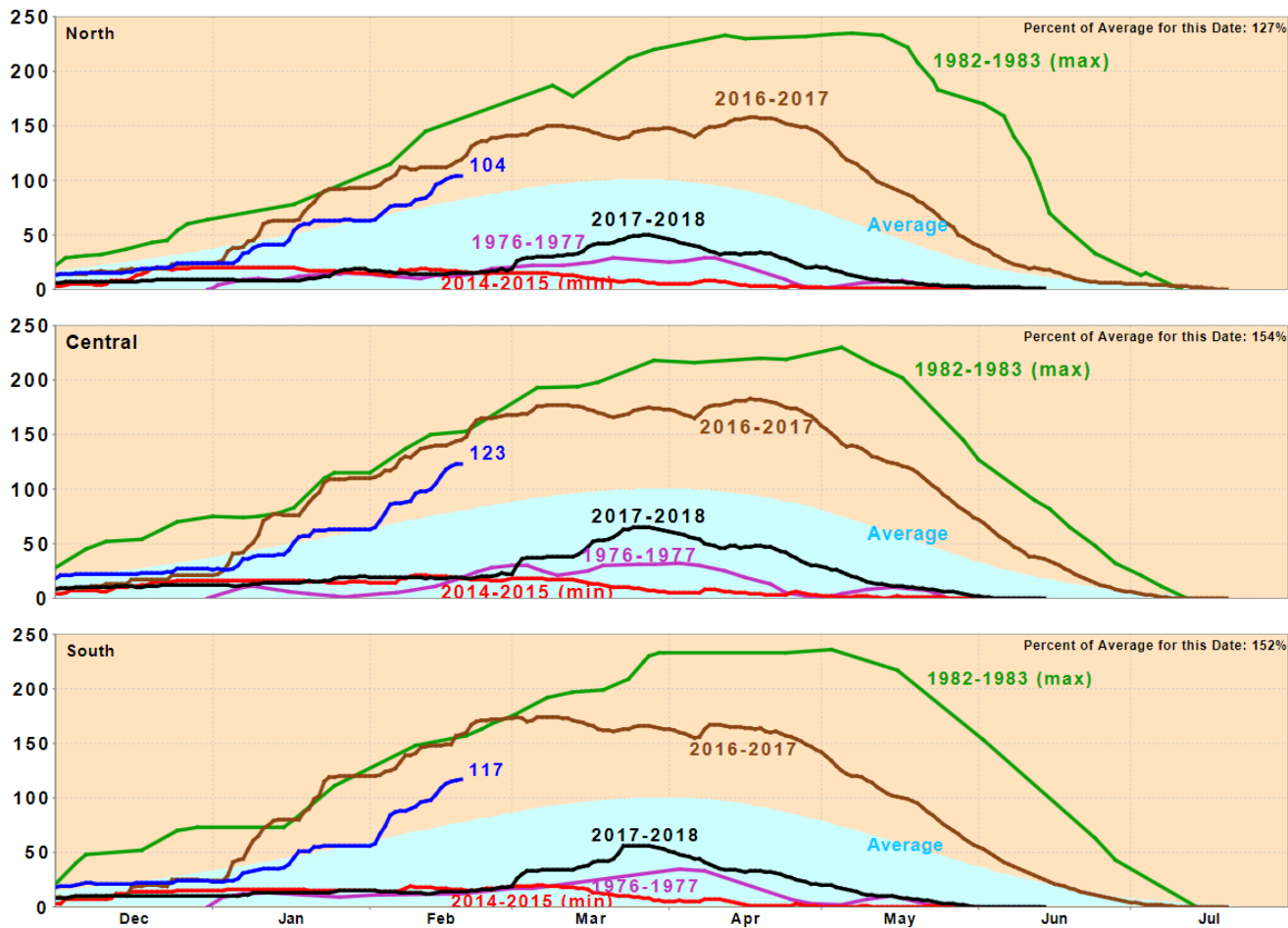


Temperature Forecast



Hydrology Forecast

California Snow Water Content, February 19, 2019, Percent of April 1 Average

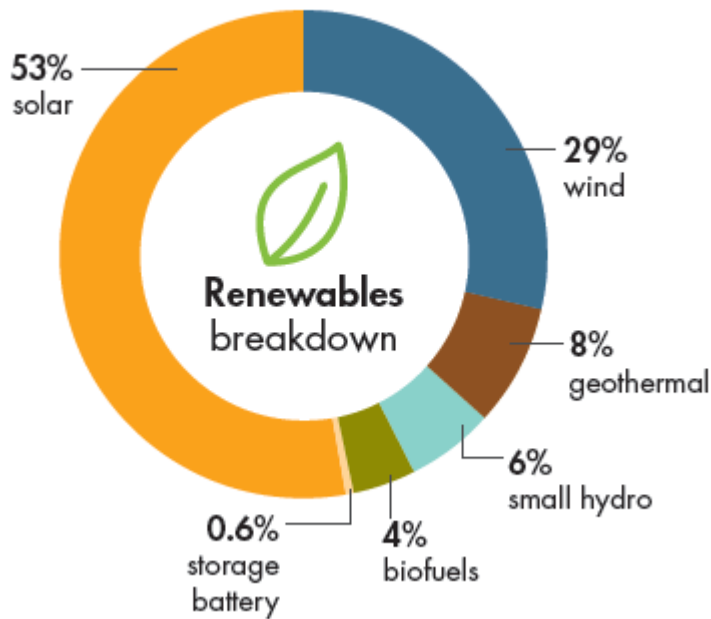








Statewide Percent of April 1: 116%

Statewide Percent of Average for Date: 146%

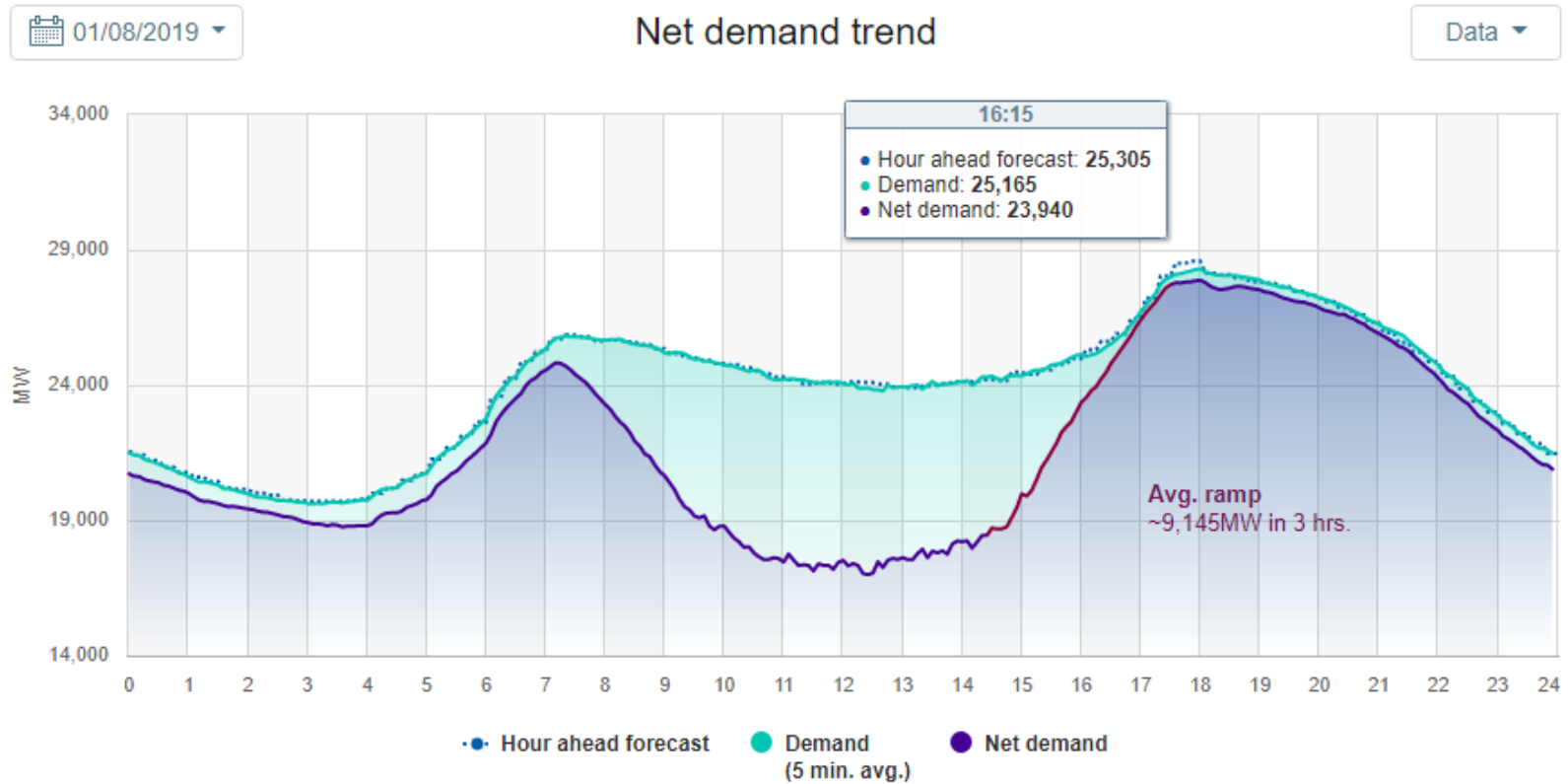
Changing Grid

Installed renewable resources *(as of 1/08/2019)*

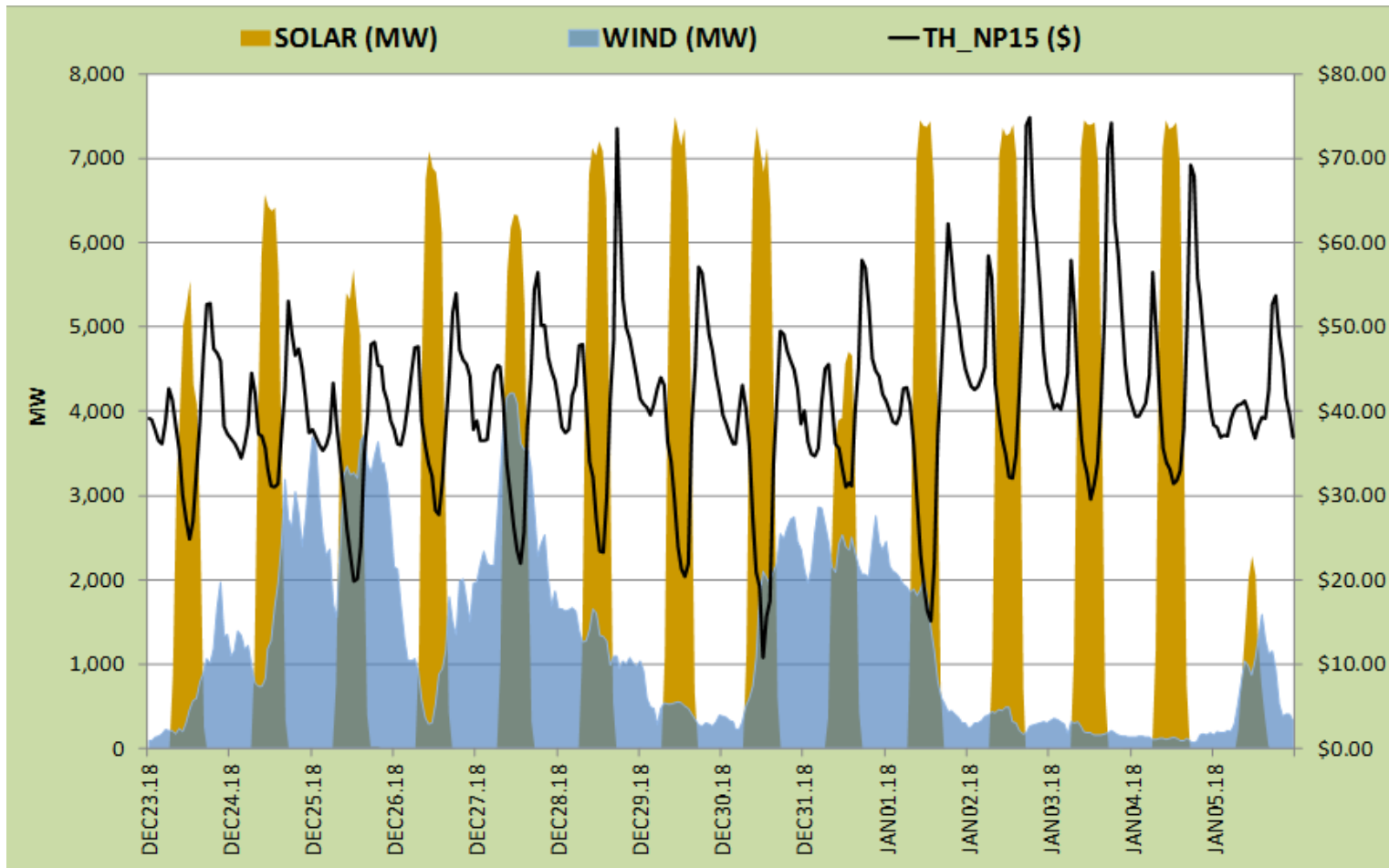


	Megawatts
 Solar	11,868
 Wind	6,505
 Small hydro	1,237
 Geothermal	1,785
 Biofuels	953
 Storage battery	136*
TOTAL	22,484

Integration of Renewables



Impact of Solar / Wind on Energy Prices



CAISO Markets

- Day-Ahead Market
 - Matching Supply / Demand
 - Majority of Transitions
 - Market Processes
 - MPM, IFM, RUC and ELS

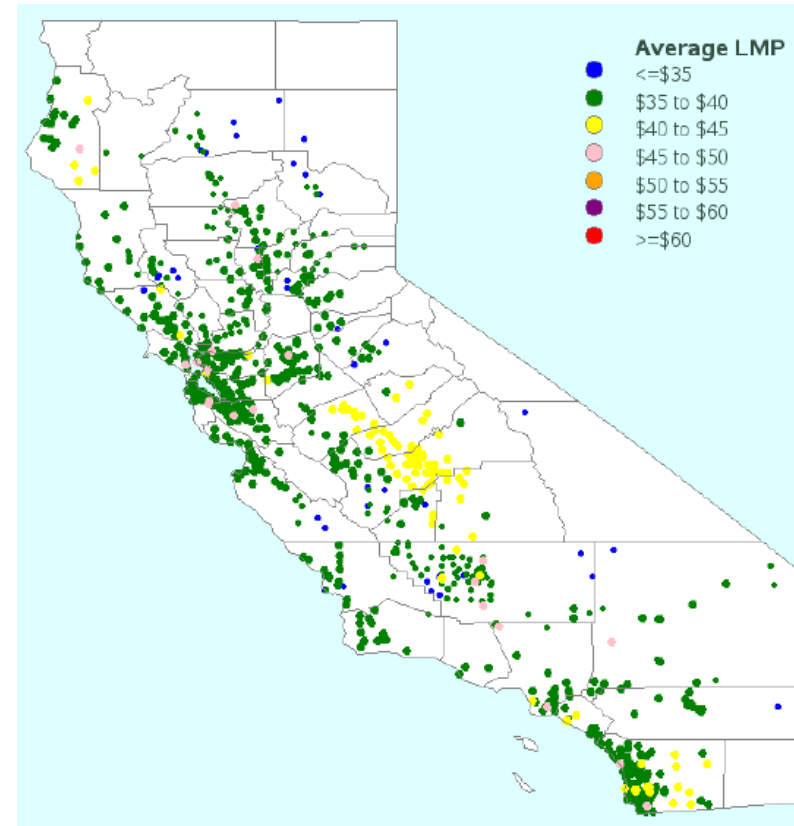
- Real-Time Market
 - Matching Supply / Demand
 - Incremental Adjustments to DAM
 - Hourly, 15-Min. and 5 Min.
 - Market Processes
 - MPM, HASP, STUC, RTUC and RTED



CAISO Nodal Pricing

- Locational Market Prices (LMP)

- Full Network Model
 - Injections and Withdrawal
- Prices Calculated at each Node
 - Load
 - Generation
 - Inter-Tie
- Price Granularity
 - Hourly, 15-Min. and 5-Min.
- Based on Cost of Serving 1 MW of Incremental Load



CAISO Nodal Pricing Settlement

- Load and Supply Nodal Settlement
 - Load Settlement at DLAP
 - Default Load Aggregation Point
 - EBCE in PG&E DLAP
 - Generation Settlement
 - Individual PNOD
 - Pricing at location of generation
 - Inter-SC Trades
 - Trading Hub Settlement
 - NP15 EZ GEN HUB
 - Weighted average of generation PNODs





Energy Risk Management

Energy Risk Management

- Risk Management Objectives
 - Mitigate Exposure to Volatility
 - Durable Rates
 - Financial Stability
 - Regulatory Compliance
- Key Energy Market Risks
 - Volumetric Risk
 - Fluctuations in the volume of supply and demand
 - Price Risk
 - Price volatility



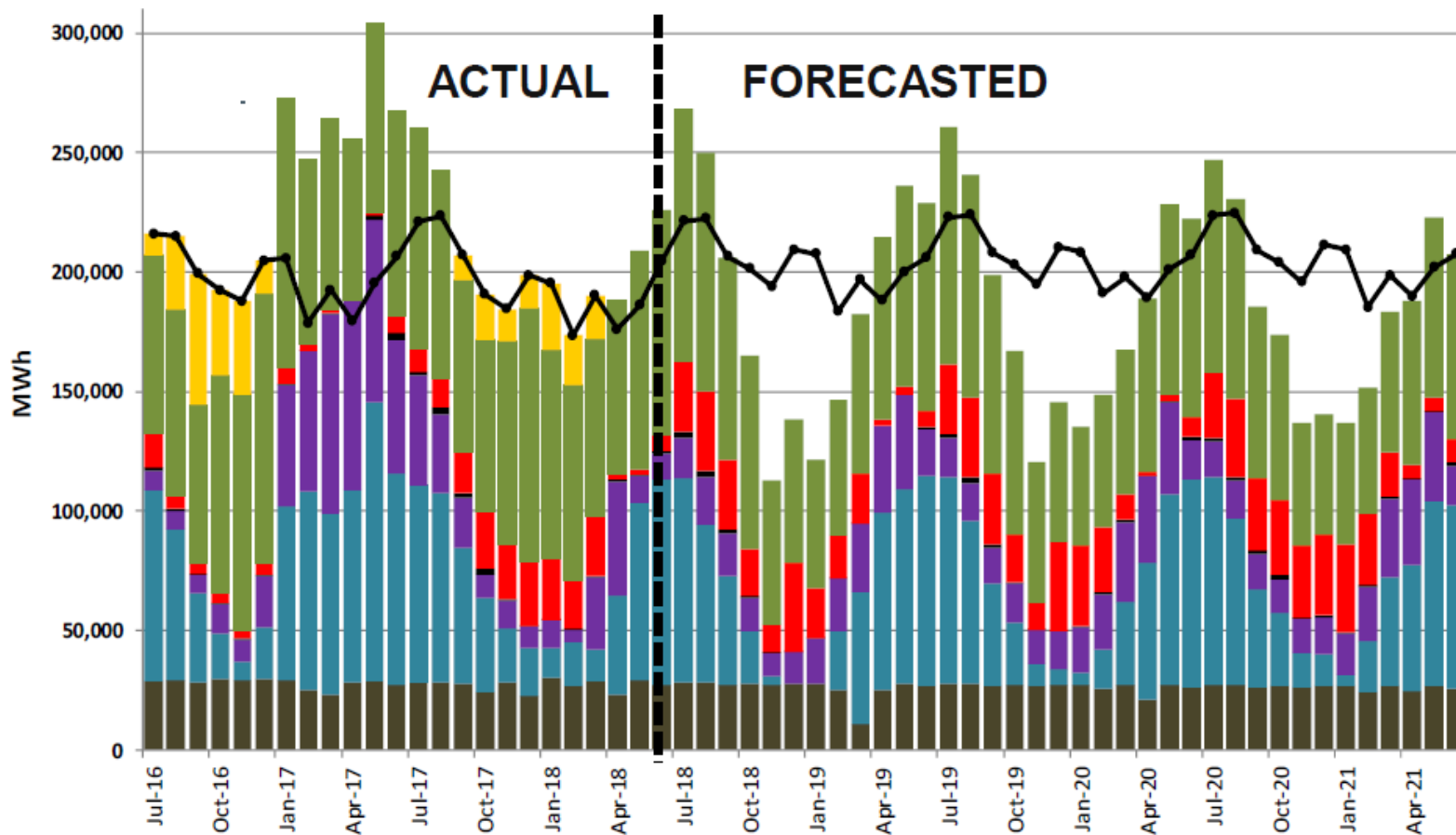
Long Term to Short Term Hedge Strategy

- Long Term Hedging
 - Load Forecasting
 - Coverage Objectives
 - Market Conditions
 - Resource Composition
- Short Term Hedging
 - Refined Load Forecast
 - Intra-Month / Intra-Day Shaping
 - Market Conditions
- Fixed Price Energy Hedging
 - Inter-SC Trades

Months to Delivery		Price Matrix Percentile						
		>60%	60%	50%	40%	25%	10%	<10%
		Covered Position as a % of Forecasted Load						
0+	3	80%	80%	85%	85%	90%	90%	100%
3+	6	70%	70%	75%	80%	80%	90%	100%
6+	9	70%	70%	75%	80%	80%	80%	90%
9+	12	60%	60%	70%	80%	80%	80%	90%
12+		60%	60%	70%	80%	80%	80%	90%

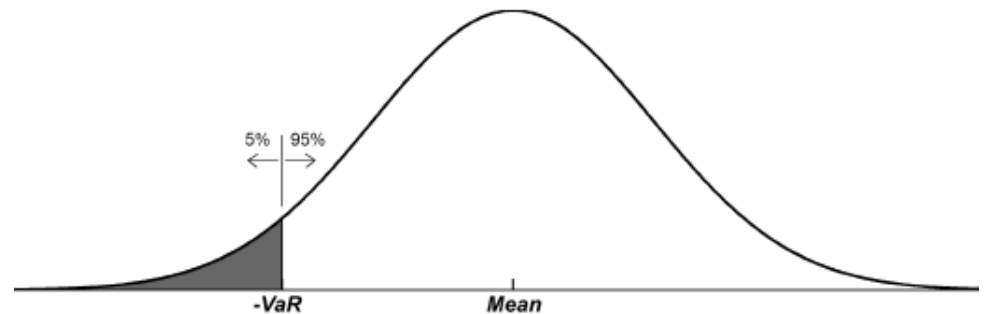


Load / Resource Balance



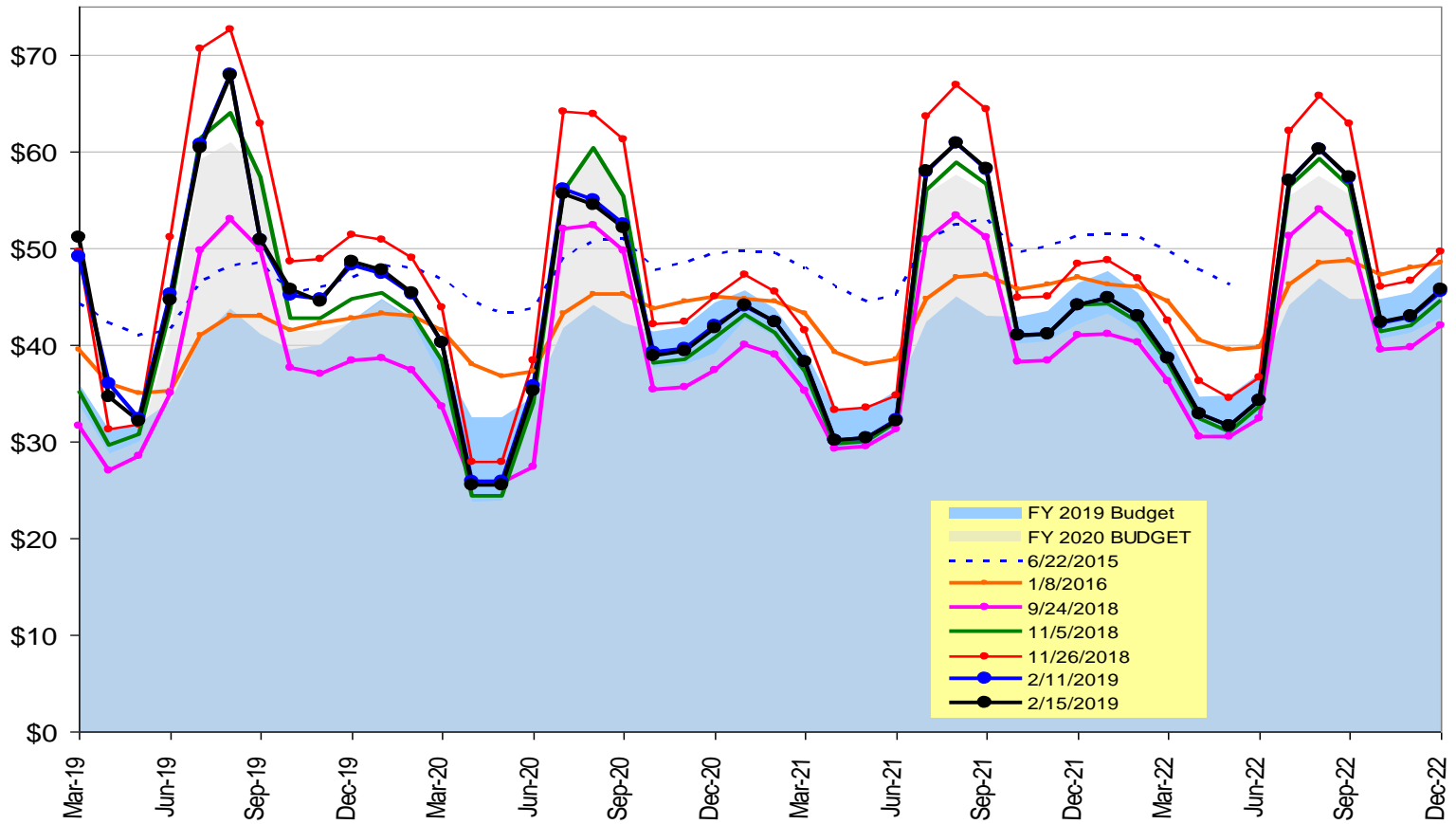
Example of Hedging Tools

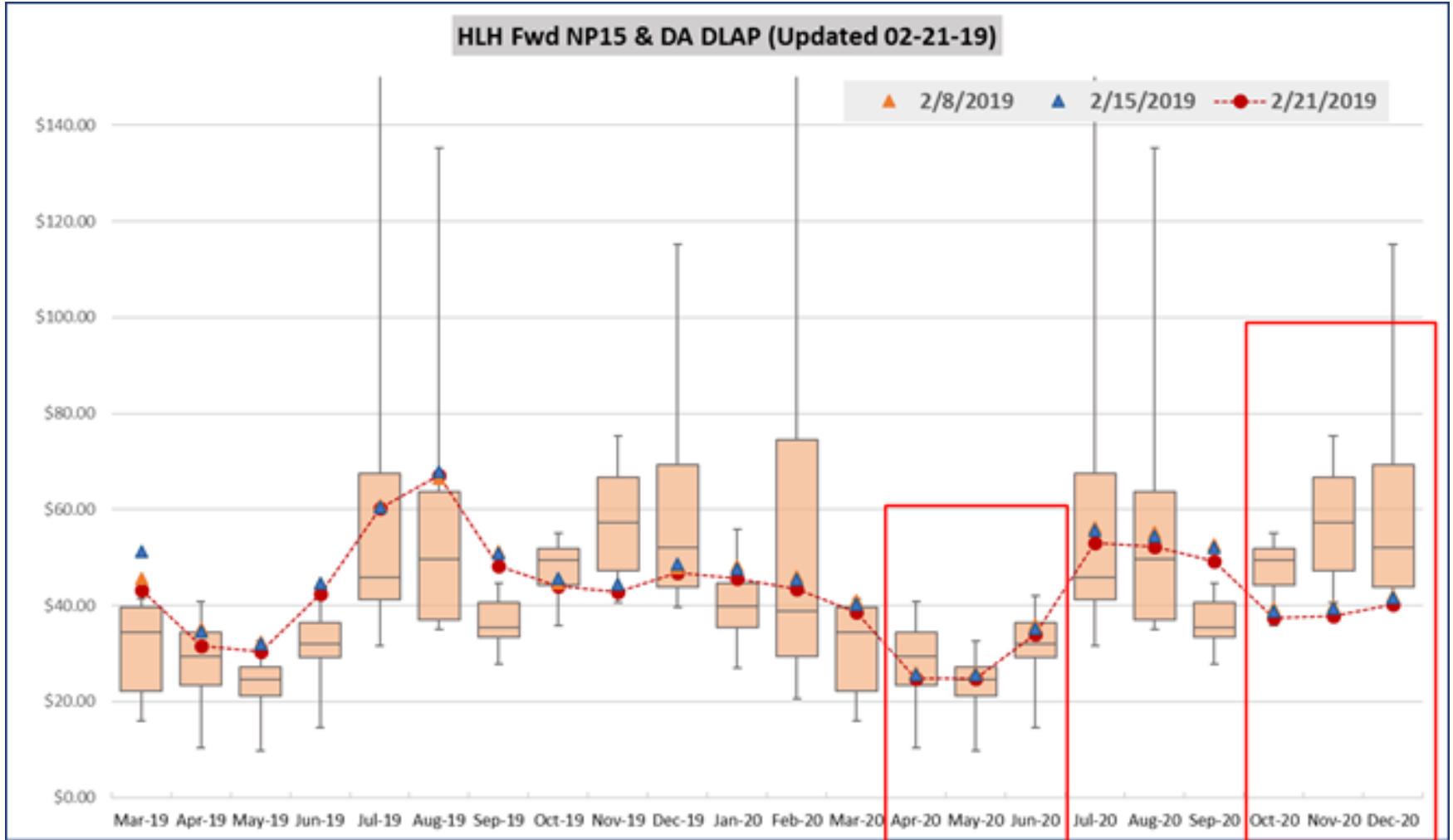
- Inter-SC Trade of Energy
 - Tool used to fix the costs of energy supply
 - All Hours (7 X 24)
 - On-Peak Delivery (HE 07 to HE 22)
 - Off-Peak Delivery (HE 01 to HE 06 & HE23/24)
 - Traded at EZ GEN HUB of PNOD
 - NP15 or associated with Physical Resource
- Imports / Exports
- Options
- Generation Resource



Forward Energy Curve

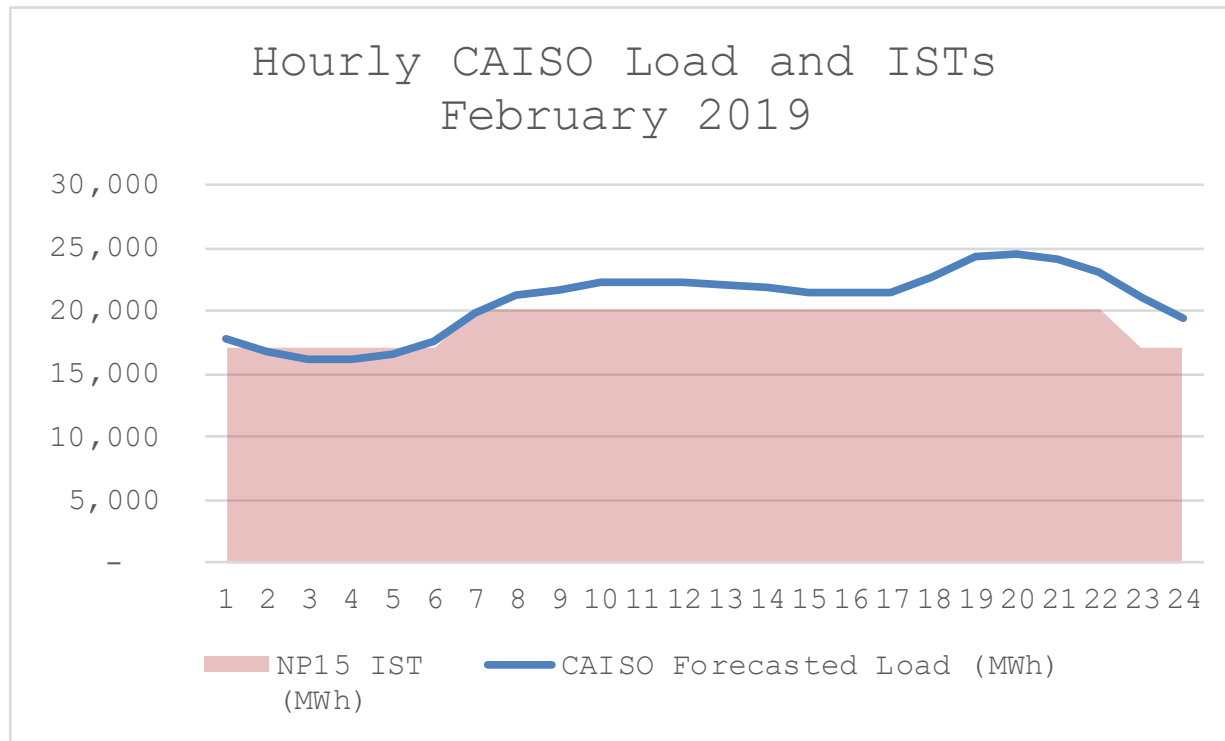
NP15 On-Peak Forward Power - EOX





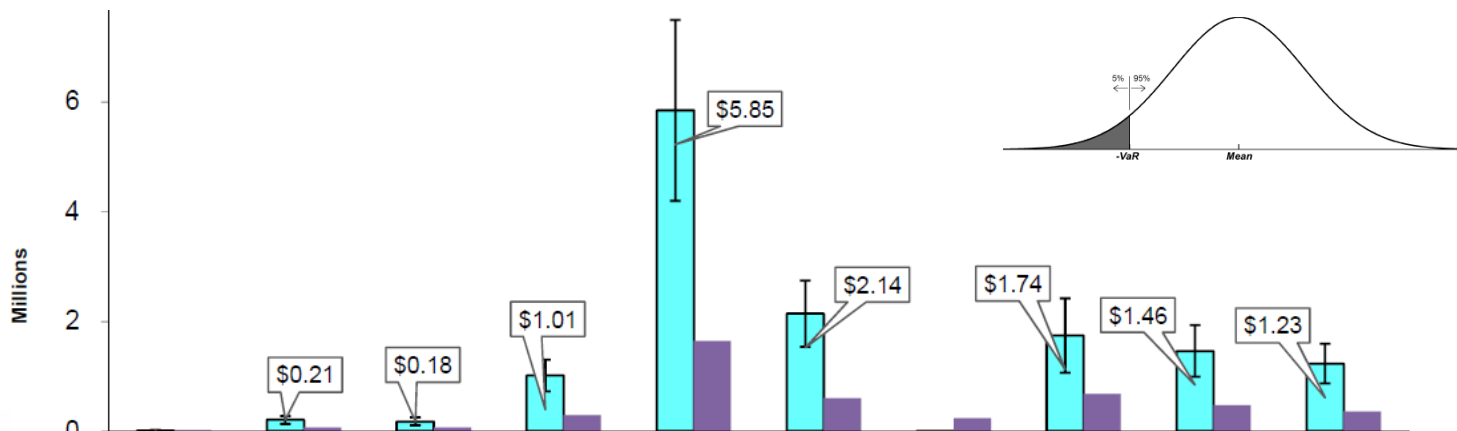
■ Base Load vs. Shaped Energy

- Mix of products purchases to match load profile
- Establish Coverage within Risk Tolerance



■ MWh Coverage and Value-at-Risk Hedging

- Match Demand with Fixed Price Supply
 - Reduces exposure to market price volatility
 - Form of Insurance
 - May include premium cost similar to insurance
- Establish Coverage within Risk Tolerance
 - Maintain open position based on value-at-risk
 - Value-at-risk is a measure of risk of loss





Resource Adequacy

Resource Adequacy Requirements

- Resource Adequacy Program
 - Developed to ensure CAISO has access to sufficient generating capability to support grid reliability
 - Create an additional revenue stream to maintain existing capacity, and incent development of new capacity
- CAISO market is based on an energy-only design
 - Cost of energy based on variable cost of operation
 - May not produce sufficient energy rents to support cost of capacity
 - Ensure specific capacity remains available for managing grid operations

Key Concepts

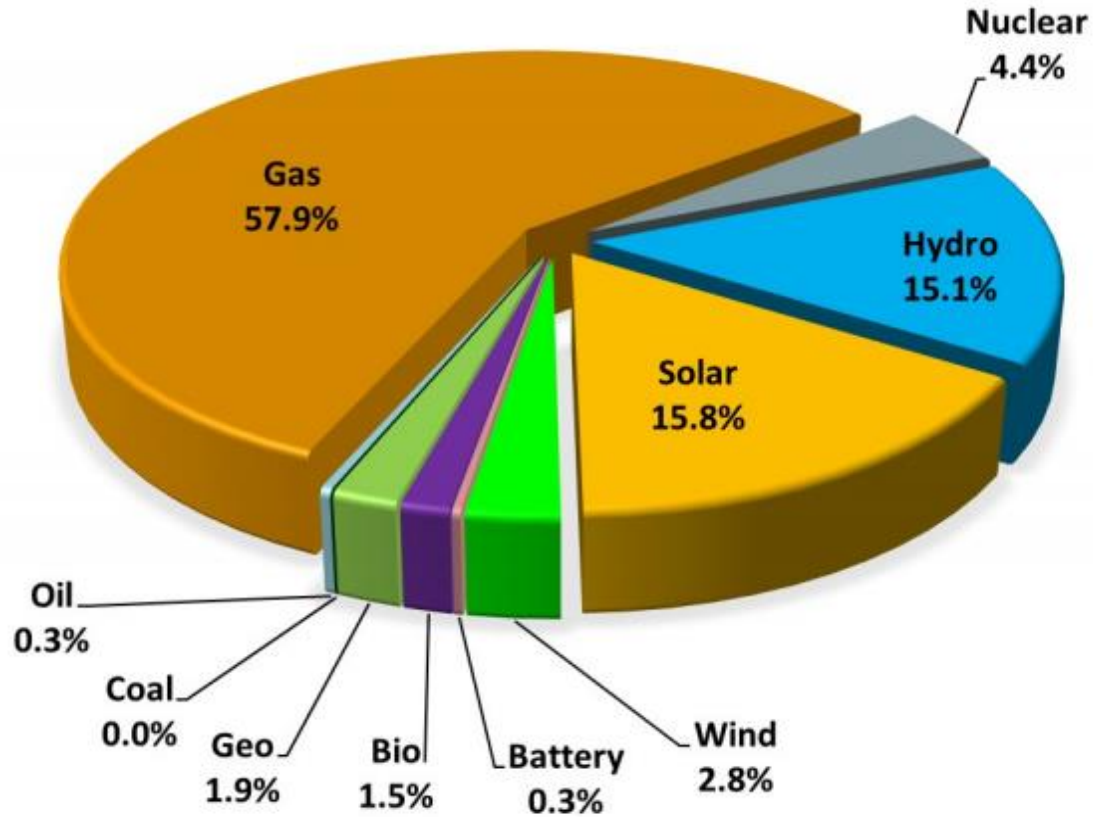
- Resource Adequacy Requirements
 - Load Serving Entities (LSE) must demonstrate they have purchased a defined amount of capacity
- System Resource Adequacy
 - **115% of LSE monthly peak-demand**
 - Supplied from qualified resources
 - Net Qualified Capacity
- Local Resource Adequacy
 - **Capacity located in specific geographic locations**
 - Sub-requirement (% of overall capacity must be local)
- Flexible Resource Adequacy
 - **Capacity with defined operational characteristics**
 - Sub-requirement (% of overall capacity with ramping)



System Resource Adequacy

- Resources interconnected in CAISO BAA
 - Generator Net Qualifying Capacity (NQC)
 - Max Capacity less station service (or ambient derate)
 - Average production capability of defined time (wind / solar)
- Imports
 - Firm energy imported into the CAISO
 - Must be bundled with Import Capability
 - To ensure sufficient BAA capacity, imports limited
 - CAISO defines a fixed amount of import capability
- Other
 - Limited Demand Response

2018 ISO SUMMER ON-PEAK NQC BY FUEL TYPE



Local Resource Adequacy

- Capacity Located in a defined Sub-Pocket

- PG&E System
- SCE System
- SDG&E System

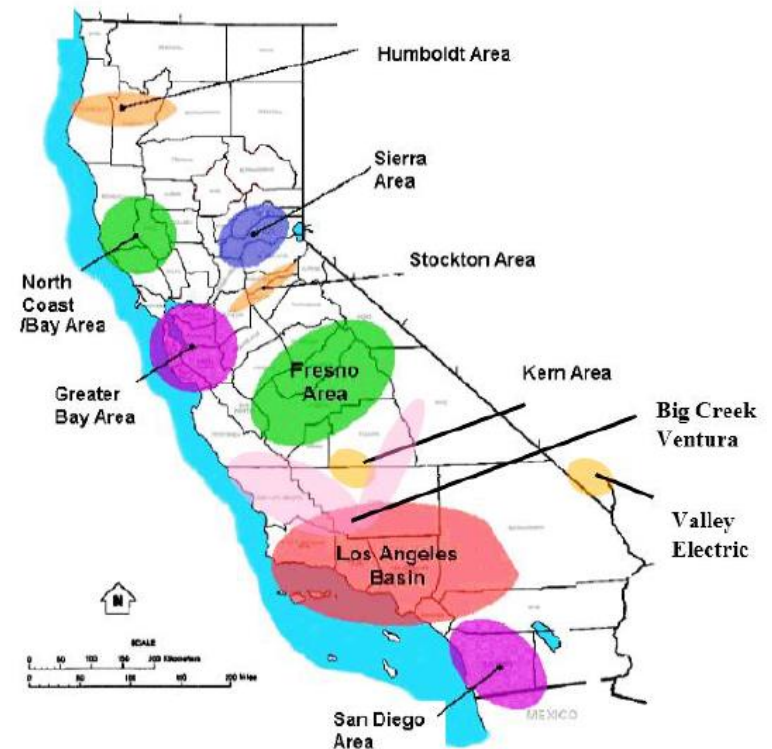
- Resources Defined by Effectiveness Factors

- Modeling based on contingency analysis
- Designed to maintain load under N-1-1 contingency

- Requirements Defined Annually

- CAISO technical study
- Impacted by resource retirements

Figure 2: LCR Areas within the ISO



Local Resource Adequacy

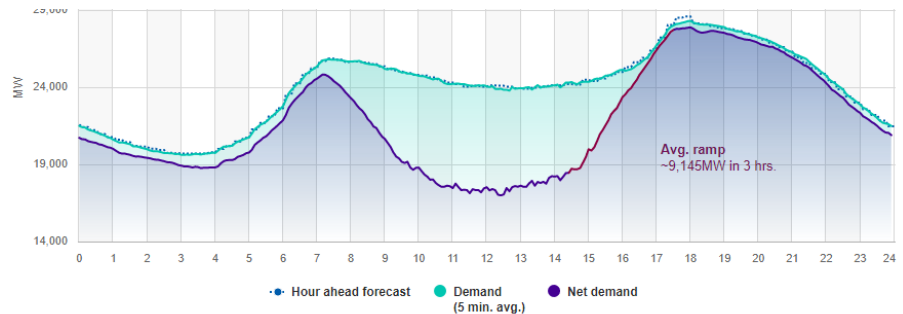
Local Area	2018 August NQC (MW)	2017 Local Req.* (MW)	2018 Local Req.* (MW)
Greater Bay Area	7,070	4,539	3,810
Other PG&E Areas**	7,529	4,766	4,942
Fresno	3,224		
Humboldt	202		
Kern	460		
North Coast / North Bay	865		
Sierra	2,147		
Stockton	631		
TOTAL NP 26	14,599	9,305	8,752
Big Creek-Ventura	5,521	1,534	1,778
LA Basin	10,283	6,595	6,693
San Diego / Imperial Valley	5,356***	3,569	3,833
TOTAL SP 26	21,160	11,698	12,304
TOTAL LOCAL	35,759	21,003	21,056

*Requirements for August 2017 are based on the month ahead RA process and reflect the 2017 local true-up. Requirements for August 2018 are based upon the year ahead RA process and do not reflect the local true-up, which will occur in April 2018.

**Local reliability areas outside the Bay Area but within the PG&E TAC area are grouped as "Other PG&E Areas" for local RA compliance.

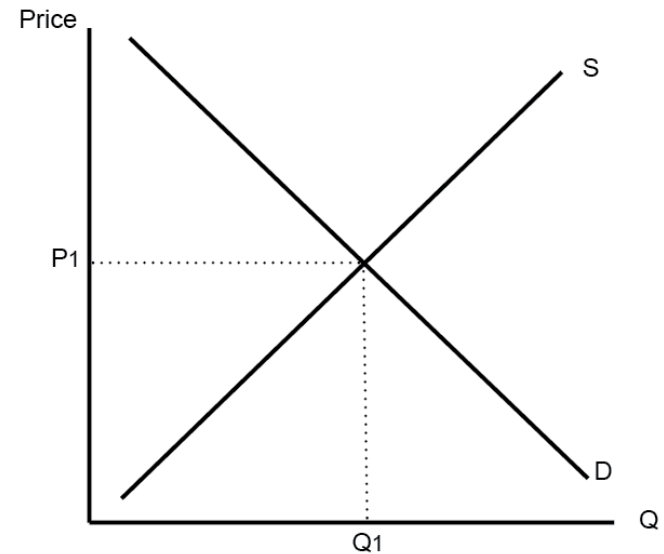
Flexible Resource Adequacy

- Resource with Flexible Operating Characteristics
 - Ramping Capability
- Types of Flexible Capacity
 - Category 1
 - Category 2
 - Category 3
- Need driven by operational variability



Resource Adequacy Challenges

- Compliance Requirement
- Limited Supply
 - Resource retirements
 - Changing grid composition
- Limited Suppliers
 - Key suppliers maintain material share of supply
- Lumpiness of Supply
 - Resource operating limitations
- Cost Increasing Dramatically





Renewable Energy Products

Renewable Energy Certificates (RECs)

- Energy produced by a CA RPS-eligible renewable energy resource
- Renewable Energy production tracked with RECs
 - REC created and transferred in WREGIS
- RPS Portfolio Content Categories
 - Category 1 REC
 - Energy and REC delivered to California BAA without substitution
 - Category 2 REC
 - Energy and REC that cannot be delivered to a CBA without substituting energy from another source
 - Category 3 REC
 - RECs that have been “unbundled” from energy delivery



Carbon Free and Low-Carbon Energy

- Carbon Free Energy
 - Certain Types of CA RPS-Eligible Resources
 - Wind
 - Solar
 - Large Hydro Resources
 - Greater than 30 MW Name Plate Capacity
 - Not RPS-Eligible, but carbon free
 - Carbon Free Imports
- Asset-Controlling Supplier (ACS)
 - Aggregation of resources with a registered emissions factor, majority large hydro
 - Generally associated with power that is imported into the CAISO

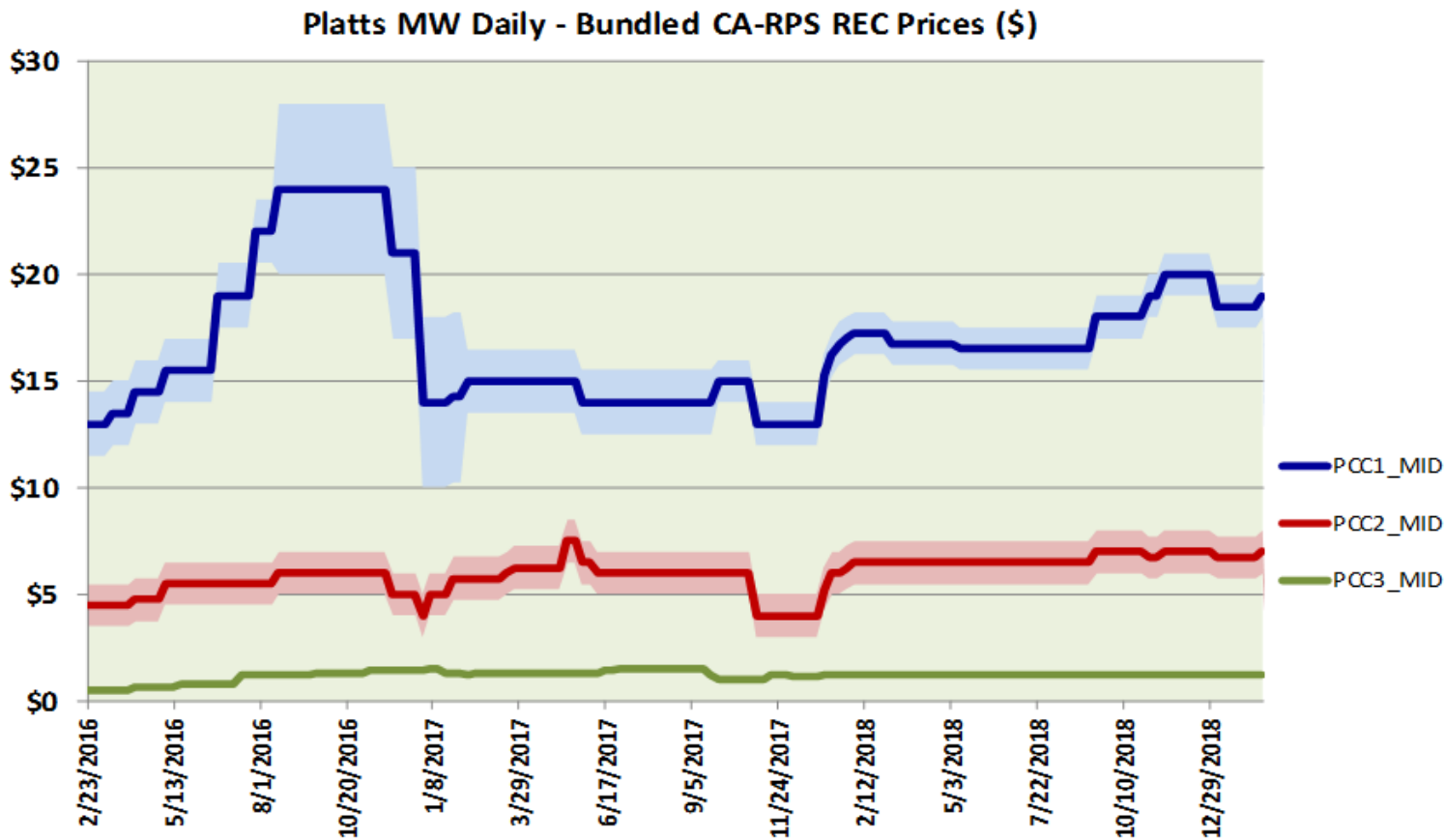


Purchasing Renewable Energy

- Purchasing Attributes
 - Category 1, 2 and 3 RECs
 - 1 REC = 1 MWh of Renewable Production
 - Mitigate exposure to value of energy
 - Index + REC Value
- Firmed / Shaped Energy
 - Renewable Energy delivered from portfolio of resources
 - Defined delivery volume and shape
- As Delivered / Resource Contingent
 - Based on output of a specific generator



CA-RPS REC Prices





Long-Term Renewable Planning

Long-Term Renewable Development

- Resource Development
 - Interconnection
 - Value of Energy
 - Operational Flexibility / Shaping
 - Capacity Factor
 - Solar and Wind Average: 30%
 - Integration of Storage
 - Distributed Energy Resources
- Diversified Portfolio



Renewable Energy & Storage Mandates

- California Renewables Portfolio Standard (RPS)

- 60% RPS by 2030
- 100% GHG-free by 2045

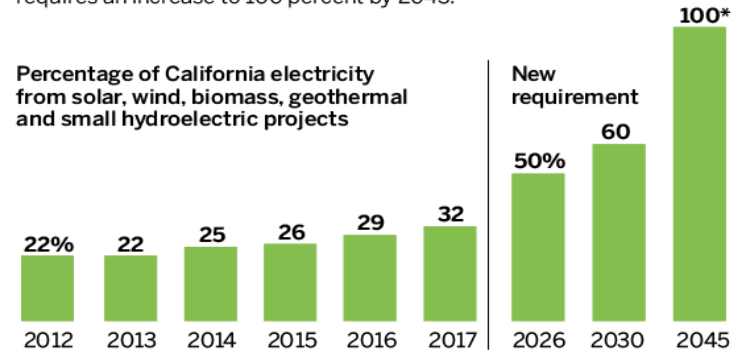
- Energy Storage Procurement Requirements

- Statewide target: 1,325 MW
- CCA targets: 1% of annual 2020 peak load

RENEWABLE ENERGY GROWTH IN CALIFORNIA

California receives 32 percent of its electricity from solar, wind and other renewable sources. A new law signed Monday by Gov. Jerry Brown requires an increase to 100 percent by 2045.

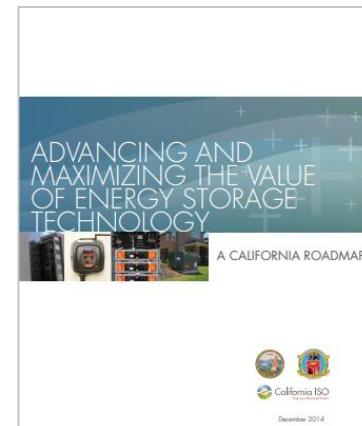
Percentage of California electricity from solar, wind, biomass, geothermal and small hydroelectric projects



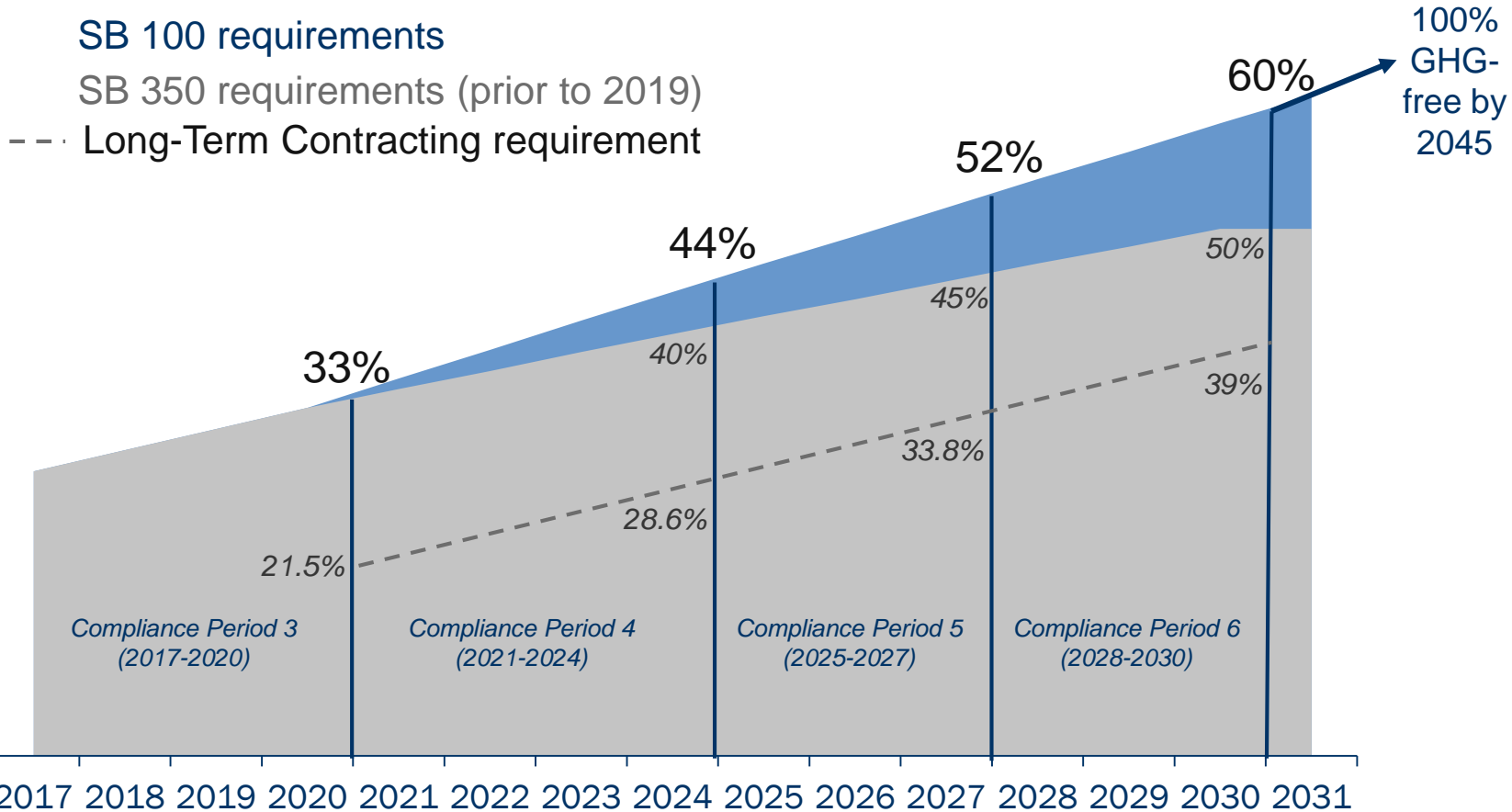
**"Non-carbon" sources like nuclear and large dams also can provide up to 40 percent.

Source: California Energy Commission

BAY AREA NEWS GROUP



State RPS Procurement % Requirements



*Beginning in 2021, 65% of RPS requirements must be procured from contracts \geq 10 years

Integrated Resource Planning

- EBCE current: 5% above current RPS-level
- 2018 IRP: maintain 5% above RPS through 2025 while meeting RPS with 85% long term contracts

What is our Path to 100% Clean Energy?

- Current law requires by 2045, but EBCE wants to get there much faster. So the question is how we get there.
- EBCE staff recommends focusing 2020 IRP on EBCE's Pathways to 100% Clean Energy

Integrated Resource Planning: 2020 Update

- Focus on developing EBCE's Pathways to 100% Clean Energy
- Include short, medium and long-term renewable and clean energy targets for EBCE
- Integrate Local Development Business Plan activities into EBCE's 100% Clean Energy IRP, including:
 - Energy efficiency, demand response, electrification, local renewables and zero-emission capacity

Integrated Resource Planning : Local stakeholder Engagement

- Kick-off 2020 IRP Update in Q2 2019
- Hold multiple rounds of public meetings across Alameda County in Q3 and Q4 2019
- Present draft 2020 IRP to Board of Directors Q4 '19 or Q1 '20
- Submit 2020 IRP to CPUC Q3 2020

Next Steps

- Identify additional deep-dive topics for future review
- May 8 (tentative) 6:00-8:00PM
 - Road to 100% Renewables

Questions / Comments

