Flexible Capacity Requirements for 2020 through 2022

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What's the purpose of this call?

- Discuss the criteria, methodology, and assumptions used in calculating monthly flexible capacity requirement.
- Calculate requirements for all LRAs within the ISO footprint for RA compliance year 2020 and advisory flexible capacity requirements for compliance years 2021 and 2022
- Discuss the input assumptions and methodology of the annual CAISO's Availability Assessment Hour (AAH).

Agenda / Overview

- Background
- Process review
  - Expected build out from all LSEs (CPUC jurisdictional and non-Jurisdictional)
  - Load, wind and solar profiles
  - Calculate 3-hour net-load ramps
  - Calculate monthly Flexible Capacity requirement
  - Add monthly maximum contingency reserve requirements
  - Next steps

Each LSE SC shall make a year-ahead and month-ahead showing of flexible capacity for each month of the compliance year

Resource Adequacy (RA)

- Ensure LSEs contract for adequate capacity to meet expected flexible needs
- Year ahead timeframe: LSEs need to secure a minimum of 90% of the next years monthly needs
- Month ahead timeframe: LSEs need to secure adequate net qualified capacity to serve their peak load including a planning reserve margin and flexible capacity to address largest three hour net load ramps plus contingency reserves
- All resources participating in the ISO markets under an RA contract will have an RA must-offer-obligation
- Required to submit economic bids into the ISO's real-time market consistent with the category of flexible capacity for which it is shown

The ISO flexibility capacity assessment is based on current LSE's RPS build-out data

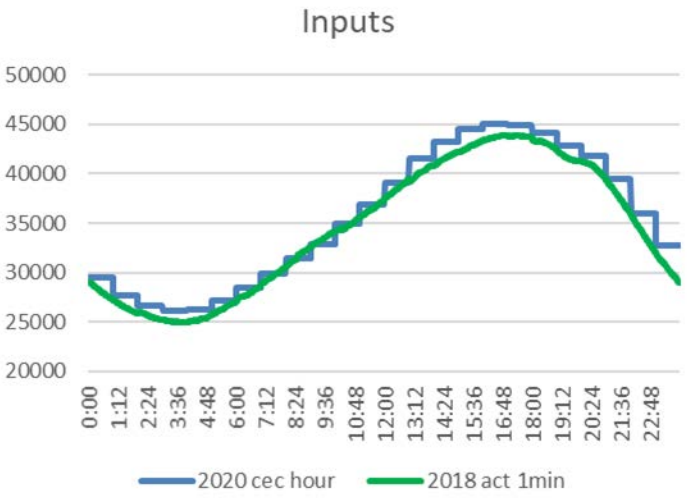
- Uses the most current data available for renewable build-out obtained from all LSE SCs
- For new renewable installation scale 2018 actual production data based on installed capacity in subsequent years
- Generate net-load profiles for 2020 through 2022
  - Generate load profiles for 2020 through 2022
  - Generate solar profiles for 2020 through 2022
  - Generate wind profiles for 2020 through 2022

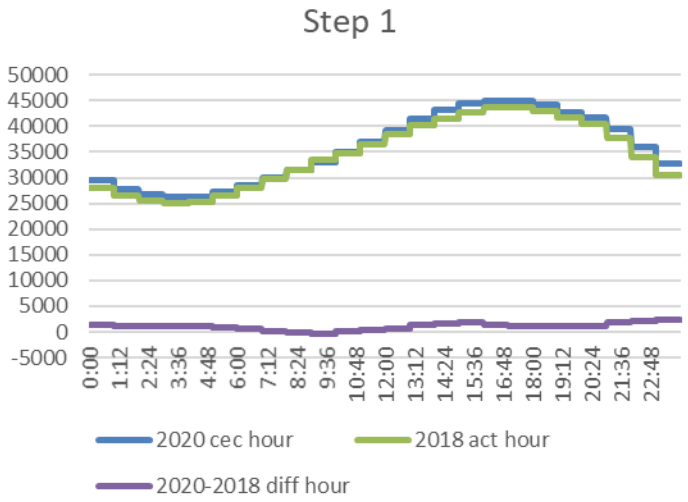
The ISO will use the CEC's 1-in-2 IEPR forecast to develop the load forecast

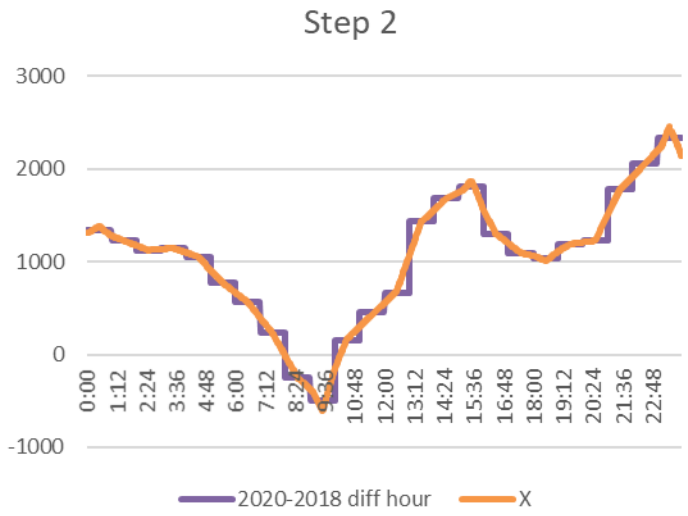
- ISO uses 1-in-2 IEPR forecast; the IEPR forecast has both an hourly view and a monthly view.
  - The forecast is correlated such that the peak of the month can be seen in the hourly profile.

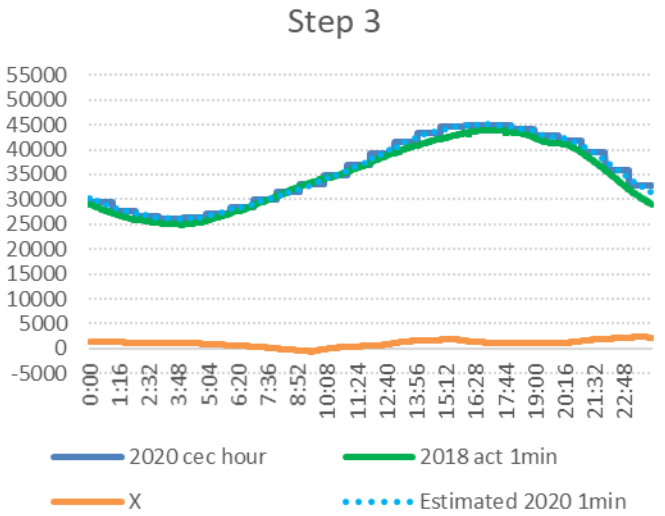
- CEC IEPR Load Forecast
  - https://www.energy.ca.gov/2018_energypolicy/documents/index.html
  - Title of File: "Corrected CAISO Hourly Results CEDU 2018-2022"
    - CAISO will be using column AR (Managed Total Energy for Load) but also analyzing column AN (Baseline Total Energy for Load) within the spreadsheet.
      - Managed Total Energy for Load = Baseline Consumption Load – Committed PV Generation – Additional achievable PV generation – AAEE – POU AAEE
      - Baseline Total Energy for Load= Baseline Consumption Load – Committed PV Generation

Example: Building 2020 1-Minute Load Profile









Hourly Load Forecast to 1 Minute Load Forecast

- Used 2018 actual 1-minute load data to build 1-minute load profiles for subsequent years
- Scaled the hourly CEC load forecast value of each hour into 1-minute forecast data using a smoothing equation looking at the differences between the forecasted year and the 2018 1-minute actuals.

2019 Load 1-Minute Forecast

- **2019 $L_{CECfcst\_1\text{-}min}$ = 2018 $L_{Act\_1\text{-}min}$ + X**
  - **Where X = Interpolated 1min profile from the difference**

    (2019 $L_{CECfcst\_hourly}$ - 2018 L_{actual_hourly})

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  - **Where X = Interpolated 1min profile from the difference**

    (2020 $L_{CECfcst\_hourly}$ - 2018 L_{actual_hourly})

*See Pg. 7 for more graphs showing steps to calculate **X**

Wind growth assumptions

- Use the actual 1-minute wind production data for the most recent year i.e. for 2020 wind forecast, use actual 1-minute data from 2018 (**$2018_{Act\_1\text{-}min}$**)
- Projects installed in 2018 would be modeled in 2019 for the months the projects were not yet in-service (e.g. projects installed in May 2018 would be included in January through April of 2018
- Scale 1-minute data using expected capacity for the new plants scheduled to be operational in 2019
- Repeat the above steps for 2020

$$\text{2019 } W_{Mth\_Sim\_1\text{-}min} = \text{2018 } W_{Act\_1\text{-}min} * \text{2019 } W_{Mth\ Capacity} / \text{2018 } W_{Mth\ Capacity}$$

$$\text{2020 } W_{Mth\_Sim\_1\text{-}min} = \text{2018 } W_{Act\_1\text{-}min} * \text{2020 } W_{Mth\ Capacity} / \text{2018 } W_{Mth\ Capacity}$$

Note: This approach maintains load/wind, load/solar and wind/solar correlations

Solar growth assumptions

Existing solar

- Use the actual solar 1-minute production data for the most recent year

  i.e. for 2019 forecast, use 2018 actual 1-minute data (**$2018_{Act\_1\text{-}min}$**)

New solar installation

- Develop 1-minute solar production profiles by scaling actual 2018 1-minute data by the expected monthly installed capacity in 2019 divided by the monthly installed capacity in 2018
- Projects installed in 2018 will be modeled in 2019 for the months the projects were not yet in-service in 2017

$$2019\ S_{Mth\_Sim\_1\text{-}min} = 2018\ S_{Act\_1\text{-}min} * 2019\ S_{Mth\ Capacity} / 2018\ S_{Mth\ Capacity}$$

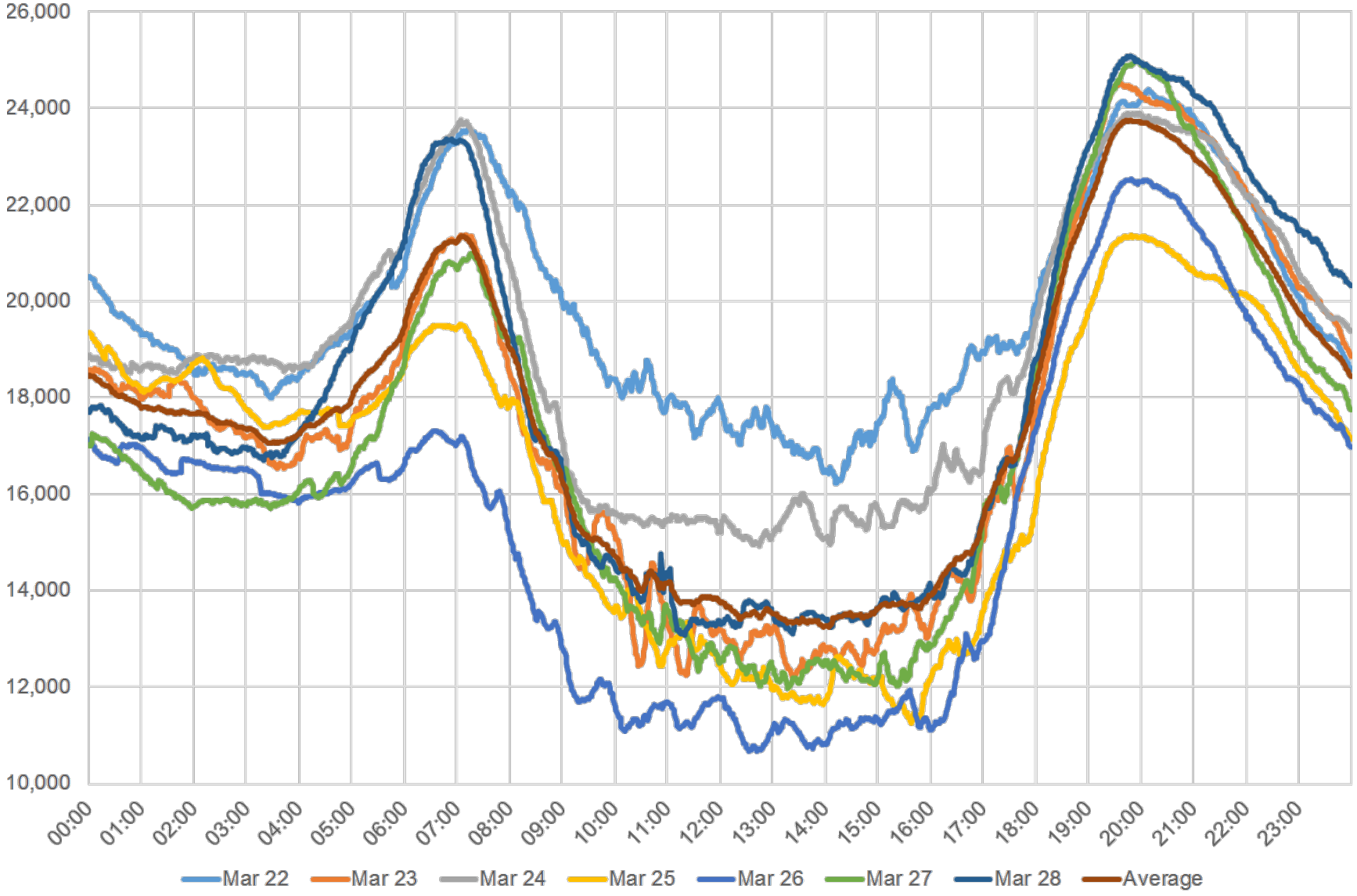
$$2020\ S_{Mth\_Sim\_1\text{-}min} = 2018\ S_{Act\_1\text{-}min} * 2020\ S_{Mth\ Capacity} / 2018\ S_{Mth\ Capacity}$$

Net-load is a NERC accepted metric[1] for evaluating additional flexibility needs to accommodate VERs

- Net-load is the aggregate of customer demand reduced by variable generation power output
- Net-load is more variable than load itself and it increases as VER production increases
- The monthly three-hour flexible capacity need equates to the largest expected up-ward change in net-load when looking across a rolling three-hour evaluation window
- The ISO dispatches flexible resources to meet net-load

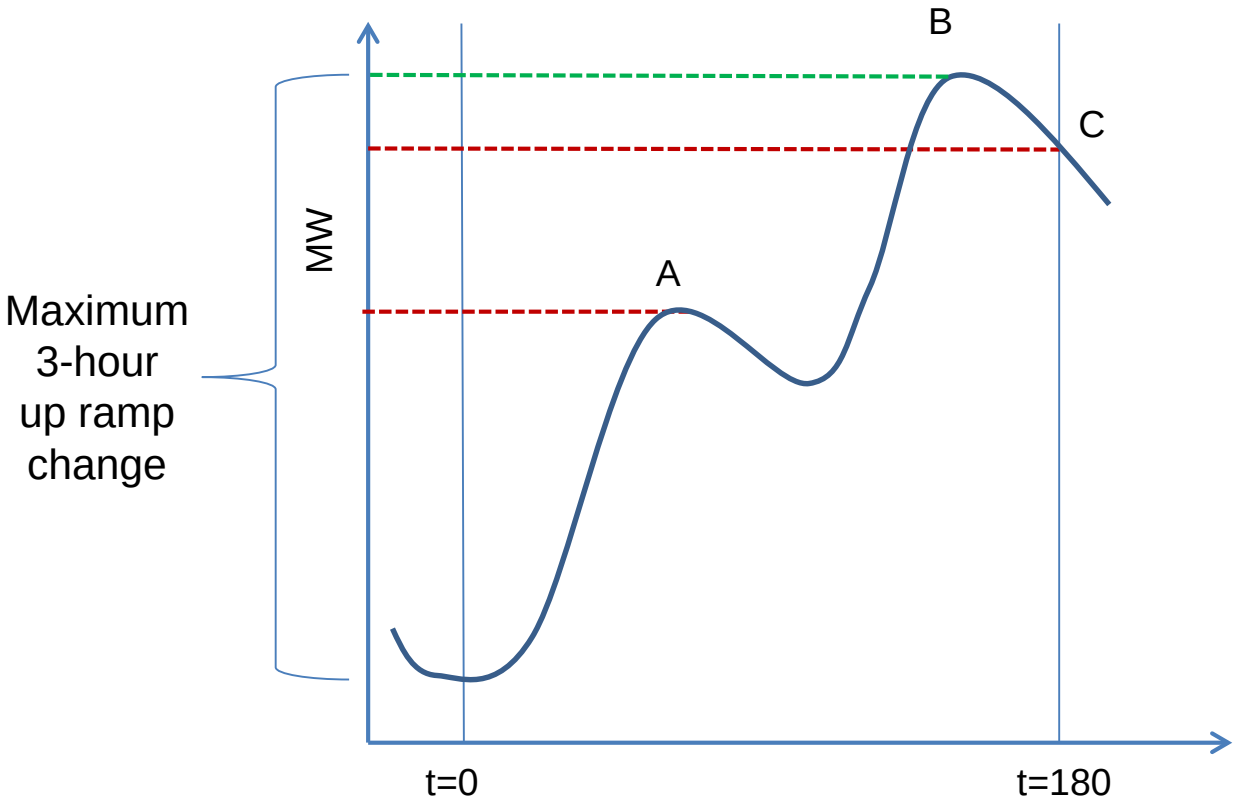
[1]NERC Special Report - Flexibility Report Requirements and metrics for Variable Generation: Implications for System Planning Studies, August 2010 . http://www.nerc.com/files/IVGTF_Task_1_4_Final.pdf

Example of net-load variability for one week in March 2017



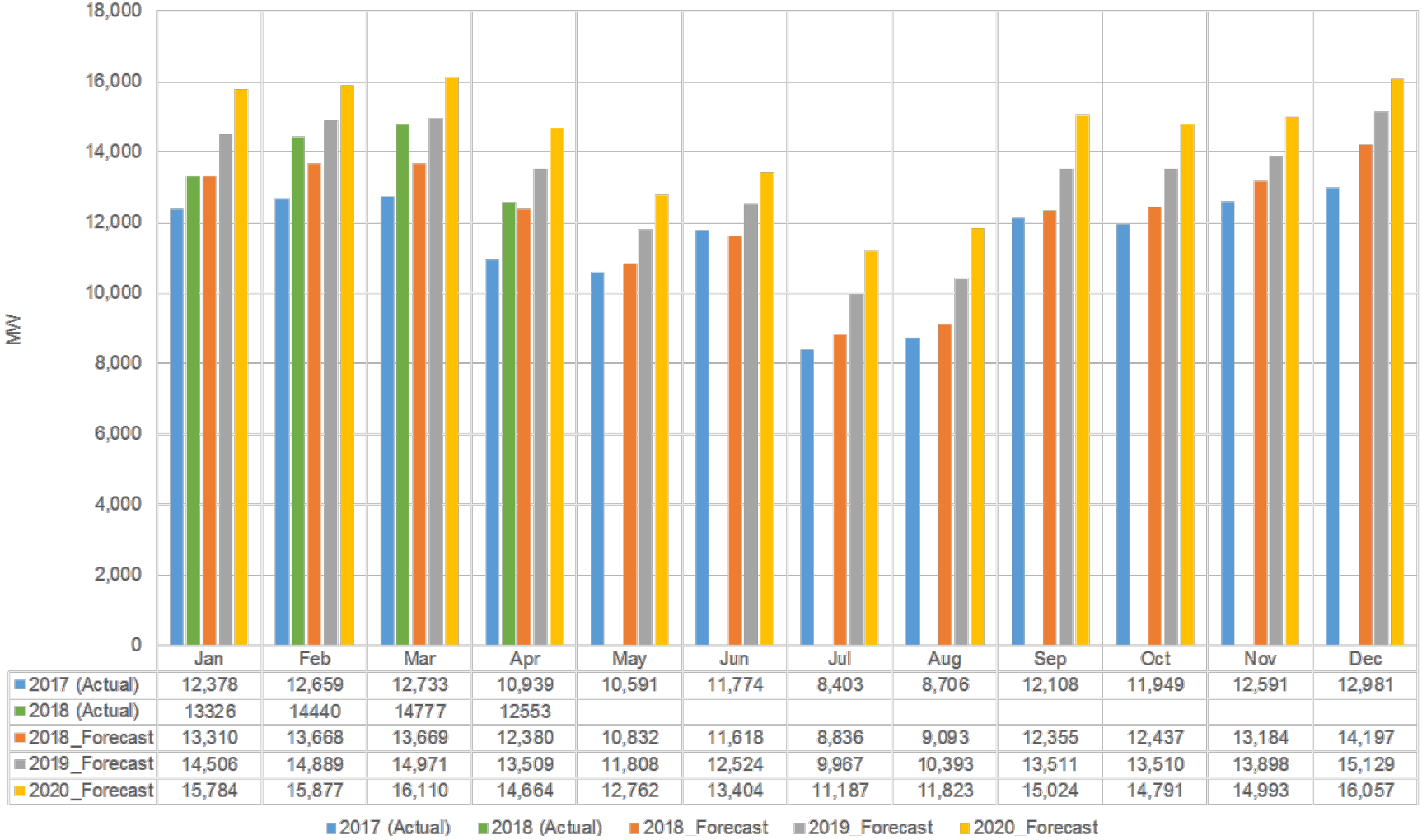
The monthly 3-hour ramping need is calculated using the largest ramp in each 180 minute period

- The maximum monthly three-hour net load ramp within a three-hour period is the highest MW value reached within any three-hour moving window
- The maximum net-load change in three-hours can occur in less than three hours



Upward Ramp = Determined by a 3-hour moving window

Expected 3-hour ramps increase through 2020 with build out of renewables and addition of behind-the-meter resources



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2017 (Actual)	12,378	12,659	12,733	10,939	10,591	11,774	8,403	8,706	12,108	11,949	12,591	12,981
2018 (Actual)	13326	14440	14777	12553								
2018_Forecast	13,310	13,668	13,669	12,380	10,832	11,618	8,836	9,093	12,355	12,437	13,184	14,197
2019_Forecast	14,506	14,889	14,971	13,509	11,808	12,524	9,967	10,393	13,511	13,510	13,898	15,129
2020_Forecast	15,784	15,877	16,110	14,664	12,762	13,404	11,187	11,823	15,024	14,791	14,993	16,057

2017 (Actual) 2018 (Actual) 2018_Forecast 2019_Forecast 2020_Forecast

Contingency reserves is a NERC/WECC requirement all BAs must have available in real-time

- Each Balancing Authority and each Reserve Sharing Group shall maintain a minimum amount of Contingency Reserve, except within the first sixty minutes following an event requiring the activation of Contingency Reserve.
- To meet WECC and NERC reliability criteria, the ISO must have contingency reserves.
- Contingencies can occur during the three hour ramps and the ISO must be prepared to dispatch contingency reserve to recover its Area Control Error (ACE) within 15-minutes following a disturbance.
- Contingency reserves are held for contingency events and cannot be dispatched to meet day-to-day net-load ramps.

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The proposed interim flexible capacity methodology should provide the ISO with sufficient flexible capacity

Methodology

Flexible $Req_{MTHy} = Max[(3RR_{HRx})_{MTHy}] + Max(MSSC, 3.5\%*E(PL_{MTHy})) + \varepsilon$

Where:

$Max[(3RR_{HRx})_{MTHy}]$ = Largest three hour contiguous ramp starting in hour x for month y

E(PL) = Expected peak load

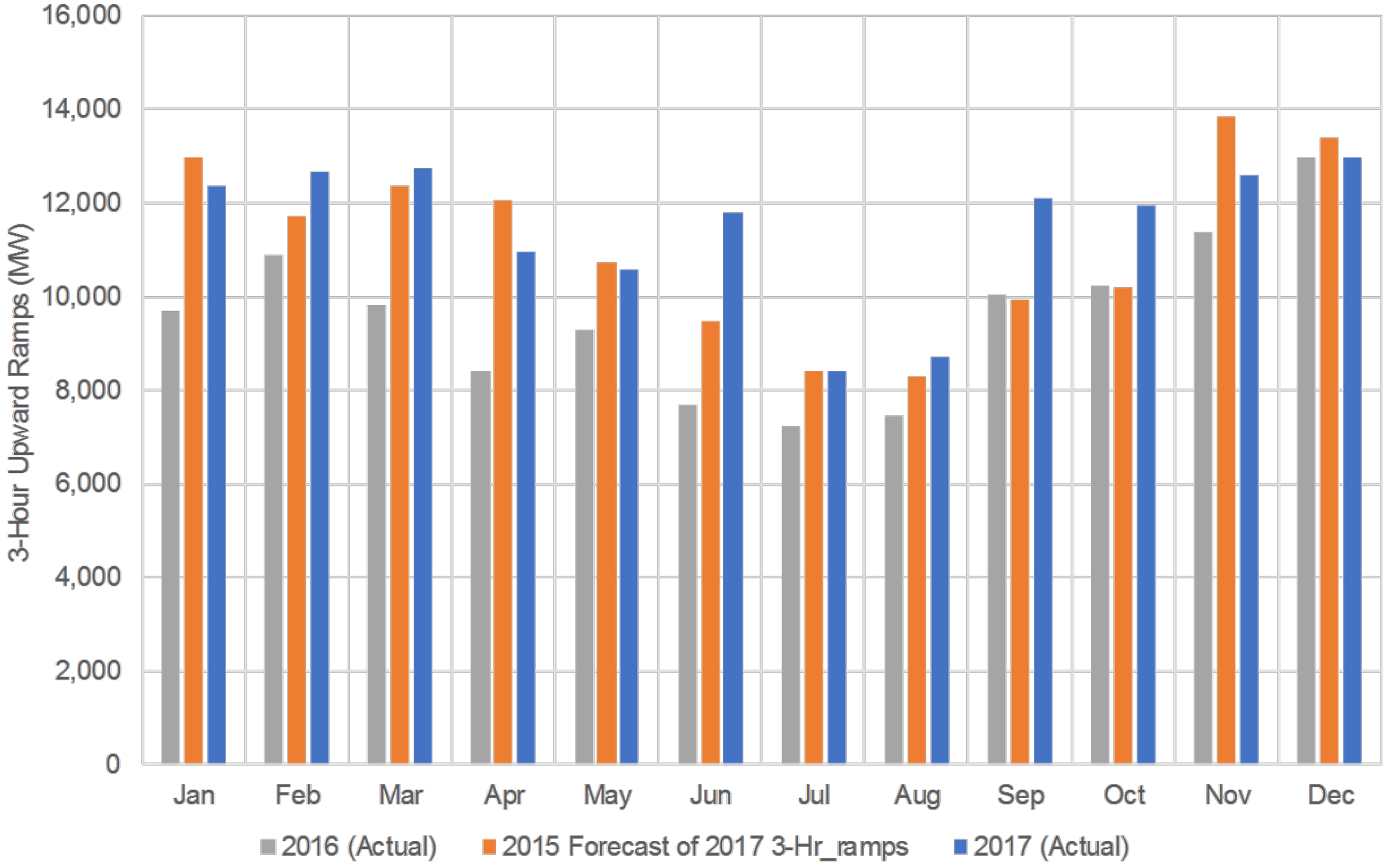
MTH_y = Month $_y$

MSSC = Most Severe Single Contingency

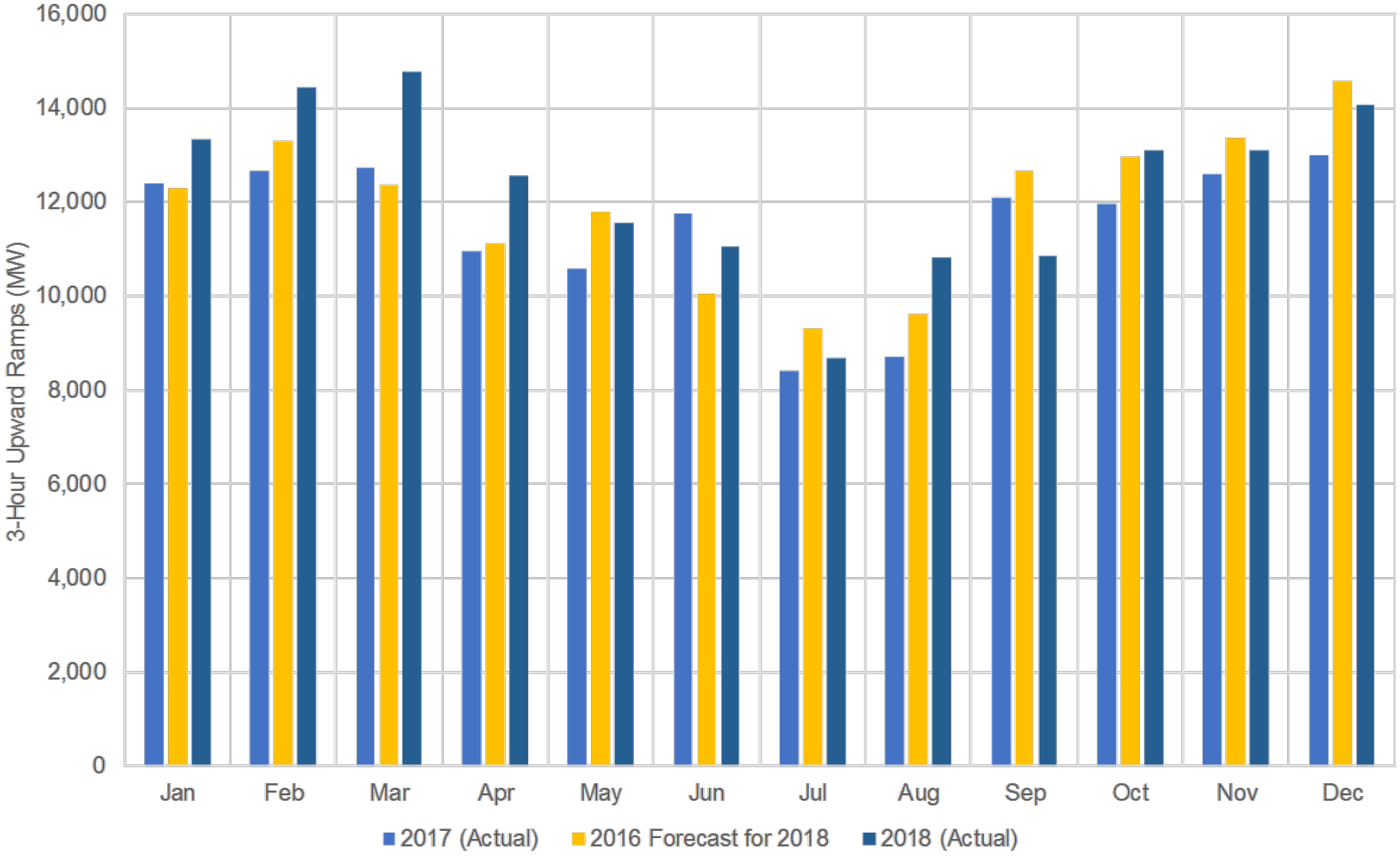
ε = Annually adjustable error term to account for load forecast errors and variability. ε is currently set at zero

For next year the CAISO will work towards changing the Flex RA standard to be reflective of the current WECC/NERC reliability requirements.

2015 forecast of 2017 3-hour upward ramps vs. actual 2017 3-hour upward ramps



2016 forecast of 2018 3-hour upward ramps vs. actual 2018 3-hour upward ramps



What data does the ISO need?

- CEC's IEPR demand forecast (e.g. 2019 – 2022 demand forecast)
- LSE SCs to update renewable build-out for 2018 through 2022 by CREZ by January 15, 2019 (Beyond 2022 if data is available)
- The data should include:
  - Installed capacity by technology and expected operating date (e.g. Solar thermal, solar PV tracking, solar PV non-tracking, estimate of behind-the-meter solar PV etc.) for all variable energy resources under contract
  - Operational date or expected on-line date
  - Location of CREZ preferably latitude and longitude coordinates
  - Interconnecting substation or closes substation or switching station
  - Resources located outside ISO's BAA must indicate if the resources are dynamically scheduled or not
- The majority of LSE SCs have already provided this data
  - LSE SCs must submit data for all LSE for which they are the SC
  - ISO is in the process of reviewing the submittal

ANNUAL REVIEW OF AVAILABILITY ASSESSMENT HOURS

Methodology Overview of System/Local Availability Assessment Hours

- Used data described in previous slides to obtain:
  - Hourly Average Load
    - By Hour
    - By Month
    - Years 2017-2021
- Calculated:
  - Top 5% of Load Hours within each month using an hourly load distribution
  - Years 2017 through 2021

Already Occurred Flex RA Key Timeline Information

- ISO published a market notice for data in December 2018 and January 2019
- CEC Hourly IEPR Forecast was finalized and published on January 7, 2019
- LSE Survey Data was due on January 15, 2019

Next Steps

- ISO Flex RA methodology and criteria stakeholder call on January 29, 2019
- Stakeholder Comments on Flex RA methodology, criteria and data used for 2020 flexible requirements due by February 12, 2019.
- Finalize methodology, criteria, and assumptions for 2020 flexible requirements by February 15, 2019.
- Publish preliminary flexible capacity and AAH requirements for 2020, 2021 & 2022 in early April 2019.
- Stakeholder call on preliminary flexible capacity and AAH requirements for 2020, 2021, and 2022 on April 4, 2019.
- Stakeholder comments on preliminary requirements due on April 15, 2019
- Issue final Flexible Capacity and AAH requirements for 2020 and projected requirements for 2021 & 2022 by May 1, 2019

Questions?

Please submit comments on the assumptions to

initiativecomments@caiso.com

by February 12th, 2019

Thank you for your participation.