Flexible Capacity Requirements for 2021 through 2023

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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 2021 and advisory flexible capacity requirements for compliance years 2022 and 2023
- 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
  - Expected monthly maximum contingency reserve requirements
  - Calculate monthly Flexible Capacity requirement
  - 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 monthly 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 2019 actual production data based on the expected installed capacity in subsequent years
- Generate net-load profiles for 2021 through 2023
  - Generate load profiles for 2021 through 2023
  - Generate solar profiles for 2021 through 2023
  - Generate wind profiles for 2021 through 2023
- CAISO will look into impacts of curtailments when running draft requirement values

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

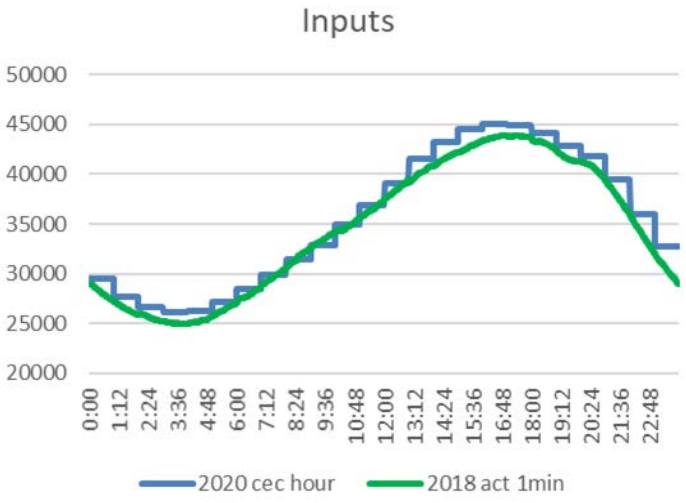
- ISO uses 1-in-2 IEPR forecast; the IEPR forecast has both an hourly view and a monthly view.
  - The forecast is correlated such that the peak of the month can be seen in the hourly profile.

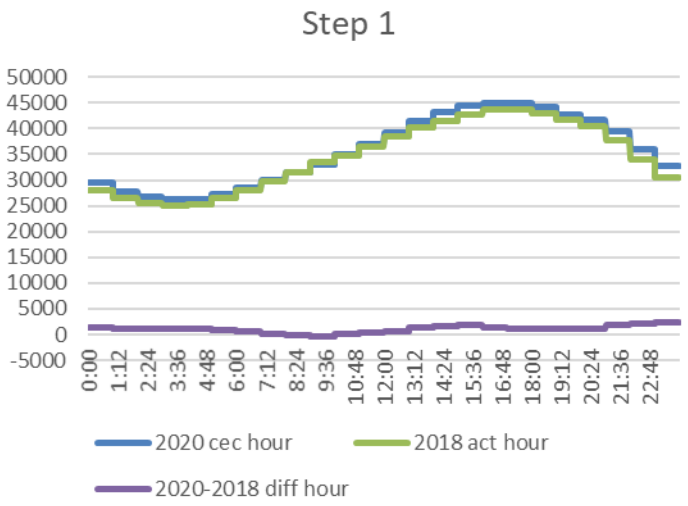
- CEC IEPR Load Forecast
  - https://ww2.energy.ca.gov/2019_energypolicy/documents/Demand_2020-2030_revised_forecast_hourly.php

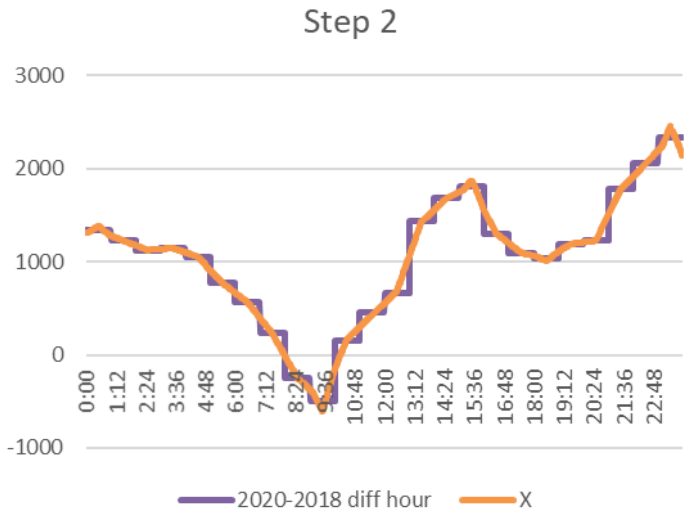
The ISO will use the CEC's 1-in-2 IEPR forecast to develop the load forecast

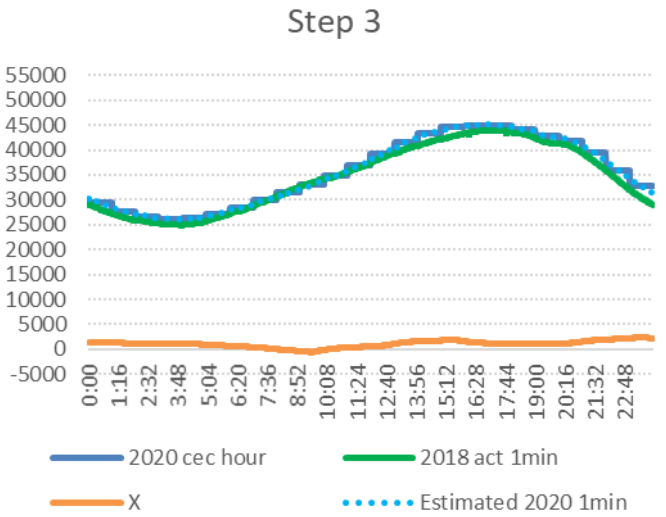
- CEC IEPR Load Forecast
  - https://ww2.energy.ca.gov/2019_energypolicy/documents/Demand_2020-2030_revised_forecast_hourly.php
  - Title of File: "CED 2019 Hourly Results - CAISO - MID-MID"
    - CAISO will be using Managed Net Load (column S) within the spreadsheet
      - **Managed Net Load (col S)** = Baseline Net Load (col R)
        - AAEE (col Q)
      - Baseline Net Load (col R) = Baseline Consumption (col M)
        - BTM PV (col N)
        - BTM Storage Res (col O)
        - BTM Storage NonRes (col P)
      - Baseline Consumption (col M) = unadjusted consumption (col E)
        + Pumping (col F)
        + climate change (col H)
        + light duty EV (col I)
        + mdhd EV (col J)
        + TOU impacts (col K)
        + other adjustments (col L)

Example: Building a1-Minute Load Profile









Hourly Load Forecast to 1 Minute Load Forecast

- Used 2019 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 2019 1-minute actuals.

2020 Load 1-Minute Forecast

- **2020 $L_{CECfcst\_1\text{-}min}$ = 2019 $L_{Act\_1\text{-}min}$ + X**
  - **Where X = Interpolated 1min profile from the difference**

    (2020 $L_{CECfcst\_hourly}$ - 2019 L_{actual_hourly})

2021 Load 1-Minute Forecast

- **2021 $L_{CECfcst\_1\text{-}min}$ = 2019 $L_{Act\_1\text{-}min}$ + X**
  - **Where X = Interpolated 1min profile from the difference**

    (2021 $L_{CECfcst\_hourly}$ - 2019 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 2019 (**$2019_{Act\_1\text{-}min}$**)
- Projects installed in 2019 would be modeled in 2020 for the months the projects were not yet in-service (e.g. projects installed in May 2019 would be included in January through April of 2019)
- Scale 1-minute data using expected capacity for the new plants scheduled to be operational in 2020
- Repeat the above steps for 2021

$$2020\ W_{Mth\_Sim\_1\text{-}min} = 2019\ W_{Act\_1\text{-}min} * 2020\ W_{Mth\ Capacity} / 2019\ W_{Mth\ Capacity}$$

$$2021\ W_{Mth\_Sim\_1\text{-}min} = 2019\ W_{Act\_1\text{-}min} * 2021\ W_{Mth\ Capacity} / 2019\ W_{Mth\ Capacity}$$

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 2020 forecast, use 2019 actual 1-minute data (**$2019_{Act\_1\text{-}min}$**)

New solar installation

- Develop 1-minute solar production profiles by scaling actual 2019 1-minute data by the expected monthly installed capacity in 2020 divided by the monthly installed capacity in 2019
- Projects installed in 2019 will be modeled in 2020 for the months the projects were not yet in-service in 2019

$$2020\ S_{Mth\_Sim\_1\text{-}min} = 2019\ S_{Act\_1\text{-}min} * 2020\ S_{Mth\ Capacity} / 2019\ S_{Mth\ Capacity}$$

$$2021\ S_{Mth\_Sim\_1\text{-}min} = 2019\ S_{Act\_1\text{-}min} * 2021\ S_{Mth\ Capacity} / 2019\ S_{Mth\ Capacity}$$

$$2022\ S_{Mth\_Sim\_1\text{-}min} = 2019\ S_{Act\_1\text{-}min} * 2022\ S_{Mth\ Capacity} / 2019\ S_{Mth\ Capacity}$$

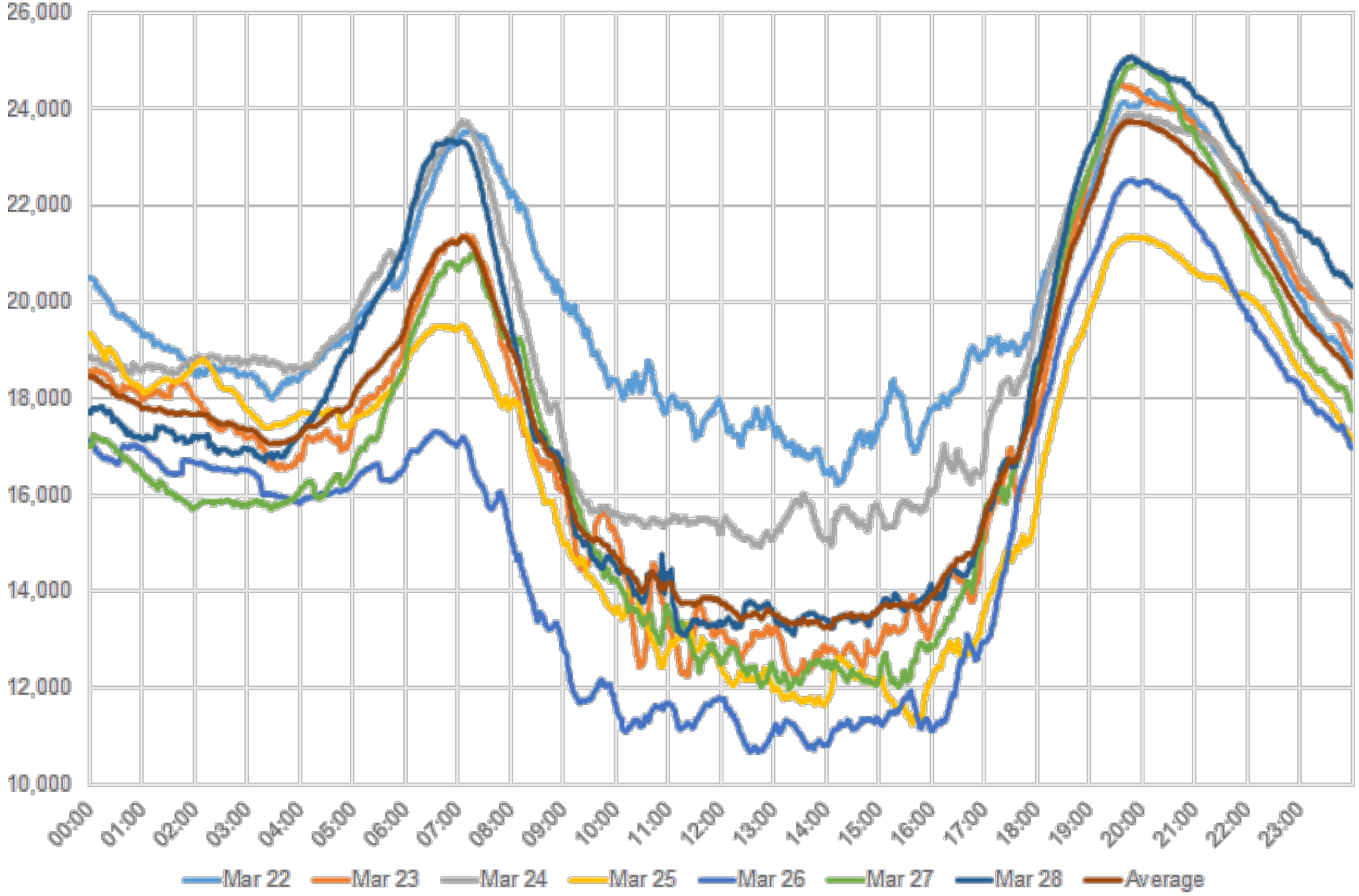
$$2023\ S_{Mth\_Sim\_1\text{-}min} = 2019\ S_{Act\_1\text{-}min} * 2023\ S_{Mth\ Capacity} / 2019\ S_{Mth\ Capacity}$$

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

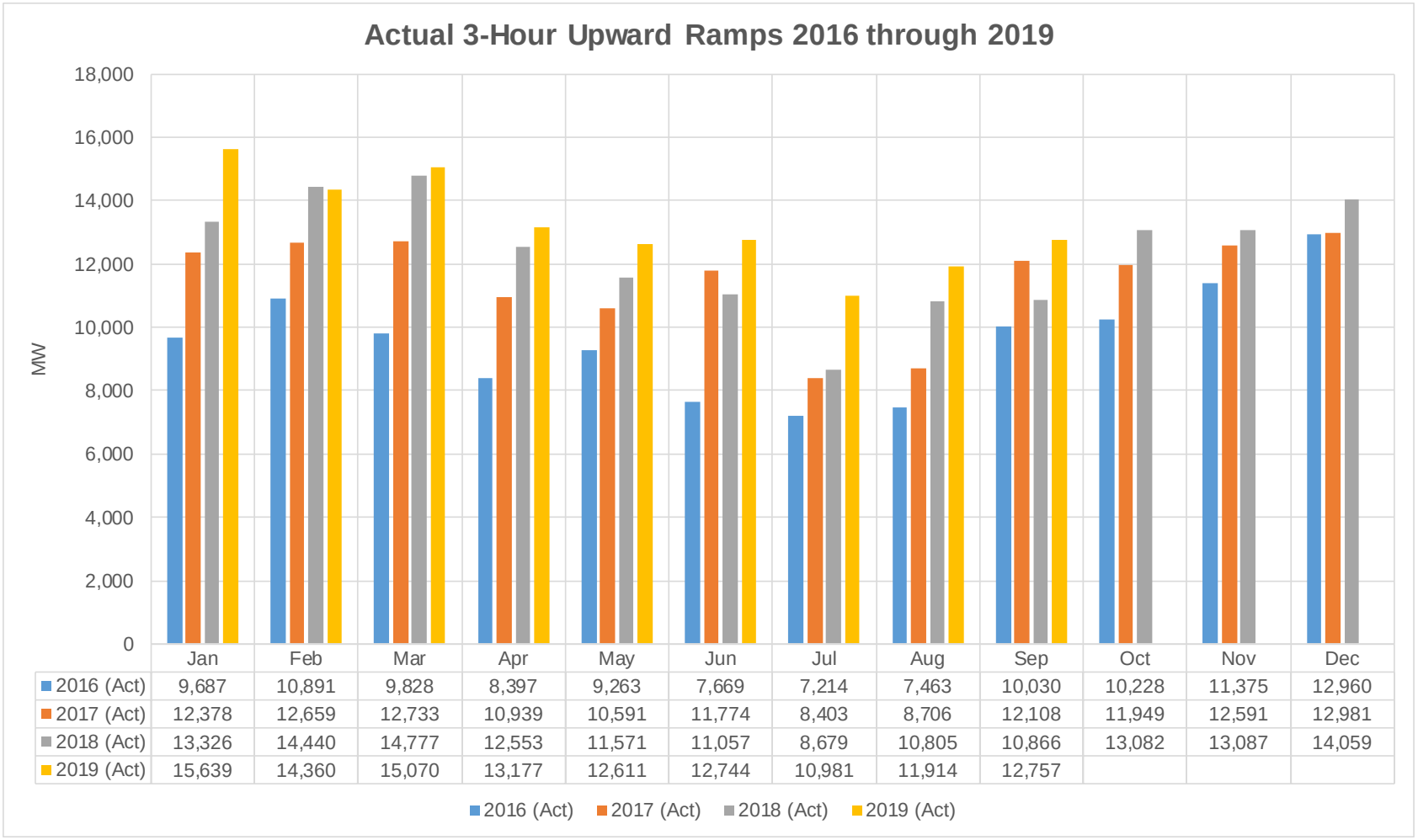
- Net-load is the aggregate of customer demand reduced by variable generation power output
- Net-load is more variable than load itself and it increases as VER production increases
- The monthly three-hour flexible capacity need equates to the largest expected up-ward change in net-load when looking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



Monthly 3-hour ramps typically increases with the build out of renewables and addition of behind-the-meter resources



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2016 (Act)	9,687	10,891	9,828	8,397	9,263	7,669	7,214	7,463	10,030	10,228	11,375	12,960
2017 (Act)	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 (Act)	13,326	14,440	14,777	12,553	11,571	11,057	8,679	10,805	10,866	13,082	13,087	14,059
2019 (Act)	15,639	14,360	15,070	13,177	12,611	12,744	10,981	11,914	12,757			

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%*$E(PL_{MTHy})$) + ε

Where:

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

E(PL) = Expected peak load

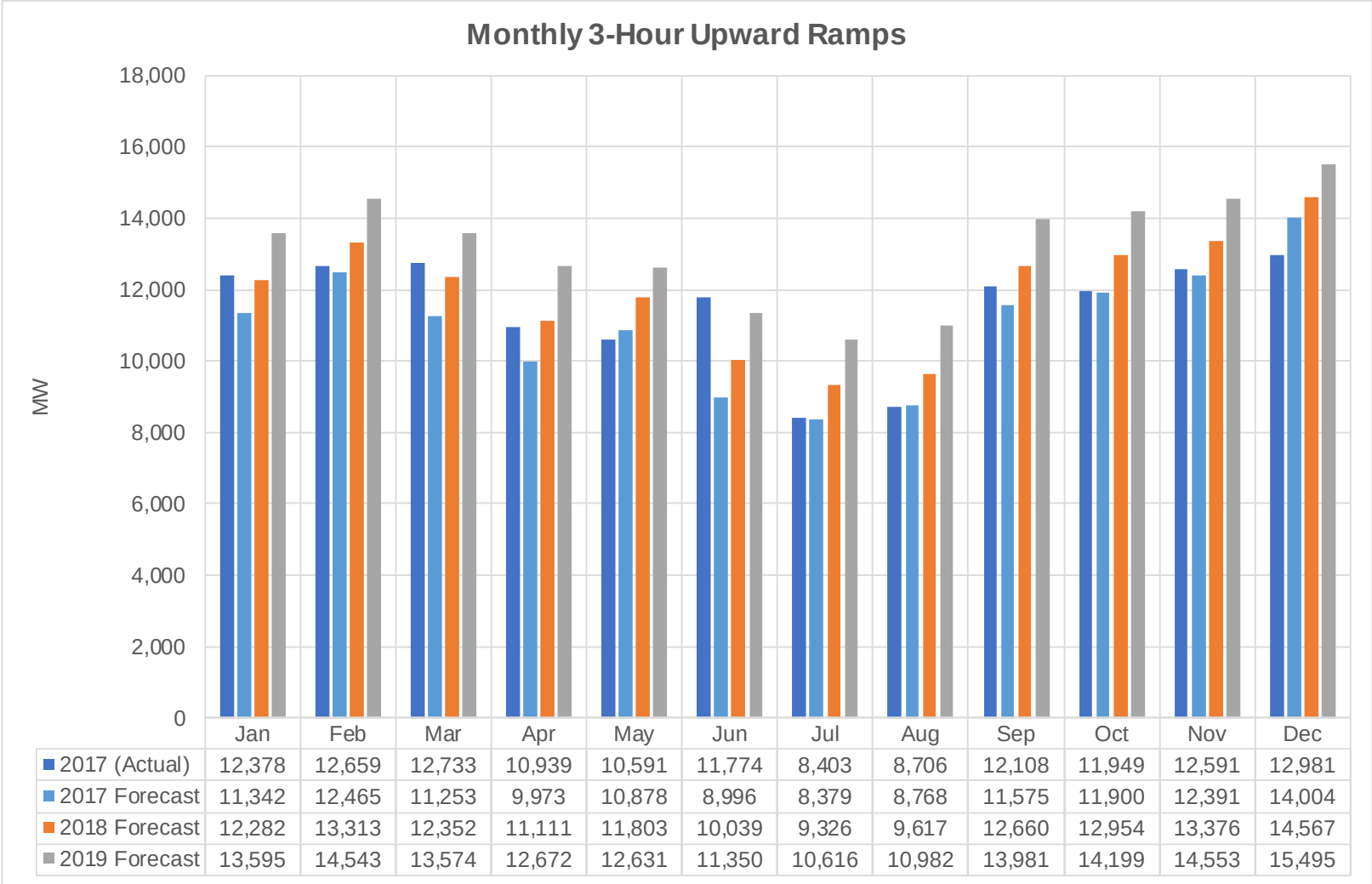
MTH_y = Month $_y$

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.

2017 forecast (using 2016 data) of 3-hour ramps for 2017, 2018 & 2019



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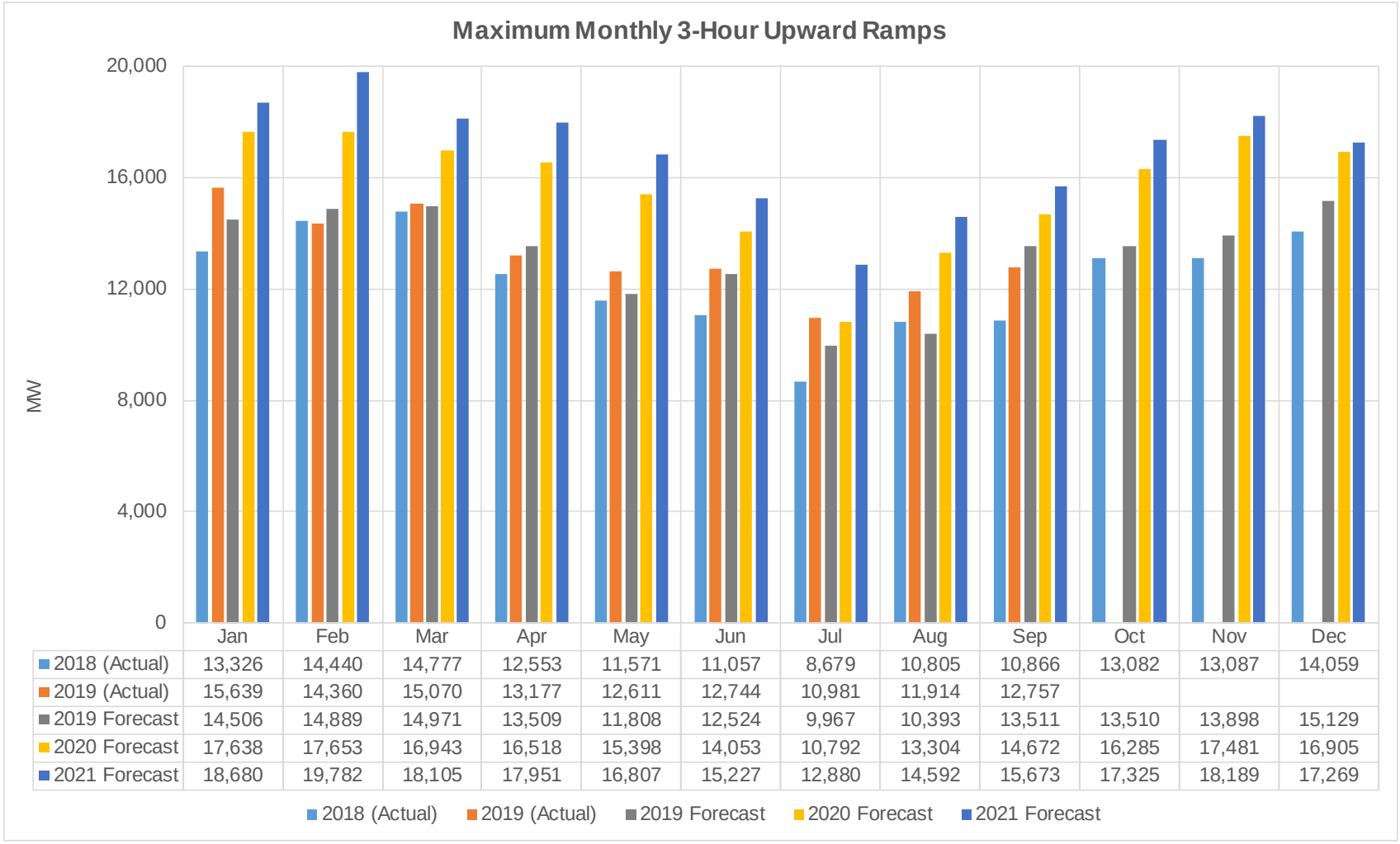
2017 (Actual)	12,378	12,659	12,733	10,939	10,591	11,774	8,403	8,706	12,108	11,949	12,591	12,981
2017 Forecast	11,342	12,465	11,253	9,973	10,878	8,996	8,379	8,768	11,575	11,900	12,391	14,004
2018 Forecast	12,282	13,313	12,352	11,111	11,803	10,039	9,326	9,617	12,660	12,954	13,376	14,567
2019 Forecast	13,595	14,543	13,574	12,672	12,631	11,350	10,616	10,982	13,981	14,199	14,553	15,495

2019 forecast (using 2018 data) of 3-hour ramps for 2019, 2020 & 2021



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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	17,638	17,653	16,943	16,518	15,398	14,053	10,792	13,304	14,672	16,285	17,481	16,905
2021 Forecast	18,680	19,782	18,105	17,951	16,807	15,227	12,880	14,592	15,673	17,325	18,189	17,269

What data does the ISO need?

- CEC's IEPR demand forecast (e.g. 2020 – 2023 demand forecast)
- LSE SCs to update renewable build-out for 2019 through 2023 by CREZ by January 15, 2020 (Beyond 2023 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, hybrid, co-located, etc.) for all variable energy resources under contract
  - Operational date or expected on-line date
  - 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 CEC IEPR data described in previous slides to obtain:
  - Hourly Average Load
    - By Hour
    - By Month
    - Years 2019-2023
- Calculated:
  - Top 5% of Load Hours within each month using an hourly load distribution
  - Years 2021 - 2023

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 16, 2020
- LSE Survey Data was due on January 15, 2020

Next Steps

- ISO Flex RA methodology and criteria stakeholder call on January 28, 2020
- Stakeholder Comments on Flex RA methodology, criteria and data used for 2021 flexible requirements due by February 11, 2020.
- Publish preliminary flexible capacity and AAH requirements for 2021, 2022 & 2023 in early April 2020.
- Stakeholder call on preliminary flexible capacity and AAH requirements for 2021, 2022, and 2023 on March 31, 2020.
- Stakeholder comments on preliminary requirements due on April 14, 2020
- Issue final Flexible Capacity and AAH requirements for 2021 and projected requirements for 2022 & 2023 by May 1, 2020

We are evaluating our Flex RA schedule based on delay of CEC IEPR forecast publication. At this time, we are expecting a two week delay. The above information is subject to change accordingly

Questions?

Please submit comments on the assumptions to initiativecomments@caiso.com by February 11th, 2020

Thank you for your participation.