Day 1 of Track 3.B.2 Workshops

Monday, February 8, 2021

9:30 a.m. – 4:30 p.m.

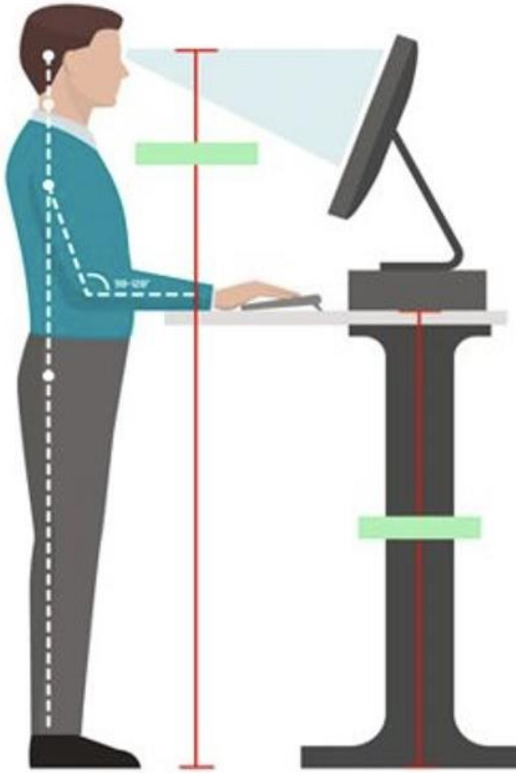
California Public
Utilities Commission

Logistics

- Online and will be recorded

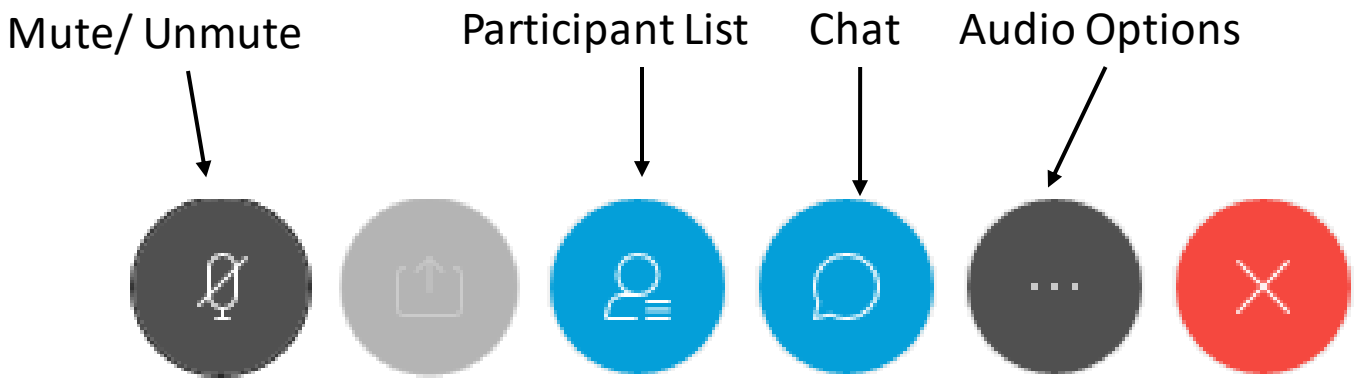
- Today's presentation & recording will be uploaded onto RA history website
  - https://www.cpuc.ca.gov/General.aspx?id=6316

- Hosts (Energy Division Staff)
  - Jaime Rose Gannon
  - Linnan Cao
- Safety
  - Note surroundings and emergency exits
  - Ergonomic check

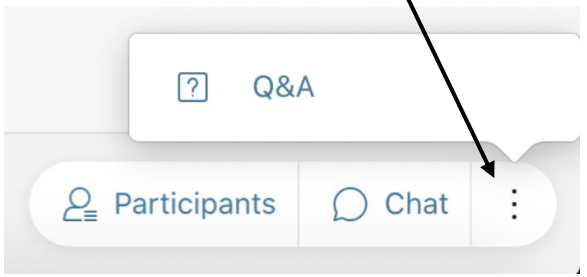


Logistics

- All attendees have been muted
- Presenters for each topic will be identified as panelists only when their topic is being addressed
- To ask questions, please use the "Q&A" function (send "To All Panelists") or raise your hand
- Questions will be read aloud by staff; attendees may be unmuted to respond to the answer. (Reminder: Mute back!)



"Q&A": on the bottom right of screen, click "3 dots"



Ground Rules

- Workshop is structured to stimulate an honest dialogue and engage different perspectives.
- Keep comments friendly and respectful.
- Please use Q&A feature only for questions, or technical issues.
- Do NOT start or respond to sidebar conversations in the Chat.

Agenda Day 1

Time	Day 1 - Monday Workshop Topics	Presenters/Time Duration
9:30-9:40 a.m.	Introduction & Safety	Energy Division, 10 min
9:40-11	Gridworks Report "Resource Adequacy: Reliability Through the Clean Energy Transition"	Arthur Haubenstock, Gridworks, 80 min
11-12 p.m.	PG&E Contract Hedge Proposal	Peter Griffes, PG&E, 60 min
12-1	Lunch	
1-1:30	PG&E "Slice of Day" Proposal Introduction	Peter Griffes, PG&E, 30 min
1:30-2:20	Determining Seasons and Slices	Luke Nickerman, PG&E, 50 min
2:20-2:30	Stretch Break	
2:30-3:10	Resource Counting	Peter Griffes, PG&E, 40 min
3:10-3:30	Need Determination and Allocation	Luke Nickerman, PG&E, 20 min
3:30-4	Must Offer Obligation	Peter Griffes, PG&E, 30 min
4-4:30	Q&A	

Agenda Day 2

Time	Day 2 - Tuesday Workshop Topics	Presenters/Time Duration
9:30-9:45 a.m.	Introduction & Safety	Energy Division, 15 min
9:45-10:15	SCE/CalCCA Proposal Mechanics Review + Q&A	Eric Little, 30 min
10:15-10:30	How Should the Commission Evaluate and Compare Proposals? + Q&A	Evelyn Kahl, 15 min
10:30-10:40	Is the Proposal Compatible with Federal & State Law? + Q&A	Evelyn Kahl, 10 min
10:40-10:50	Stretch Break	
10:50-12 p.m.	Will the Proposal Improve Reliability? + Q&A	Eric Little + Stakeholder Panel, 70 min
12-1	Lunch	
1-2	Is the Proposal Compatible with Existing Policy & Programs? + Q&A	Nick Pappas + Stakeholder Panel, 60 min
2-2:30	What Other Implementation Issues Require Consideration? + Q&A	Eric Little + Nick Pappas, 30 min
2:30-3	Can the Proposal Be Implemented Timely with Minimum Market Disruption? + Q&A	Eric Little + Stephanie Tanenhaus, 30 min
3-3:15	Does the Proposal Provide Wholesale Energy Price Mitigation? + Q&A	Eric Little + Nick Pappas, 15 min
3:15-4:30	Catch Up & Wrap Up	

Agenda Day 3

Time	Day 3 - Wednesday Workshop Topics	Presenters/Time Duration
9:30-9:40 a.m.	Introduction & Safety	Energy Division, 10 min
9:40-11:20	Frank Wolak Presentation on Q&A Document	Frank Wolak, 1 hour 40 min
11:20-11:30	Stretch Break	
11:30-12 p.m.	Energy Division Bid Cap Proposal	Michele Kito, 30 min
12-1	Lunch	
1-2	CAISO UCAP Proposal	CAISO, 60 min

Track 3B.2 - December 11, 2020 revised Scoping Memo

- The scope of Track 3B.2 includes the following issues:

1. Examination of the broader RA capacity structure to address energy attributes and hourly capacity requirements, given the increasing penetration of use limited resources, greater reliance on preferred resources, rolling off of a significant amount of long-term tolling contracts held by utilities, and material increases in energy and capacity prices experienced in California over the past years.
   a) Specifically, address the direction the Commission intends to move in with respect to larger structural changes (e.g., capacity construct addressing energy attributes and reliance on resource use-limitations forward energy requirement construct). Set forth the necessary milestones and additional details that must be determined in order to implement the adopted direction for a compliance year no earlier than 2023.

Track 3B.2 Calendar

TRACK 3B.2 CALENDAR	
Event	**Date**
Revised Track 3B.2 proposals due*	December 18, 2020
Comments on Track 3B.2 proposals	January 15, 2021
Workshop on revised Track 3B.2 proposals	Early - mid February 2021
Second revised Track 3B.2 proposals due	February 26, 2021
Comments on Track 3B.2 proposals	March 12, 2021
Reply comments on Track 3B.2 proposals	March 23, 2021
Proposed Decision on Track 3B.2	May 2021

Gridworks Report "Resource Adequacy: Reliability Through the Clean Energy Transition"

9:40 - 11:00 a.m.

Arthur Haubenstock, Senior Fellow, Gridworks

GRIDWORKS

Resource Adequacy: Reliability Through the Clean Energy Transition

CPUC RA Workshop: Feb. 8, 2021

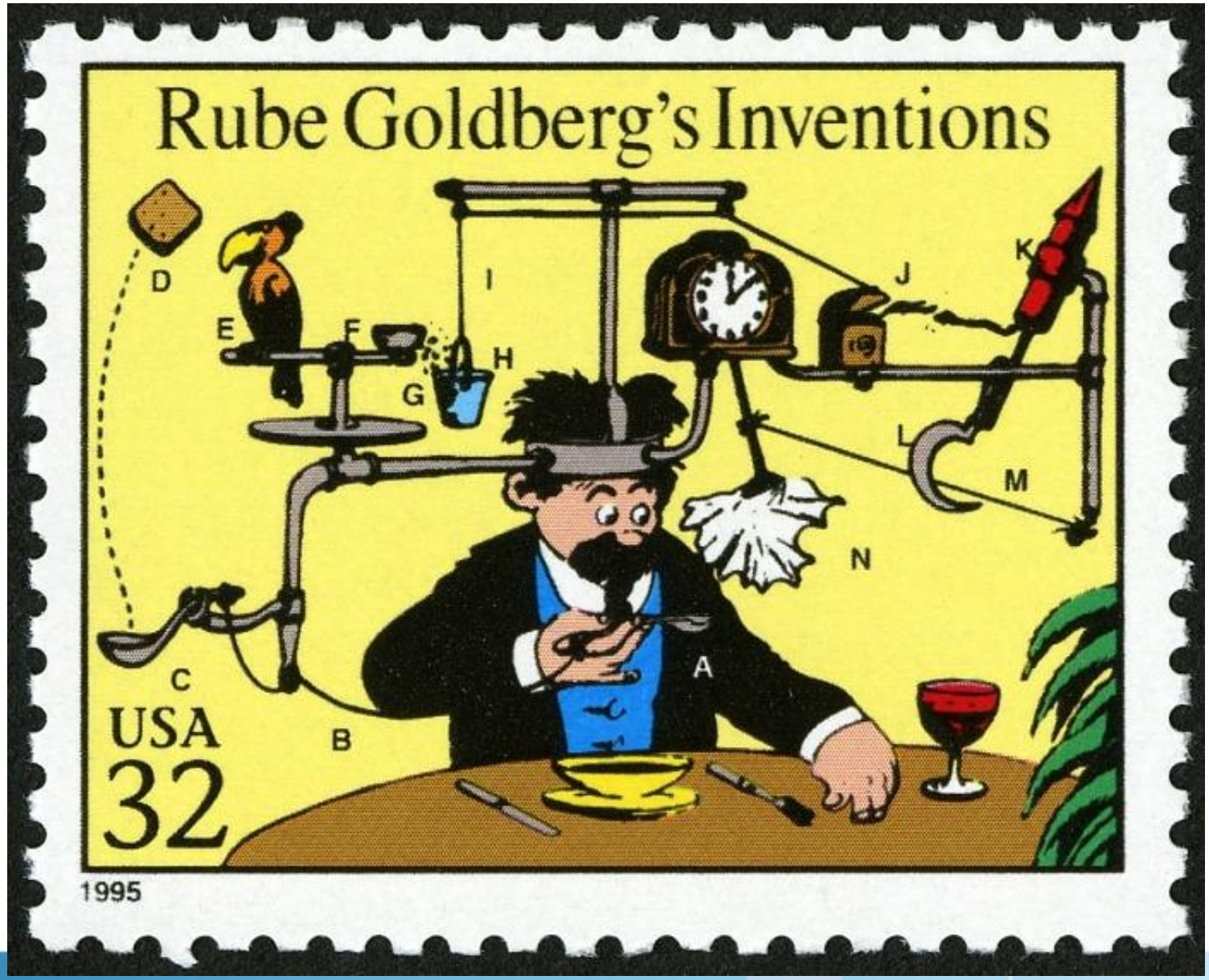
The decarbonization of our economy is within reach, and more important than ever.

Gridworks convenes, educates, and empowers stakeholders working to build a healthier and more equitable, sustainable and affordable future for all through decarbonization.

We facilitate difficult discussions and collaboration to determine the best approach to meet decarbonization goals

- Engage policymakers, advocates, energy providers and utilities
- Create a collaborative environment
- Build consensus to enable policy action

GRIDWORKS



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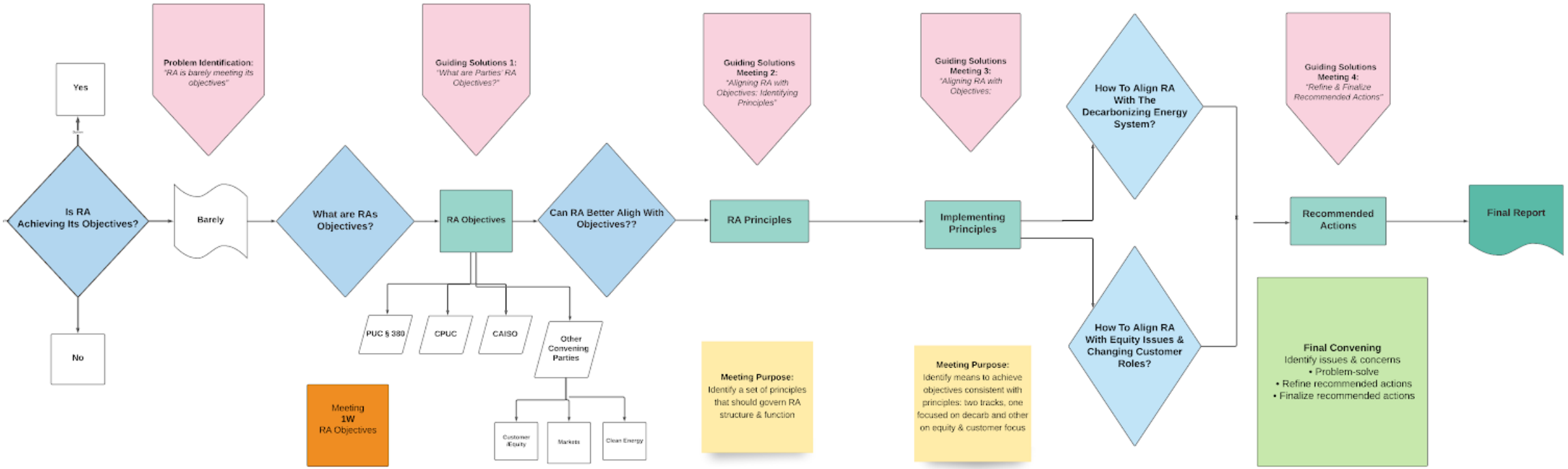
Approach


Yes
No
Is RA Achieving Its Objectives?
Problem Identification: "RA is barely meeting its objectives"
Barely
What are RAs Objectives?
Guiding Solutions 1: "What are Parties' RA Objectives?"
RA Objectives
PUC § 380
CPUC
CAISO
Other Convening Parties
Customer /Equity
Markets
Clean Energy
Meeting 1W RA Objectives
Can RA Better Aligh With Objectives??
Guiding Solutions Meeting 2: "Aligning RA with Objectives: Identifying Principles"
RA Principles
Meeting Purpose: Identify a set of principles that should govern RA structure & function
Guiding Solutions Meeting 3: "Aligning RA with Objectives:
Implementing Principles
Meeting Purpose: Identify means to achieve objectives consistent with principles: two tracks, one focused on decarb and other on equity & customer focus
How To Align RA With The Decarbonizing Energy System?
How To Align RA With Equity Issues & Changing Customer Roles?
Guiding Solutions Meeting 4: "Refine & Finalize Recommended Actions"
Recommended Actions
Final Convening
Identify issues & concerns
• Problem-solve
• Refine recommended actions
• Finalize recommended actions
Final Report

- Observations on Today's RA Program
- Objectives for RA Reform
- Principles for the Future RA Program
- Criteria to Evaluate Reform Proposals

Reforming Resource Adequacy

- The Current RA Paradigm is at Best "Barely Working" – And at Worst "Isn't Doing Its Primary Job." Why?
- What the August 2020 Event & Reactions Tell Us About Resource Adequacy's Inadequacies
- Reliability - But Not in Every Sense of the Word

Customer/Equity
Clean Energy
Markets

Air quality and community resilience, including microgrids and other systems in the disadvantaged communities
Ensuring RA prioritizes community health improvements in low-income, communities of color currently overburdened.
Facilitate away from natural gas plants, prioritizing equity communities
Framework that takes the customer perspective on reliability, recognize that climate disruption will account for most significant power outages (less so than capacity shortfall), and fully incorporate DERs and microgrids into concept of "adequacy."

Acceleration of procurement for RA and GHG reductions in a coordinated fashion.
Align RA objectives with pollution reduction and community energy access and resilience goals and incentives
Counting rules for disparate resources, including valuing reliability contributions
Fair, reasonable accurate rating for BTM and utility-scale solar
Immediate incremental changes (including on DERs) with an eye towards more substantive changes to meet objectives of decarbonization, equity, resilience.
Progress on new resource (DERs and utility scale hybrids) contribution to RA
Reliability into next phase of decarbonization (net peak, energy sufficiency, renewable / storage integration)
Supporting addition of storage portfolios to the RA fleet & to meet system needs

Better integrate RA and integrated resource planning processes, rationally assigns procurement for both objectives, and ensure development of robust backstop mechanism.
Framework design recognizing Long-term (IRP) and short-term reliability (RA) solutions with affordability and complexity in mind
How incentives in RA align with energy market incentives
RA requirements sufficient to ensure reliability
RA targets that account for all system stress conditions and allow for the optimal resource portfolio to meet those conditions
Rational policy on imports
Recognize needs of and planning for the grid recognize changes in resources and demand
Better integrate RA and integrated resource planning processes, rationally assigns procurement for both objectives, and ensure development of robust backstop mechanism.

ESIG Principles
1: Load participation fundamentally changes the resource adequacy construct.
2: Modeling chronological operations across many years is essential.
3: Quantifying size, frequency, and duration of capacity shortfalls is critical to finding the right resource solutions.
4: There is no such thing as perfect capacity.
5: Reliability criteria should not be arbitrary, but transparent and economic.

Straw Principles- RA Should:
· Be Technology-neutral
· Be Transparent
· Be Simple & Easy to Implement
- Ease Contracting & Exchange
· Maintain a reasonable level of reliability at reasonable cost
- Clearly and transparently identify the balance struck between reliability and cost
- Clearly identify the conditions under which demand may not be served
· Advance state policy objectives, including:
- Prioritizing the perspectives, needs and experience of equity communities
- Reducing climate emissions
- Reducing other environmental impacts
· Consider customer perspectives, needs and experience in identifying objectives, and in its implementation
· Equitably allocate resource requirements to all load serving entities
· Ensure all load serving entities have the incentive to contribute to reliability, with flexibility to
- Provide value for customers, and
- Advance state and local policy objectives
· Provide for forward and operational visibility into resource performance
· Provide for verification of resource performance
· Incent provision of energy at times, and at prices, beneficial to cost-effective, reliable energy service
· Consider & incorporate conditions in other Western markets

Resource Adequacy Isn't A Single Reliability Program- It's Three (and Potentially Four)

- Planning
- Procurement
- Performance
- & Price?

Conclusions

- Parties and program leaders are deeply concerned
- Remain focused on bulk reliability – while recognizing need for resilience
- Focus on complementing clean energy goals

  PUC Code 380(b): "the commission shall ensure the reliability of electrical service in California while advancing, to the extent possible, the state's goals for clean energy, reducing air pollution, and reducing emissions of greenhouse gases"
- Enhance integration with neighbors
- Solve for constraints beyond the peak and net-peak
- Think again about how, and whether, capacity-ratings will still work and by extension, the capacity-based system
- Energy-based alternatives also face challenges

Recommendations

Begin by saying what you want the program to do…

before trying to patch it, again.

Recommended Evaluation Criteria - Does the Proposal:

- Provide the resources needed for bulk power system reliability?
- Make the program simpler, easier to understand, and ease both transactions and compliance?
- Increase the availability of resources to meet demand, including imports, under reasonably foreseeable stress conditions?

Recommended Evaluation Criteria - Does the Proposal:

- Improve program and energy system cost-effectiveness?
- Encourage innovation and competition to enhance performance and reduce cost?
- Advance clean and equitable energy system goals, and contribute to a smooth transition?
- Favor long-term regulatory and market certainty over short-term incremental improvements?

Poll:

- Which of these criteria is most important?
  - *Provide the resources needed for bulk power system reliability?*
  - *Make the program simpler, easier to understand, and ease both transactions and compliance?*
  - *Increase the availability of resources to meet demand, including imports, under reasonably foreseeable stress conditions?*
  - *Improve program and energy system cost-effectiveness?*
  - *Encourage innovation and competition to enhance performance and reduce cost?*
  - *Advance clean and equitable energy system goals, and contribute to a smooth transition?*
  - *Favor long-term regulatory certainty over short-term incremental improvements?*
  - *Other [please provide]*

Discussion:

- How do these criteria apply to your RA reform proposal, or to those you might consider supporting?
  - *Provide the resources needed for bulk power system reliability?*
  - *Make the program simpler, easier to understand, and ease both transactions and compliance?*
  - *Increase the availability of resources to meet demand, including imports, under reasonably foreseeable stress conditions?*
  - *Improve program and energy system cost-effectiveness?*
  - *Encourage innovation and competition to enhance performance and reduce cost?*
  - *Advance clean and equitable energy system goals, and contribute to a smooth transition?*
  - *Favor long-term regulatory certainty over short-term incremental improvements?*
  - *Other [to be discussed]*

HOW CAN WE HELP?

Arthur Haubenstock

ahaubenstock@gridworks.org | 415 518 3814

www.gridworks.org

GRIDWORKS

PG&E Presentations

11:00 - 12:00 p.m. Contract Hedge Proposal

1:00- 4:30 p.m. "Slice of Day" Proposal

Pacific Gas and Electric

Peter Griffes, Luke Nickerman, Rhett Kikuyama

Track 3B.2 Proposals (R.19-11-009)

February 8, 2021

Together, Building a Better California

Agenda

Topic	End Time	Allotted Time (Mins)	Slide(s)
Introduction/Ground Rules	11:10a	10	3
Contract Hedge Proposal	12:00p	50	4-11
Lunch	1:00p	-	
Introduction to “Slice-of-Day”	1:30p	30	12-16
Determining Seasons and Slices	2:20p	50	17-30
Break	2:30p	-	
Resource Counting	3:10p	40	31-39
Needs Determination and Allocation	3:30p	20	40-43
Must-Offer-Obligation	4:00p	30	44-45
Q&A	4:30p	30	

Ground Rules

- **Please mute your microphone/audio.**
- **Please submit your questions through the chat function.**
- **Facilitator shall note the questions for the speaker(s) with Q&A at the end of each section (10 Minutes).**
- **Additional Q&A at the end of the workshop (30 Minutes).**
  - **Please raise your hand and you will be called upon by the facilitator.**

Contract Hedge Proposal

11-12 p.m.

Key Objectives for Contract Hedge Proposal

- Commission has expressed an interested in having RA program have an impact on energy market prices
  - Such a mechanism would attempt to address market power and hedging concerns
- Find a framework that is implementable
- Explore a framework that addresses the highest prices
- PG&E Proposals:
  - Submitted the contract hedge proposal on December 18
  - Commented on ED's bid cap proposal in Track 3B1, suggesting an alternative design

Contract Hedge Proposal (Background)

Problem Statement: **Energy prices** may be impacted by the expiration of **tolling contracts** primarily held by the IOUs (and subject to least-cost dispatch), as these are being replaced with **RA-only contracts**.

- PG&E's proposal offers an additional approach to address these concerns relative to the LCD principle, bid cap, or forward energy requirement options that have already been proposed in this OIR.

The proposal is designed to create an incentive for generators to bid into the CAISO energy market at levels that produce an efficient outcome

Contract Hedge Proposal (Framework)

Aligns RA compensation to a unit's performance in the energy market on an ex-post basis

- The contract would identify the variable operating costs (or relevant proxy) and require a rebate of revenue in excess of those costs.
  - For example, a thermal unit's cost would include: fuel, variable O&M, and emissions costs, which would be specified in the contract and excess market revenues would be rebated.
- The Commission would require these terms for RA contracts.

This could increase capacity prices but this would be offset with rebates. The proposal could also mitigate market power in the energy market.

Contract Hedge Proposal (Example)

Illustrative Thermal Unit Example*

- Assumptions:
  - Generator Heat Rate: 9,000 MMBtu/MWh
  - Variable O&M: $5.00/MWh
  - Fuel Price: $3.20/MMBtu (or a fuel price index)
  - Emissions Cost: $1.00/MMBtu
- Variable Cost: $43.00/MWh
- Rebated amount = MW * (Locational Marginal Price - specified variable cost),

  if LMP > variable cost and would go to the LSE holding the contract

* Approaches for other resources would need to be developed. For instance, for energy storage resources, the contract could be based on the spread between the charging costs and discharging revenues.

Contract Hedge Proposal (Feedback)

Parties commented on PG&E's proposal:

- Does Commission have authority to dictate contract terms and enforce cost-based energy bidding?
- Deviates too far from a market-based model to a cost-based, admin-heavy approach
- Unclear how this applies to hydro, storage, import, DR resources
- Setting marginal costs for some resources could be difficult
- Fails to recognize supplier's bid strategy may have more factors than variable operating costs
- Would require renegotiation of most current RA contracts
- Transferring energy margins to the buyer leaves the seller with operating risks

Contract Hedge: Bid Cap Alternative

- PG&E filed comments in response to the ED's proposal on a bid cap
- The comments suggested considering an alternative to the bid cap approach that would require a hedge similar to PG&E's contract hedge proposal
- PG&E believes this approach would meet the objective of limiting market power while enabling more efficient administration
  - A bid cap would require checking large amounts of bidding data to ensure compliance
  - The hedge approach would involve including the term in the RA contract instead enabling an easier review of contract terms

Contract Hedge: Bid Cap(Example)

Illustrative Example

- Rebated amount = MW * (Locational Marginal Price – Price Hedge)
- If LMP > Price Hedge, rebate would go to the LSE holding the contract
- Assumptions:
  - Trigger level for price hedge is $500/MWH
  - LMP is $550/MWH
  - Contract is for 50 MW
- Rebate = 50 * ($550 -$500) = $2500

Lunch **Break**

Until 1 p.m.

https://www.slidecamp.io/home

Introduction to “Slice-of-Day”

1-1:30 p.m.

Summary: Slice-of-Day Proposal

Key Objectives:

- Reforms the RA program to address **near-term** (net peak load) and **long-term** (reliability in all hours of day) **RA issues**
- Structures the RA program to recognize the **energy-limited nature** of the evolving resource mix
- Balances increases in administrative burden in some areas with decreases in administrative burden in other areas

Key Changes:

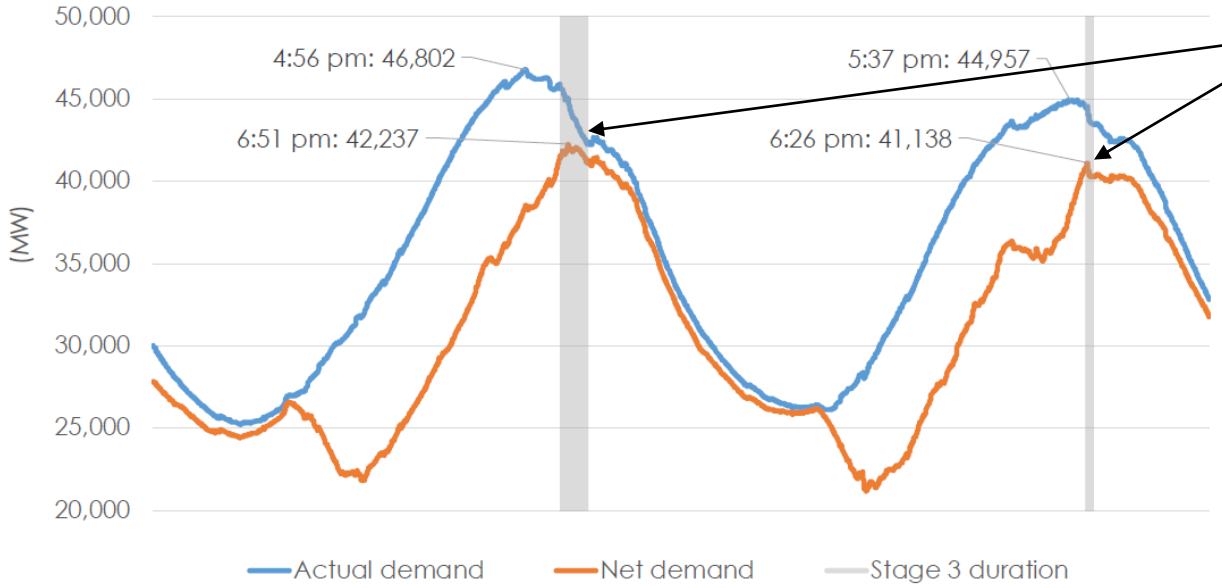
- **Multiple RA requirements over the course of the day**
- **Seasonal requirements in lieu of monthly requirements**
- **Exceedance methodology for all resources**
- **Incorporates energy storage charging needs**

Background: Slice-of-Day Proposal

The RA program must evolve to address demand in all hours of the day

- California's RA program was designed to meet **gross peak demand**
  - But the resource mix is increasing its reliance on **energy-limited** resources
- The summer 2020 events highlighted the **challenges with the current approach**
  - Meeting **net peak demand** has become a growing concern
  - **Challenges in other hours** are likely in the future as large levels of energy storage are added

Actual Demand and Net Demand for August 14 and 15
(from Prelim Root-Cause Analysis Report)



Outages coincide with net peak demand

Prelim Root-Cause Analysis Report:
"Today, **the single critical period of peak demand is giving way to multiple critical periods during the day** including the net demand peak, which is the peak of load net of solar and wind generation resources." (p. 47)

Comparison: Slice-of-Day Proposal

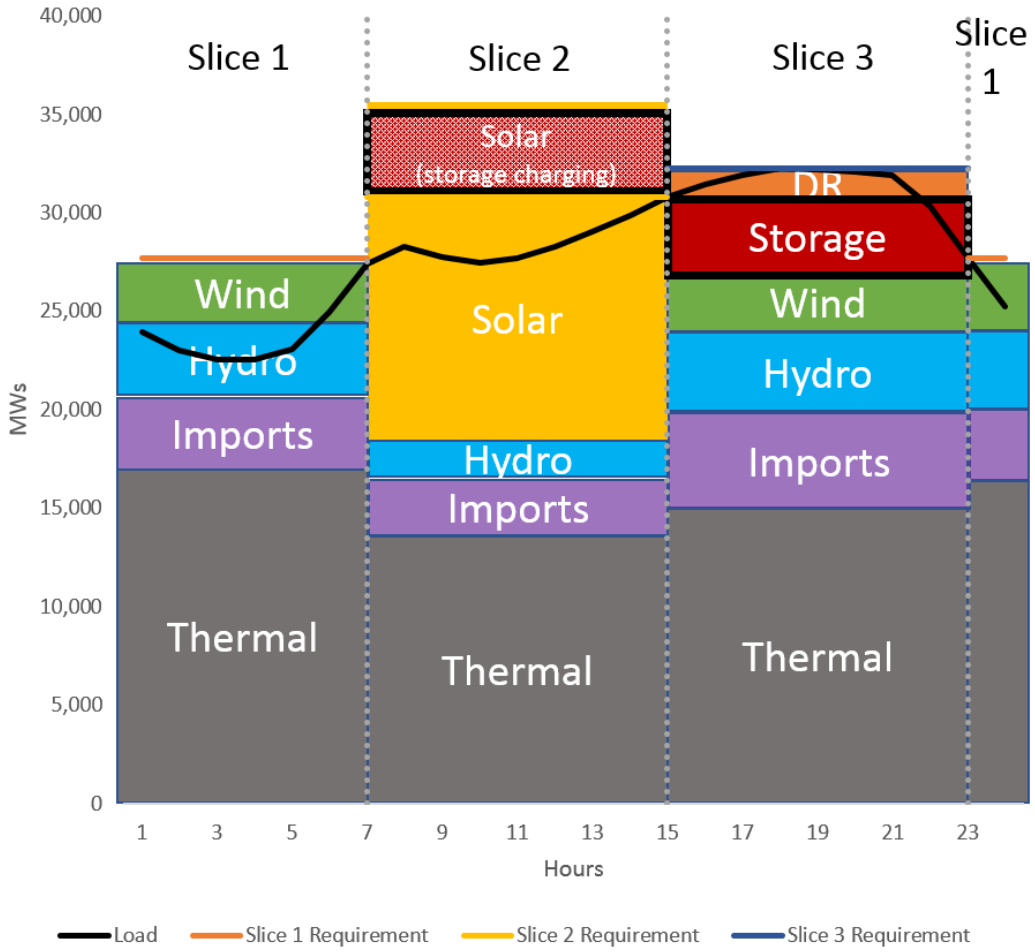
To address the changing resource mix, the proposal changes the RA requirement from a single peak period to multiple peak periods or "slices" across a 24-hour period

Summary of "Slice-of-Day" Changes Relative to Status Quo

#	Description	Today	"Slice-of-Day"
1	RA Showing Requirements	Gross peak hour; annual and monthly	Peak hour in each slice-of-day; seasonal
2	Establishment and Allocation of Requirements	Top-down based on forecasted peak load	Top-down or bottoms-up based on forecasted peak load in each slice-of-day
3	Resource Counting	Resource/technology dependent (PMax, exceedance, ELCC)	Exceedance (determined for each slice-of-day)
4	Energy Market Obligation	24/7	All hours during slice-of-day for which the resource is shown
5	RA Requirements Related to Energy Storage Charging	None	LSE is obligated to show capacity to meet charging needs

Example: Slice-of-Day Proposal

Illustrative RA Requirements and Resource Stack



- Resources would count for each slice-of-day based on the ability of the resource to produce during that period.
- Energy storage presents a unique operational characteristic in that it needs to charge to discharge.
  - In addition to a positive NQC, it would also have a 'negative NQC' that would increase the LSE's requirement in one of the other slices.

Determining Seasons and Slices

1:30-2:20 p.m.

Key Objectives for Seasons and Slices

Establishing seasons and slices that balance multiple objectives is feasible with reasonable administrative effort

Key Objectives:

- Level of accuracy that ensures the desired level of reliability
- Manageable administrative burden
- Facilitates greater participation of renewable resources and energy storage
- Accounts for energy storage charging needs
- Provides revenue sufficiency for fossil units needed for reliability purposes, but also results in lower utilization of those units to meet state policy goals
- Does not result in unmanageable impacts to outage scheduling for resources

Data Considerations

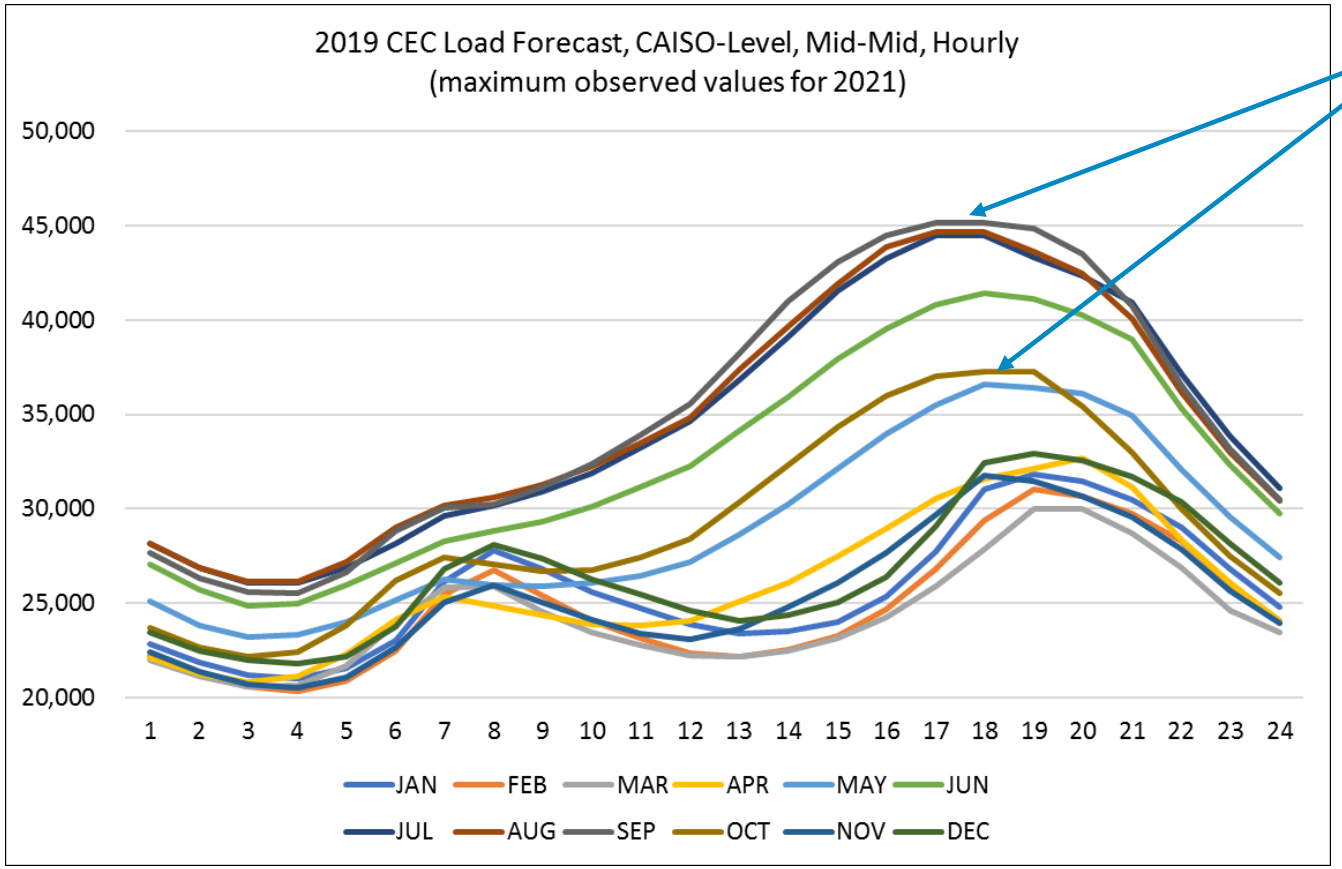
- Load Forecast[1]
  - Likely to require an **8,760 system load shape** (e.g. CEC hourly IEPR forecast)
- Resource Contribution[2]
  - Intended to better integrate a diverse resource mix; therefore, **resource-level production and market availability data** is needed
- Initial Observations on Technology Type
  - **Non-Use-Limited (e.g. thermal and baseload)**
    - Generally the same RA value for every season and slice
  - **Use-Limited (e.g. solar, wind and hydroelectric)**
    - Generally different RA values for a particular season and slice)
    - Energy storage may depend on the underlying charging source

[1] 2019 CEC Adopted Load Forecast, CAISO-level, Mid-Mid, Hourly, 2021 data

[2] CAISO resource supply data from OASIS, 2018-2019

Load Forecast

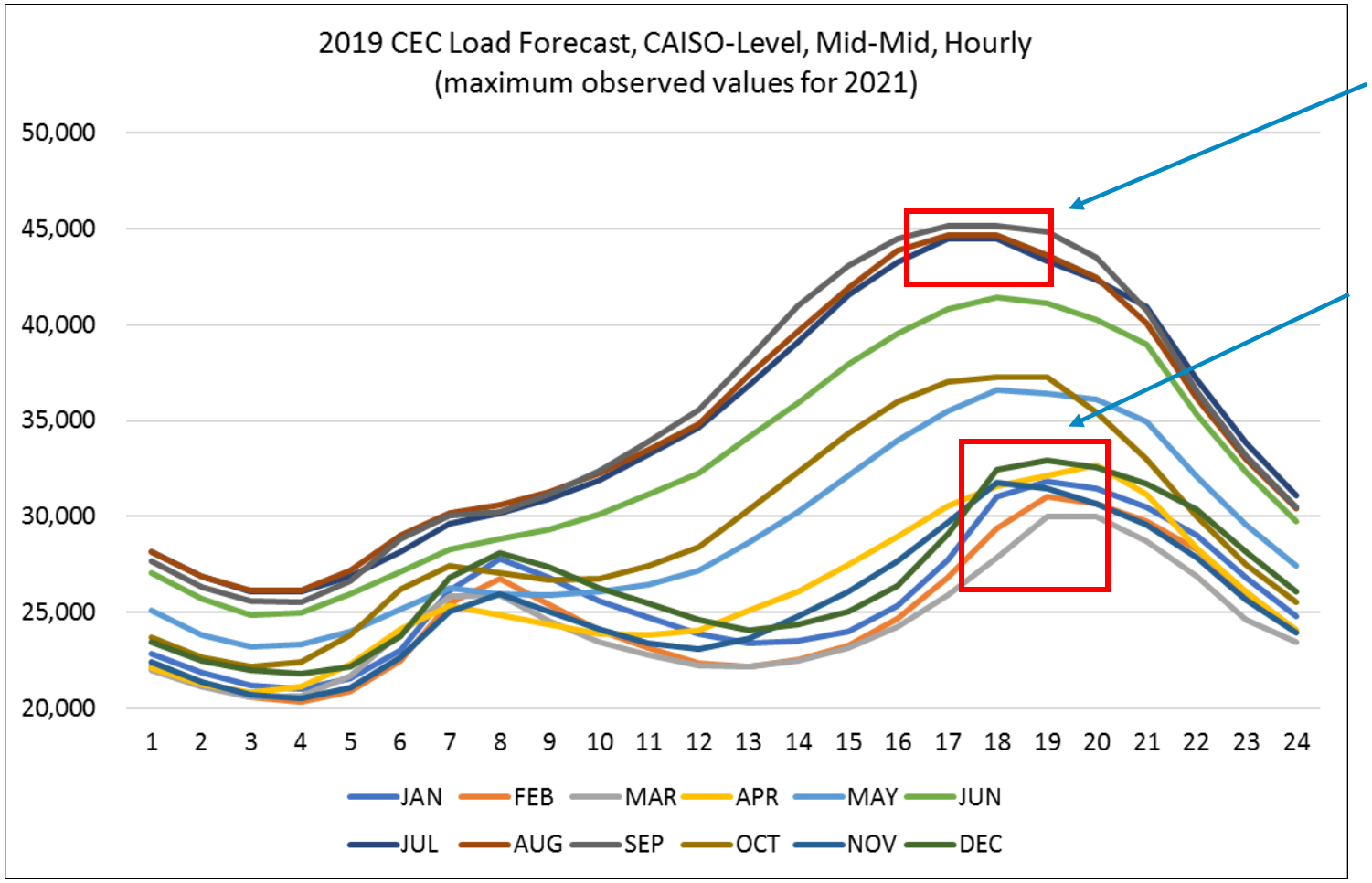
- **Current RA requirements are based on the monthly gross peak demand.**
- **PG&E has applied a similar approach at the hourly level to determine requirements by season and slice.**



Current requirements set at the monthly peak for each month

Determining Seasons

Monthly load shapes can be "grouped" to create seasons



"Peak" months are July to September

"Off-Peak" months are November to April

What about May, June or October?

Another Way to Look at the Load Forecast

Solely based on a load perspective, 3 seasons might make sense[3]

HE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	22,853	22,205	21,981	22,107	25,085	27,075	28,164	28,145	27,695	23,685	22,375	23,439
2	21,844	21,224	21,110	21,251	23,825	25,707	26,845	26,876	26,321	22,630	21,349	22,459
3	21,166	20,560	20,579	20,824	23,192	24,832	26,053	26,117	25,605	22,134	20,701	21,951
4	20,991	20,349	20,645	21,122	23,314	24,974	26,089	26,153	25,527	22,422	20,487	21,782
5	21,552	20,886	21,695	22,293	24,013	25,954	26,900	27,206	26,620	23,798	21,047	22,174
6	23,016	22,439	23,954	24,134	25,170	27,137	28,168	29,038	28,841	26,219	22,643	23,758
7	26,146	25,461	25,835	25,364	26,239	28,298	29,617	30,163	30,074	27,429	25,032	26,810
8	27,790	26,769	25,870	24,837	25,981	28,829	30,189	30,604	30,228	27,058	25,968	28,106
9	26,779	25,410	24,526	24,332	25,891	29,289	30,896	31,285	31,130	26,678	25,016	27,345
10	25,607	24,034	23,436	23,875	26,082	30,129	31,890	32,255	32,375	26,729	24,122	26,279
11	24,742	23,134	22,779	23,792	26,451	31,175	33,222	33,470	33,904	27,441	23,393	25,435
12	23,849	22,362	22,200	24,062	27,163	32,254	34,657	34,813	35,375	28,378	23,092	24,611
13	23,393	22,151	22,164	25,069	28,630	34,166	36,813	37,385	38,245	30,362	23,609	24,062
14	23,524	22,521	22,440	26,087	30,245	35,931	39,075	39,636	40,971	32,294	24,805	24,364
15	23,988	23,288	23,118	27,487	32,119	37,957	41,578	41,895	43,101	34,314	26,084	25,015
16	25,323	24,638	24,247	28,961	33,970	39,520	43,288	43,857	44,469	35,971	27,640	26,408
17	27,697	26,836	25,917	30,561	35,467	40,841	44,485	44,679	45,149	37,022	29,675	29,094
18	31,056	29,374	27,839	31,605	36,618	41,421	44,477	44,653	45,184	37,253	31,750	32,411
19	31,848	30,999	30,008	32,112	36,419	41,104	43,306	43,644	44,861	37,271	31,462	32,903
20	31,434	30,635	29,975	32,669	36,109	40,258	42,359	42,461	43,520	35,420	30,642	32,552
21	30,487	29,771	28,717	31,133	34,915	38,975	40,923	40,064	40,737	32,992	29,542	31,691
22	28,985	28,293	26,882	28,350	32,087	35,326	37,125	36,160	36,527	29,999	27,862	30,375
23	26,801	26,033	24,580	26,056	29,558	32,323	33,849	32,978	33,169	27,478	25,674	28,176
24	24,804	24,030	23,430	24,060	27,420	29,714	31,106	30,397	30,459	25,506	23,917	26,070
	Winter				Shoulder	Summer				Shoulder	Winter	

Loads > 40,000 MWs for June – September

May and October are shoulder months

Low loads for November - April

BUT, seasons must also consider the supply shape

[3] 2019 CEC Load Forecast, CAISO-Level, Mid-Mid, Hourly: (Maximum Observed Values for 2021)

Solar

Solar is the largest variable resource and will grow in the coming years.

CAISO Solar Production Data, Average for 2018-2019 (Average intended to approximate 50% exceedance)

HE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-	0	-	0	0	1	4	1	0	-	-	0
2	-	0	-	-	0	1	4	1	-	-	-	-
3	-	0	0	-	0	1	4	1	-	-	-	-
4	-	-	-	-	0	-	4	1	-	-	-	-
5	-	-	-	-	0	-	4	0	-	-	-	-
6	-	-	-	-	0	2	3	-	-	-	-	-
7	0	79	112	302	1,068	1,599	912	343	62	-	206	4
8	927	2,165	1,753	3,135	4,438	5,524	4,333	3,449	2,449	1,141	2,550	1,082
9	3,720	5,618	5,107	6,707	7,152	8,251	7,375	7,310	6,789	5,195	5,685	3,637
10	5,573	7,175	7,113	8,322	8,429	9,438	8,795	9,056	8,907	7,843	6,933	5,105
11	6,234	7,622	7,917	8,990	9,213	10,072	9,553	9,835	9,666	8,698	7,262	5,584
12	6,396	7,566	8,186	9,226	9,440	10,412	10,007	10,202	9,898	8,950	7,271	5,795
13	6,400	7,472	8,154	9,280	9,396	10,511	10,123	10,287	9,939	8,971	7,150	5,771
14	6,235	7,275	7,910	9,149	9,302	10,462	9,988	10,233	9,874	8,956	6,925	5,496
15	5,573	6,858	7,575	8,986	9,090	10,276	9,789	10,046	9,726	8,853	6,144	4,768
16	3,797	5,688	6,898	8,411	8,611	9,794	9,378	9,582	9,294	8,344	3,690	2,597
17	969	2,716	5,488	7,563	7,749	9,033	8,623	8,726	8,183	6,257	762	265
18	20	217	3,183	5,704	6,338	7,582	7,220	6,836	5,187	2,048	70	3
19	3	8	754	2,086	3,181	4,580	4,241	3,017	1,101	73	1	1
20	2	4	25	92	425	1,029	905	292	11	4	1	0
21	2	1	8	0	8	18	18	10	2	1	1	0
22	0	1	1	0	3	2	10	5	1	-	1	0
23	0	1	-	0	1	2	8	3	1	-	1	0
24	-	0	-	0	1	2	4	2	0	-	0	0

June has the **most production** for solar – may make sense to include for summer season

October **production falls off** – throughout the day – may not make sense to include for summer season

May could work for summer season

Wind

Wind is also a large variable resource that should be considered in optimizing the seasons.

CAISO Wind Production Data, Average for 2018-2019 (Average intended to approximate 50% exceedance)

HE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1,032	1,766	1,752	2,834	3,337	3,429	3,286	3,167	2,514	1,638	958	1,069
2	1,020	1,758	1,710	2,762	3,252	3,360	3,201	3,059	2,443	1,612	904	1,043
3	973	1,674	1,665	2,680	3,180	3,232	3,063	2,926	2,309	1,570	917	1,028
4	943	1,589	1,720	2,626	3,058	3,089	2,894	2,736	2,163	1,495	910	1,012
5	957	1,484	1,664	2,555	2,875	2,901	2,700	2,514	1,979	1,458	889	966
6	936	1,444	1,580	2,385	2,697	2,685	2,460	2,270	1,783	1,407	856	941
7	916	1,428	1,490	2,216	2,510	2,391	2,192	2,034	1,597	1,317	824	945
8	856	1,389	1,405	2,040	2,352	2,061	1,873	1,744	1,432	1,236	807	930
9	817	1,353	1,390	1,941	2,192	1,821	1,591	1,451	1,305	1,126	848	938
10	833	1,402	1,401	1,940	2,044	1,657	1,336	1,226	1,187	1,069	903	967
11	877	1,499	1,417	1,912	1,929	1,550	1,202	1,061	1,095	1,073	951	998
12	892	1,570	1,437	1,911	1,918	1,524	1,138	1,033	1,080	1,087	990	1,033
13	901	1,656	1,477	1,988	2,032	1,594	1,197	1,150	1,145	1,116	1,013	1,065
14	933	1,753	1,573	2,114	2,173	1,760	1,378	1,384	1,311	1,148	1,009	1,080
15	949	1,828	1,695	2,285	2,433	2,024	1,653	1,690	1,519	1,211	1,002	1,077
16	928	1,856	1,796	2,463	2,750	2,367	2,018	2,056	1,724	1,271	1,000	1,076
17	924	1,840	1,810	2,604	3,045	2,728	2,435	2,438	1,908	1,338	997	1,097
18	944	1,773	1,752	2,745	3,248	3,011	2,764	2,779	2,128	1,358	966	1,095
19	991	1,744	1,764	2,827	3,331	3,230	2,990	3,010	2,321	1,423	967	1,104
20	1,000	1,758	1,817	2,806	3,331	3,339	3,180	3,174	2,509	1,511	976	1,133
21	981	1,776	1,829	2,859	3,393	3,456	3,365	3,342	2,611	1,553	985	1,166
22	964	1,788	1,829	2,875	3,462	3,485	3,420	3,356	2,562	1,577	1,035	1,142
23	946	1,835	1,801	2,844	3,453	3,481	3,388	3,292	2,495	1,578	1,060	1,108
24	976	1,815	1,794	2,847	3,432	3,492	3,327	3,251	2,470	1,588	1,057	1,066

Wind produces most during the **early morning and evening** in the summer months

October-March has much **less wind production and variability** throughout the day

Hydroelectric

Hydroelectric has the ability to dispatch across different slices of day, but has seasonal constraints that are important to consider.

CAISO Hydro Production Data, Average for 2018-2019 (Average intended to approximate 50% exceedance)

HE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1,873	2,085	2,669	3,446	3,548	3,500	3,327	3,029	2,671	1,827	1,606	1,812
2	1,792	2,029	2,623	3,417	3,450	3,377	3,192	2,878	2,537	1,721	1,450	1,665
3	1,743	2,003	2,586	3,351	3,358	3,298	3,111	2,769	2,462	1,655	1,372	1,581
4	1,743	2,035	2,576	3,349	3,333	3,280	3,065	2,708	2,399	1,632	1,386	1,580
5	1,855	2,139	2,678	3,409	3,439	3,347	3,099	2,756	2,460	1,707	1,495	1,716
6	2,090	2,422	2,873	3,535	3,627	3,491	3,225	2,955	2,681	2,003	1,802	2,048
7	2,440	2,781	3,124	3,625	3,604	3,417	3,233	3,107	2,849	2,329	1,986	2,297
8	2,457	2,609	3,073	3,487	3,347	3,148	3,059	2,932	2,681	2,323	1,815	2,234
9	2,040	2,165	2,704	3,203	3,113	2,977	2,929	2,653	2,281	1,808	1,390	1,928
10	1,792	1,974	2,484	3,026	2,966	2,919	2,945	2,580	2,241	1,534	1,218	1,700
11	1,709	1,890	2,374	2,952	2,878	2,918	2,991	2,682	2,252	1,476	1,156	1,523
12	1,657	1,844	2,310	2,894	2,847	2,920	3,016	2,804	2,296	1,441	1,106	1,400
13	1,646	1,813	2,267	2,859	2,856	2,988	3,176	2,882	2,360	1,458	1,117	1,358
14	1,676	1,821	2,256	2,859	2,879	3,047	3,344	3,081	2,504	1,492	1,211	1,406
15	1,739	1,854	2,273	2,936	2,941	3,147	3,539	3,269	2,629	1,580	1,429	1,557
16	1,956	2,002	2,352	3,032	3,005	3,239	3,728	3,422	2,776	1,733	1,883	2,000
17	2,476	2,417	2,529	3,113	3,162	3,499	4,031	3,694	3,003	2,027	2,504	2,715
18	3,052	3,023	2,898	3,355	3,391	3,803	4,338	4,001	3,362	2,698	2,836	3,172
19	3,108	3,213	3,320	3,747	3,813	4,204	4,661	4,416	3,763	3,074	2,806	3,181
20	2,941	3,085	3,427	4,037	4,203	4,497	4,846	4,524	3,792	3,036	2,669	3,025
21	2,711	2,933	3,347	4,056	4,301	4,429	4,700	4,337	3,588	2,820	2,410	2,835
22	2,382	2,647	3,161	3,902	4,178	4,264	4,401	4,011	3,370	2,503	2,110	2,537
23	2,124	2,390	2,931	3,648	3,910	3,885	3,926	3,560	3,055	2,212	1,922	2,269
24	1,977	2,195	2,747	3,514	3,691	3,631	3,556	3,218	2,806	1,983	1,714	1,962

Hydroelectric has good resource **availability from April – September**, but produces **lower amounts from October - March**

Key Takeaways for Seasons

- Load Forecast
  - Summer months should include Jun – Sept, based on load forecast
  - Oct and May have loads below 40,000 MWs, but still ~5,000 MWs above Nov – Apr loads

- Resource Contribution
  - **Solar**
    - Including Oct in summer months would reduce solar availability for other summer months (Jun – Sept)
    - May could be included in summer months for solar, but would increase May requirements by ~8,000 MWs
  - **Wind**
    - Similar to solar, including Oct in summer months would reduce wind availability for other summer months
    - Load shape similarities for: 1) Apr – Sept, 2) Nov – Jan, and 3) Feb, Mar, and Oct
  - **Hydroelectric**
    - Load shape similarities for: 1) Oct – Mar and 2) Apr – Sept

Options for Seasons: Putting It All Together

- **Option 1: Summer, Winter, Shoulder:**
  - Periods:
    - Summer: June – September
    - Winter: November – April
    - Shoulder: May and October
  - Pros: Minimizes window of costliest RA season (e.g. "summer")
  - Cons: "Shoulder" period could be confusing

- **Option 2: Early Summer, Late Summer, Winter:**
  - Periods:
    - Early Summer: May, June, July
    - Late Summer: August, September, October
    - Winter: November – April
  - Pros: Better matches some resources' contribution
  - Cons: Expands window of costliest RA season (e.g. "summer") to six months; could be problematic for the outage season

Let's use Option 1 as an example for looking at slices of the day

Determining Slices

- **Important Considerations:**
  - Load Forecast
    - Establishes the RA requirements for each slice
    - Requirements set at the peak load in each slice (average could also be used, but approach needs to be balanced with PRM)
  - Solar and Wind Resources
    - Have the greatest variability throughout the day; need to examine how slices fit with solar and wind data
  - Other Resources
    - Have less variability throughout the day (e.g. dispatchable hydroelectric, thermal, baseload resources such as nuclear, geothermal, biomass)
  - Storage
    - QC is based on four-hour availability
    - Length of key slices to be set at four hours
- **Other Considerations:**
  - Slices of the day do not need to be the same length
  - Slices of the day can vary by season

Example of Slices for a Day

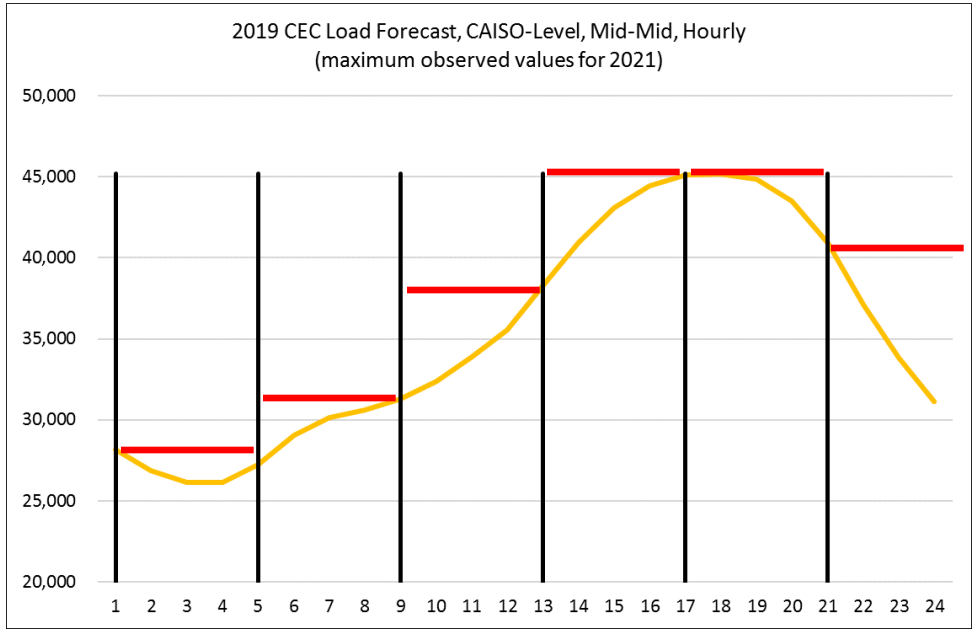
Load

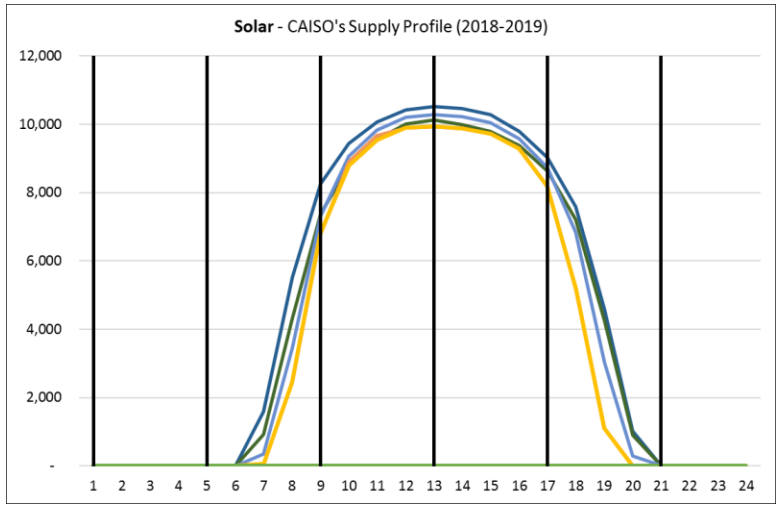
- The following slices are based on a four-hour block and are the same length (as a starting point)
- Horizontal bars show RA requirements, based on maximum in each observed slice

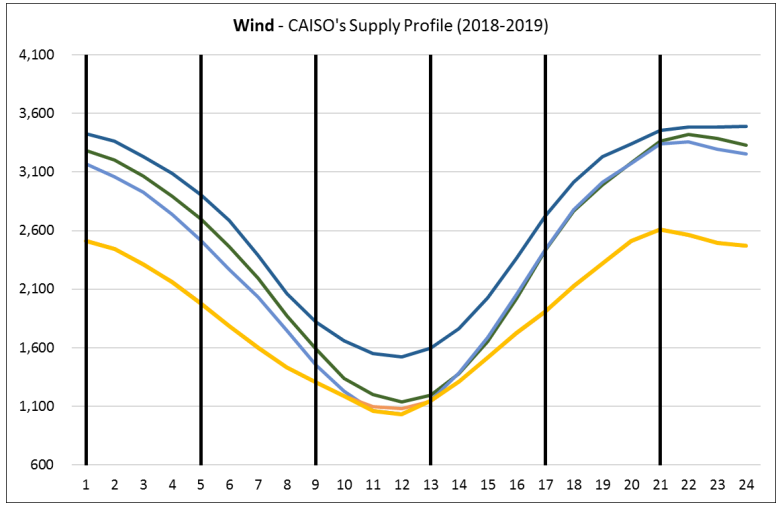
Resources

- Resource availability to be addressed in next section

Example: Summer load shape w/o PRM (June – September) based on highest observed values for these months







Note: Solar / Wind data is based on average 2018-2019 CAISO generation data

Observations

- **Summer Slice Periods**:
  - **Solar / Wind**: Periods selected to optimize for solar and wind production
  - **ELCC Comparison**: Solar / wind value provides more value than under the current ELCC approach:
    - Current NQC value of solar in September: 1,679 MWs (2021 NQC list)
    - Current NQC value of wind in September: 865 MWs (2021 NQC list)
- **For Other Periods:**
  - **Other Seasons**: may need to use different slices of time periods
  - **Trade-Offs**: between maximum resource production and administrative simplicity

Stretch Break :)

Please be back at 2:30 p.m.

Image Source: iamthinks.blogspot.com
https://www.showeet.com/19/06/2016/templates/title-slide-templates-for-powerpoint-and-keynote/

Resource Counting

2:30-3:10 p.m.

Key Objectives for Resource Counting

PG&E believes an exceedance-based approach for all resources best achieves these objectives

- Simplify resource counting rules
  - Create a framework that allows for easy identification of a specific resource's value at any time of year
  - Align with CAISO's UCAP proposal on data to use for determining exceedance values
- Address the need for more than one RA value for solar and wind resources
- Use resource counting rules to inform the design of the slice-of-day framework
- Ensure physical characteristics are considered and incorporated

Counting Rules: Existing vs. Proposed

	Current Counting Approach	Options for Proposed Approach
Solar/Wind	ELCC	X% exceedance, with weighting; generation based; by season and slice
Dispatchable Thermal	PMax	PMax w/ exceedance-based thermal derates; generation or bid based
Hydroelectric	Exceedance; bid based; monthly value	Existing approach; by season and slice
Non-dispatchable	Average generation output during peak	X% exceedance; generation based; by season and slice
Storage	PMax measured over a 4-hour output	Maximum capability measured over a slice; Requires LSE to show capacity to charge the resource
Imports	Contracted amount	

New Resource Treatment: At least 3 years of data is needed for exceedance; New resources would receive a technology average (technology factors) until sufficient data is available.

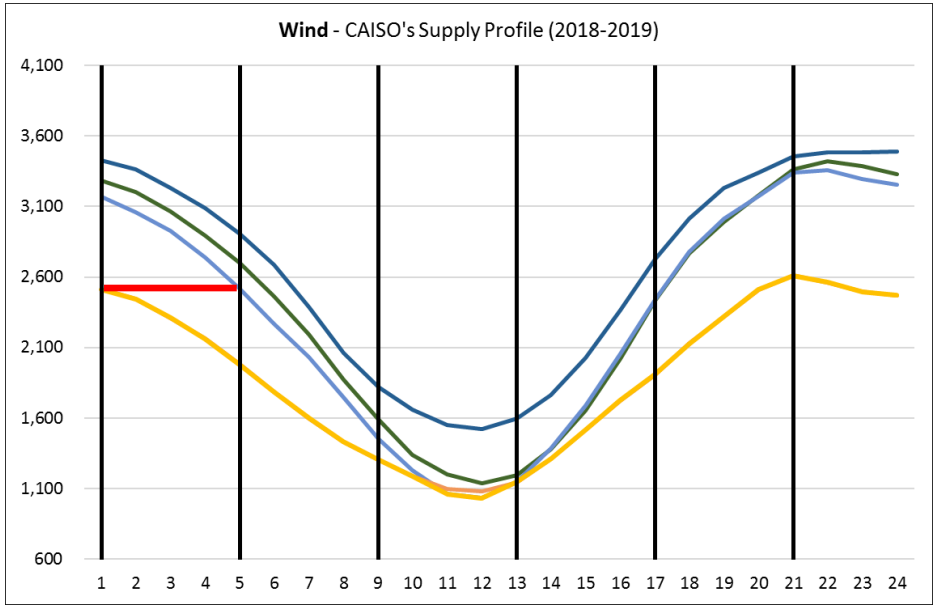
Resource Value for Wind / Solar

Draw upon approach used for hydroelectric exceedance

- "Dry" water year receives greater weight
- Similarly, lower monthly data receives higher weight for wind / solar

Example:

- Includes wind profiles for four summer months with six 4-hour slices
- Exceedance value set based on the observed production in each season and slice
  - In this case, four summer months, in each 4-hour slice
- In the example, the lowest profile would receive higher weight to account for the variability
  - See red bar, which is intended to demonstrate a value below the average



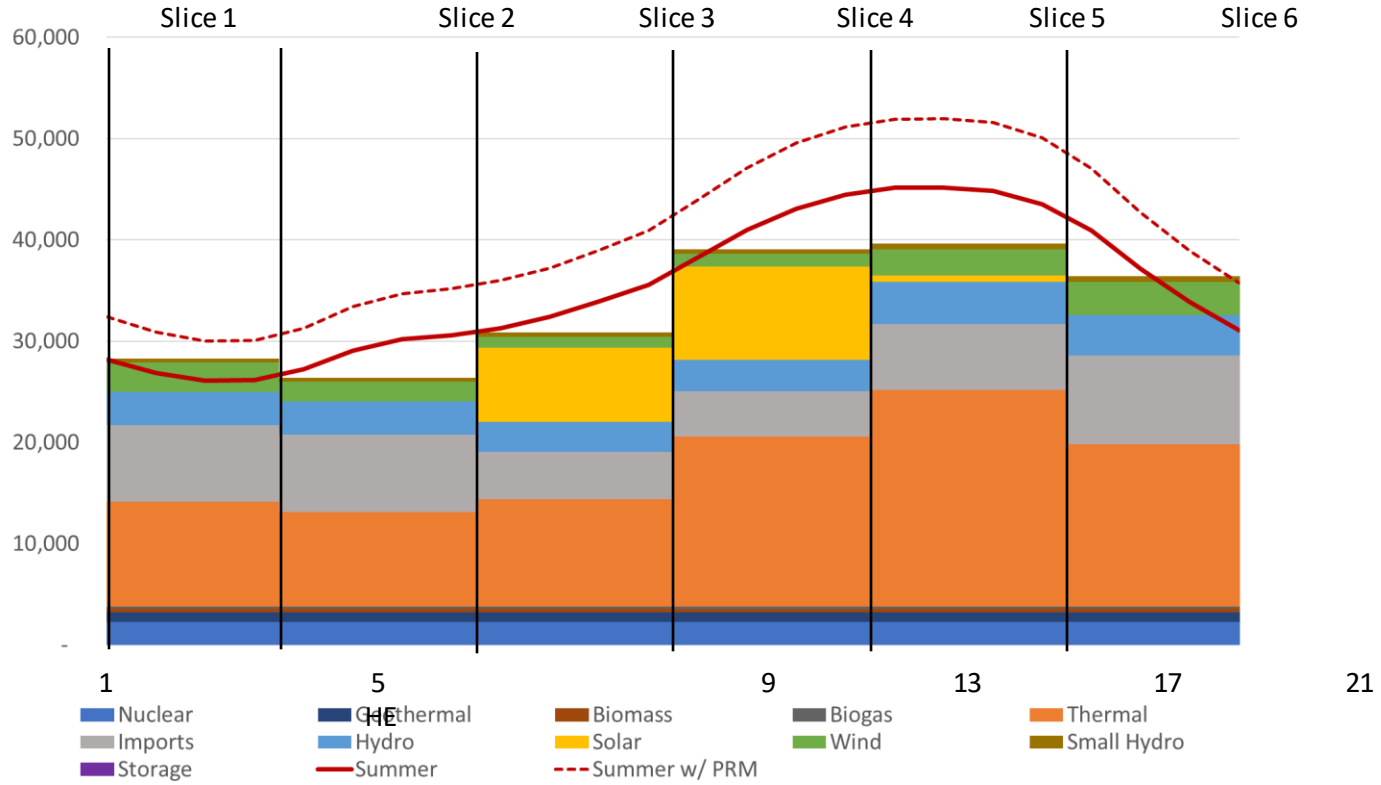
Requirements and Resource Stacks

- The following uses the 2021 CEC hourly forecast, 2018-19 CAISO production data, and 2021 NQC data to generate draft requirements and resource stacks
  - Intended as an example for discussion purposes to illustrate the season and slice approach
  - Made assumptions about exceedance values

- Some Outstanding Issues:
  - PRM level – needs to consider the exceedance approach used for variable resources (solar, wind, hydroelectric)
  - Imports level – used historical production as a starting point

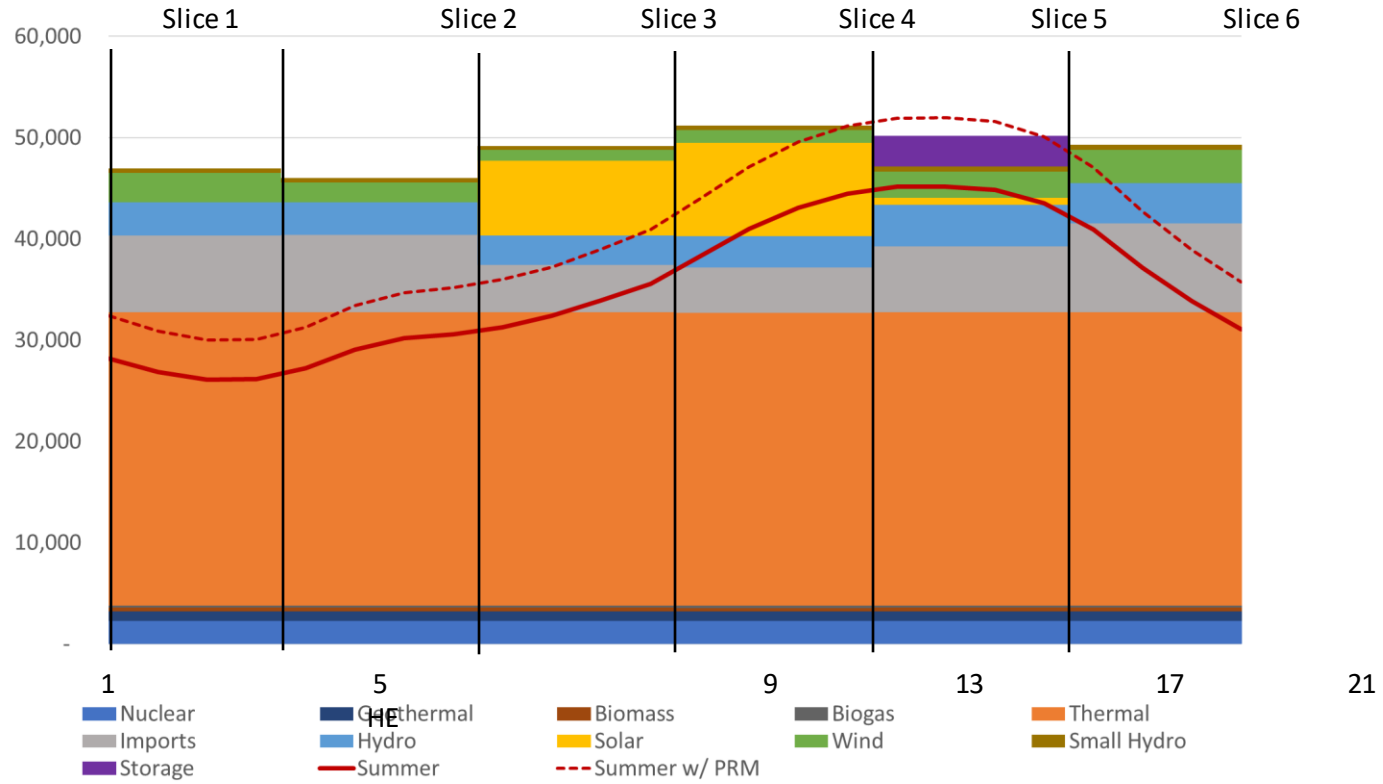
Illustrative Stacking of Resources Against Sample Requirements

- **The following is a sample stack using June – September for summer**
- **Resource values: Use exceedance proxies based on 2018-2019 CAISO generation data**
- **Observations:**
  - Shortages exist when strictly using generation, particularly for evening; CAISO data doesn't include storage or DR
  - Clear that a different view of fossil is needed – the resource is available in morning hours, it just was not needed



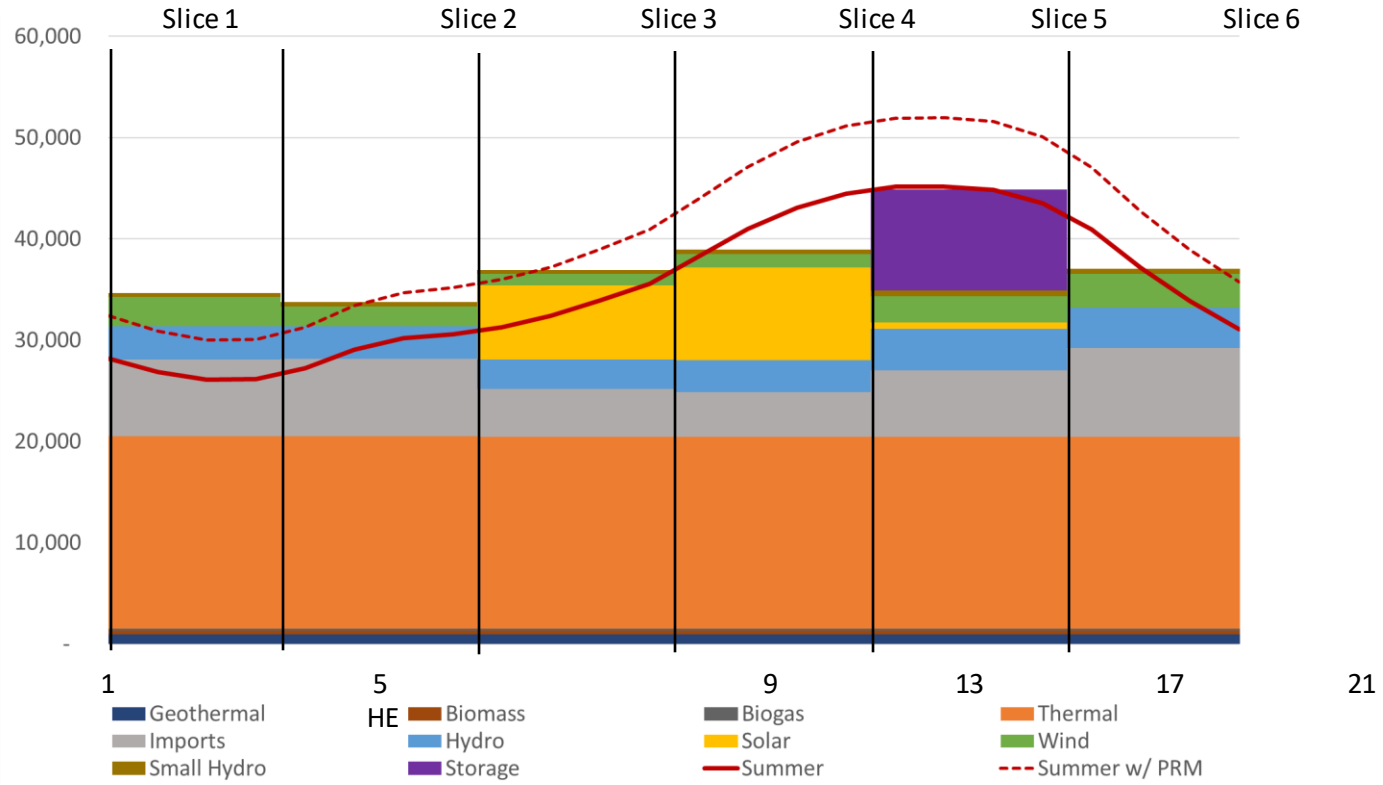
A Different View for Thermal; Includes Energy Storage

- **Thermal changed to 2021 NQC value (or PMax)**
- **Added 3,000 MWs of storage (proxy for IRP procurement)**
  - Requirement would need to be increased in another slice
- **Still shortages in slice 5 depending on PRM; is consistent with summer shortages**
- **Final exceedance approach for wind and solar needs to be considered with the PRM**
  - PRM, needs to be considered, but not in Track 3B.2



Use Case as a Planning Tool

- **10 GWs of thermal replaced with 10 GWs of storage; Nuclear also removed**
  - It's clear natural gas for storage isn't a one-for-one swap
- **Slice 5 is still a problem, but others have become problematic too**
- **Slices 3 and 4 likely will have significant additional solar, but slice 6 is worrisome**
- **Still need to account for storage charging**
  - No slice can support all of it based on this resource mix



Wrap Up

- Resource counting is a key part of the restructuring of the RA paradigm
- Resource counting will have to go hand in hand with setting requirements and reserve margins
- Slice-of-day highlights need to focus on all hours of the day as the resource mix changes
- Products could be transacted on a slice basis, not unlike how capacity is currently transacted on a monthly basis

Need Determination and Allocation to LSEs

3:10-3:30 p.m.

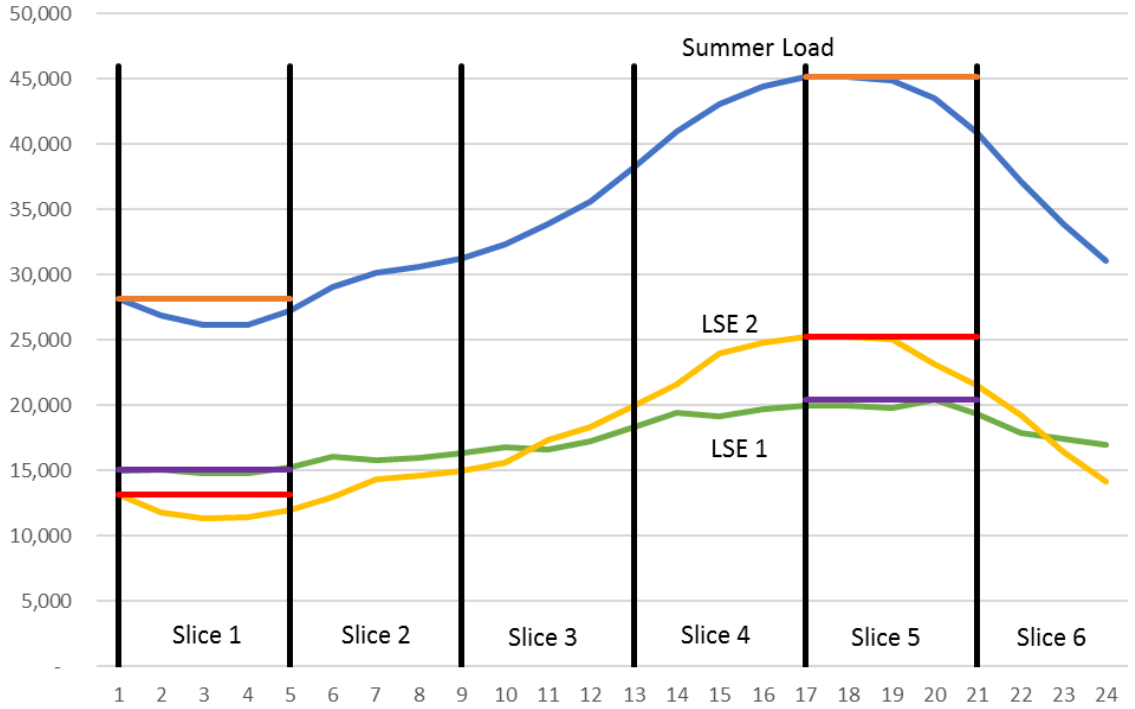
Options: Need Determination and Allocation

Key Objectives: (1) Adopt a framework that is implementable, (2) Minimize over-procurement risk, and (3) Fairly allocate costs between LSEs

		Requirements	LSE Allocation	Notes
1	**Top Down** Existing allocation approach by season	CAISO level; Set based on existing hourly forecast	Existing LSE peak monthly load shares are applied to each season	Uses existing data; easy to implement
2	**Hybrid** Allocation by LSE-specific loads in each season and slice	CAISO level; Set based on existing hourly forecast	Based on LSE-specific loads in each season and slice	Need LSE hourly forecasts; greater granularity provides equitable allocation; additional administrative effort
3	**Bottoms Up** Different LSE seasons and slices	LSE level; Seasons and slices set based on load and resource mix of each LSE	Allocation N/A; Need to confirm that aggregated requirements meet system needs	Need LSE hourly forecasts; differing seasons / slices across LSEs would be administratively burdensome

Illustrative Example: Hybrid Approach

- **Hypothetical market in which there are two LSEs**
- **Each has approximately 50% of the total energy load, but different load shapes**
  - LSE 1 has a relatively flat load and LSE 2 has a peakier load
- **Overall requirements would be set at the maximum value for each slice**
  - The orange horizontal lines illustrate how this would work for the overall requirement
- **The LSE requirements would be set based on the load share: (1) of total energy or (2) contribution to coincident peak within the slice**
  - The red and purple horizontal lines in the graph below illustrate how this would work for two of the slices



Next Steps

- Determine how much variation exists between LSEs' load shapes.
  - Is a hybrid approach worth pursuing?

- If the variation warrants additional administrative complexity, consider:
  - Phased approach: Perhaps start with top-down approach and transition to hybrid approach once requisite data is available
  - Pursue hourly LSE-specific load forecasts

Must-offer-obligation in energy market

3:30 - 4 p.m.

Must Offer Obligation

Current must-offer obligation (MOO) is for all resources to bid 24x7 in both the day-ahead and real-time markets.

PG&E's filed proposal:

- MOO for both day-ahead and real-time markets only applying to the slice-of-day the resource was counting for RA
- Storage resource would also commit to charging during a specific slice-of-day and provide capacity to produce energy during that slice

PG&E's current proposal:

- MOO for day-ahead market only applying for slice of day the resource was counting for RA
- Storage resources be linked to capacity to produce energy during another slice of day

What's the relationship between planning and operations?

Q&A/Discussion

Until 4:30 p.m.

California Public Utilities Commission

Thank you for attending today's Track 3.B.2 Workshop.
Feedback welcome.

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