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24-Hourly Slices

RA Slice of Day Workshop

October 6, 2021

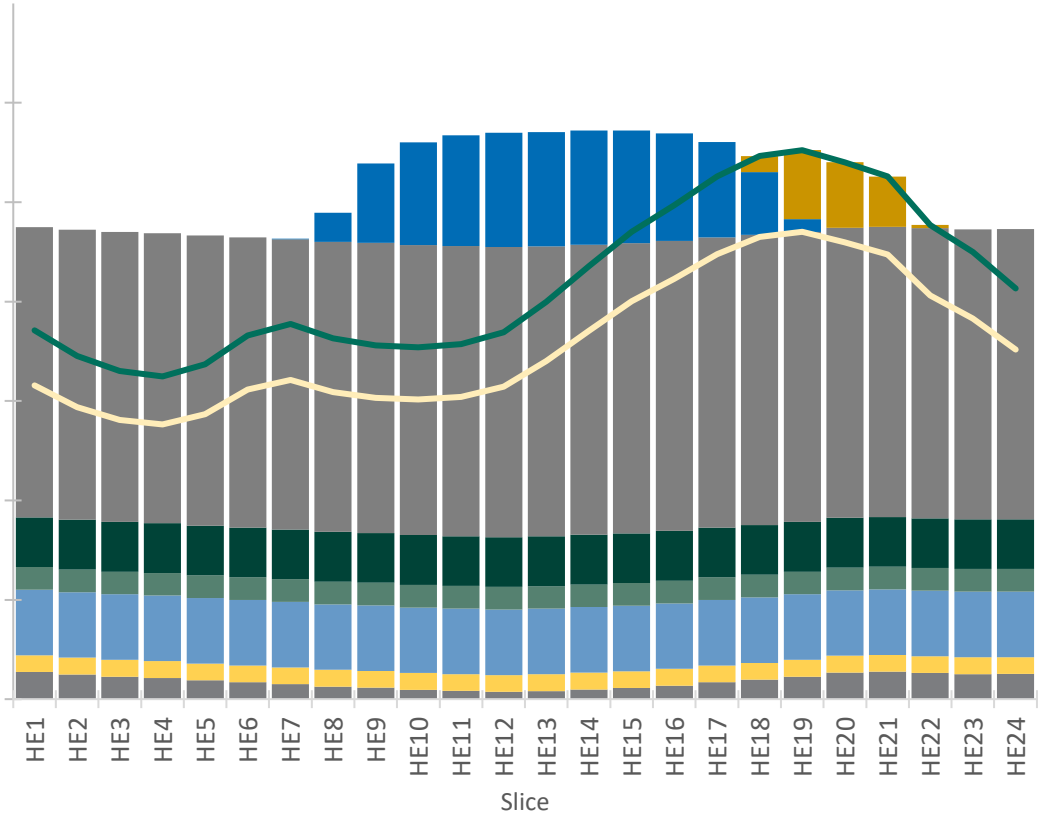
- Agenda
  - Basic framework and resource counting
  - Comparison of hourly vs. 4-hour slices
  - Illustrative showing
  - Conclusion

Introduction

- SCE has been exploring a 24-hourly slice/monthly showing framework
  - One showing per month based on the "worst" day of the month; each hour is a slice
  - Hourly renewable capacity profile based on each LSE's unique renewable portfolio
  - Requirement for portfolio to meet load+PRM in all slices (i.e., sufficient capacity in every hour)
  - Requirement to show sufficient excess capacity to meet energy storage charging/pumping
  - Resources have a full-capability ("24 hour") must-offer requirement; no "unbundling" of "single slice capacity products"
- Rationale for considering a 24-hourly slice framework
  - Load and renewable supply changes dramatically hour to hour
    - Month-month variations are even larger
    - Will evolve over time as the fleet evolves
  - Increasing the size of slices can lead to inefficiencies
    - The larger the slice, the more renewable output is "penalized"
    - Use limited resource capabilities may not match the length of a slice; when this happens, it creates prima facie inefficiencies
    - Need for use limited resources may straddle slices
  - Both the showing and procurement are administratively workable and follow most of the current practices

24-Hourly Slices: Basic Framework and Resource Counting

Illustrative LSE Resource Showing



- For each month, each LSE must demonstrate it has enough capacity to satisfy its load profile + PRM in all 24 hours on the CAISO's "worst day" in that month
- Resource counting will generally be defined in the following manner:
  - **Solar and wind** will count based on their hourly profiles; Must be fully deliverable
  - **Standalone batteries** count based on their capacity and duration as shown by the LSE
  - **Use-limited resources** count based on their capacity and available duration as shown by the LSE
  - **Other resources** will have a single counting value (e.g., NQC)
  - **Contracted resources** (e.g., 16-hour imports) must be shown in their available hours
- Additional checks will be applied to confirm run-hour feasibility of use-limited resources:
  - **Standalone batteries** must demonstrate there is sufficient "excess capacity" in other hours for their dispatch (plus losses)
  - **Hydro** must have sufficient energy to support the shown capacity

Additional Design Details

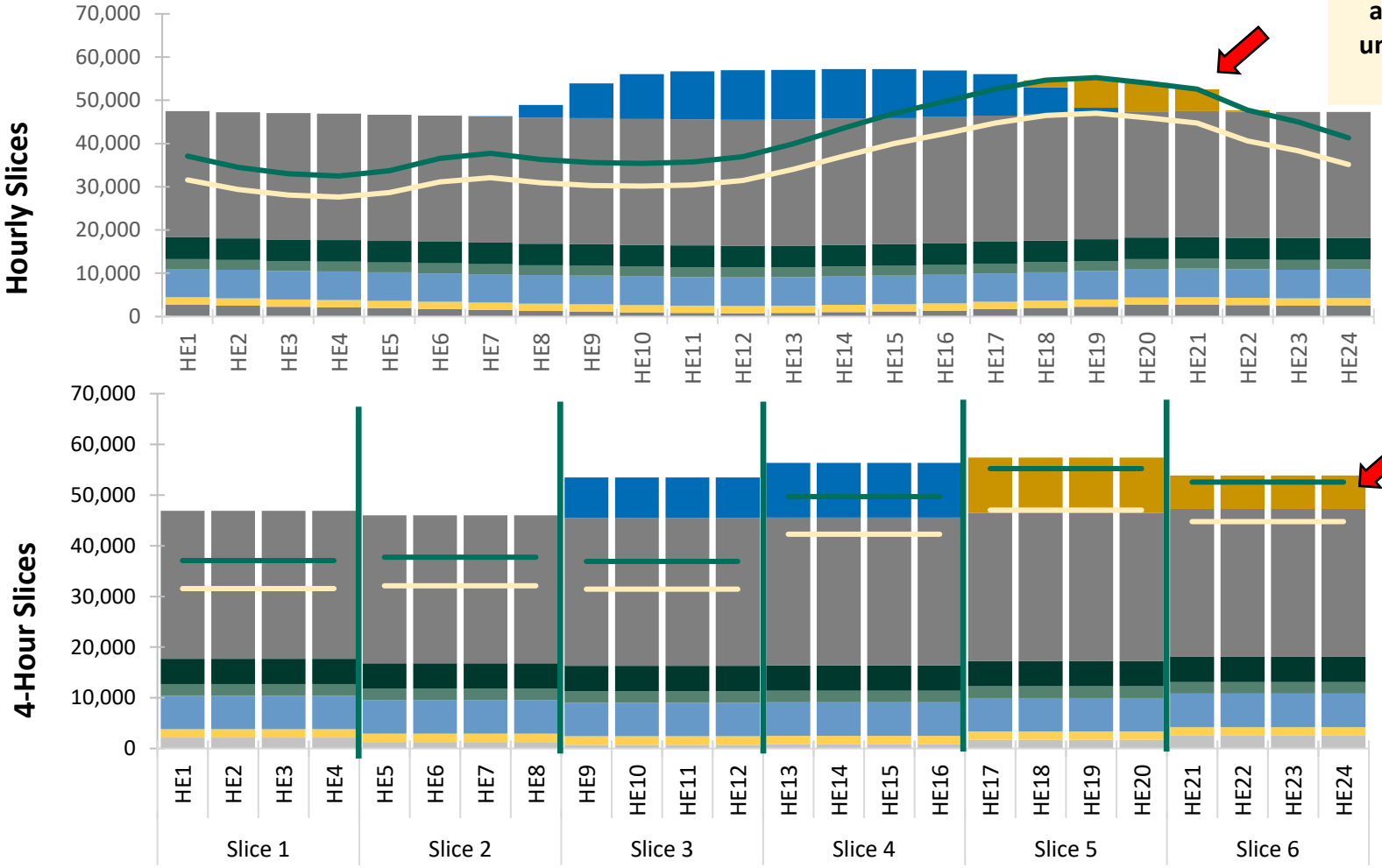
- Resource attributes and capabilities are bundled
  - No unbundling of hourly slices; aligns with existing must-offer obligation
    - Resources do not sell 24 separate hourly products
    - Multiple hourly products becomes overly complex and creates concerns with resource selling the same RA capacity 24 times
  - Resources can continue to sell portions of their capacity to different LSEs
    - *E.g.,* Resource A can sell 70% of its total capacity to LSE 1 and 30% of its capacity to LSE 2)
- "Full-capability/all-hour" must offer obligation (MOO)
  - Buyers purchase capacity along with all flexibility/attributes (*e.g.,* system/local/flex) and use-limitations based on the physical capability of the resource
  - Resources that have sold capacity have a must-offer obligation equal to the sold amount for all hours they are capable of producing
    - *E.g.,* a gas unit without run restrictions must offer for all 24 hours
  - RA showing does not govern how resources are dispatched by the CAISO

Slices Larger than 1 Hour Can Create Costly Procurement Inefficiencies

- SCE has attempted to quantify the extra cost resulting from slices larger than 1 hour
- Major sources of inefficiencies of **multiple-hour slices** include:
  - Storage and other use-limited resources cannot be allocated hourly, and as a result multiple-hour slices will result in over-procurement to meet the same PRM
    - Example (shown on next slide): Assume 4-hour slices
    - Assume that a 4-hour battery is needed at its max capacity for 1) the *last 3* hours of slice 5, and 2) the *first* hour of slice 6
    - The capacity can only be shown in either slice 5 or slice 6
    - The LSE will need to buy/show twice as much storage in order to show storage in both slice 5 and slice 6 (even though the extra storage is <u>not</u> needed to maintain reliability)
  - Failure to give run-hour limited resources credit when they don't fit fully into slices
    - Example: Assume 4-hour slices. A 7-hour resource can only be shown in one slice. Its value in the remaining 3 hours goes unrecognized.
  - The "worst" hour within the slice will set the requirement for the entire slice
    - Can also result in over-procurement and penalizes renewables
    - Determination of "worst" hour for blocks is not a trivial undertaking
- Additional inefficiencies occur if showings are seasonal

Comparison of hourly vs. 4-hour slices

Use-limited resources can be utilized precisely and efficiently under an hourly showing



Excess procurement required to meet maximum PRM because of the choice of slice hours

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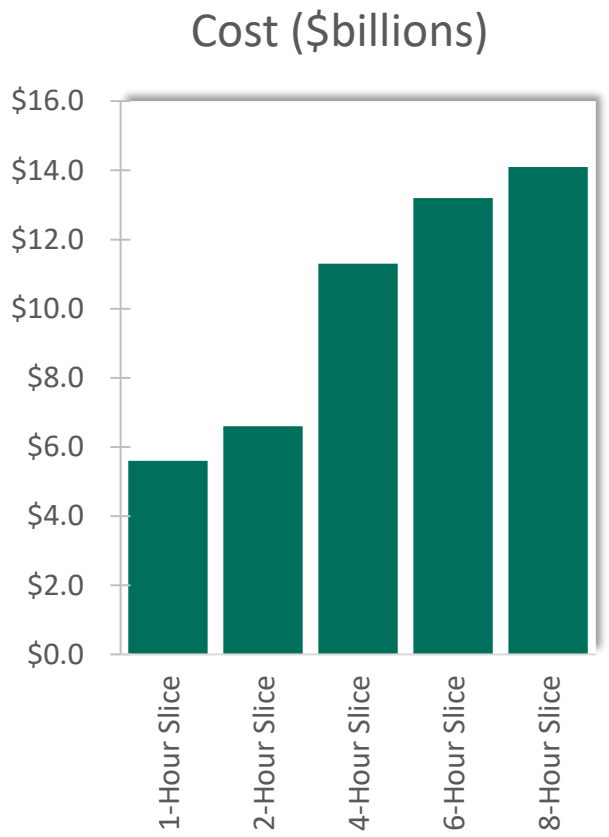
SCE Estimates that Slices Larger than 1 Hour Can Create Costly Procurement Inefficiencies

Hours Per Slice	Storage Required to Meet Slice Requirements (MW)	Installed Cost ($billions)
1	7,000	$5.6
2	8,200	$6.6
4	14,100	$11.3
6	16,500	$13.2
8	17,600	$14.1



- Layers in 4-hour batteries to meet showing requirements; assumes cost of $200/kWh (source: NREL Cost Projections for Utility-Scale Battery Storage 2021 Update)
- IEPR CAISO system load forecast for September 2030 with 17.5% PRM
- Assumes combined worst load/worst production in the slice sets requirement

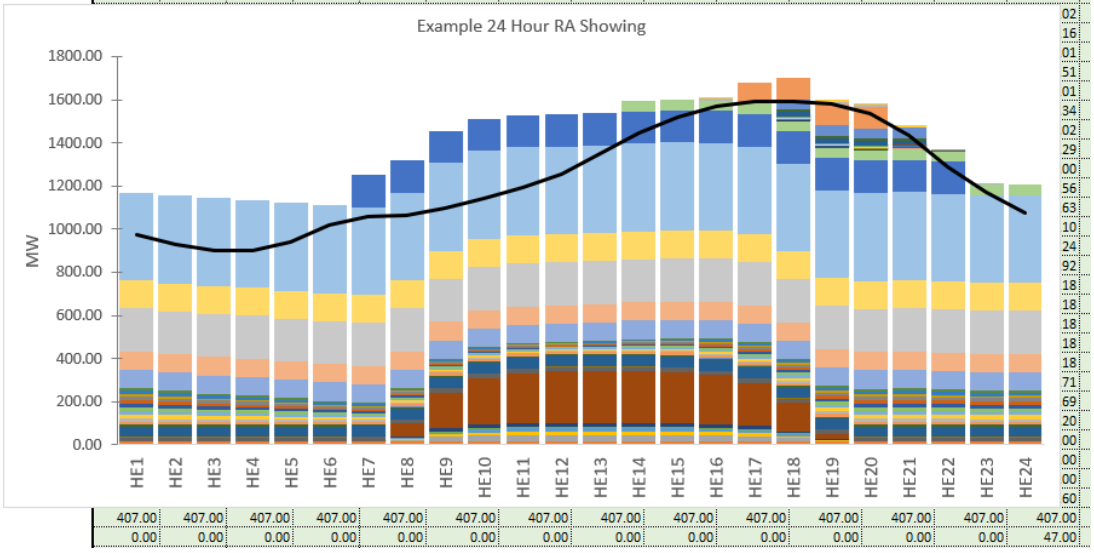
Showing Mechanics: Single Showing, Pass/Fail

Storage Efficency Penalty:	1.25 x
RA Capacity Showing Check:	Pass
Storage Excess Capcity Check:	Pass

RA Requirement	976	928	903	900	938	1,017	1,060	1,066	1,097	1,141	1,195	1,254	1,348	1,444
Total Supply	1,169	1,156	1,143	1,136	1,123	1,111	1,251	1,319	1,457	1,512	1,529	1,533	1,537	1,594
Short (Long)	(193)	(228)	(241)	(236)	(184)	(94)	(191)	(253)	(360)	(371)	(334)	(279)	(189)	(150)

Required Showing Data (Feel free to change parameters)						
Resource Name	Technology	Shown NQC MW	Hours/Duration	Shaped Allocation?	First Available Hour (HE)	Last Available Hour (HE)
Resource 1	HL IMPORT	150	16	1	7	22
Resource 2	BIOMASS	15.00	24	1	1	24
Resource 3	SUN	31.36	24	1	1	24
Resource 4	SUN	17.92	24	1	1	24
Resource 5	SUN	15.68	24	1	1	24
Resource 6	SUN	7.84	24	1	1	24
Resource 7	SUN	18.82	24	1	1	24
Resource 8	SUN	250.00	24	1	1	24
Resource 9	WATER	19.02	24	1	1	24
Resource 10	WATER	2.29	24	1	1	24
Resource 11	WATER	50.00	24	1	1	24
Resource 12	WATER	6.56	24	1	1	24
Resource 13	WATER	1.63	24	1	1	24
Resource 14	WATER	12.10	24	1	1	24
Resource 15	WIND	30.52	24	1	1	24
Resource 16	WIND	40.32	24	1	1	24
Resource 17	WIND	36.00	24	1	1	24
Resource 18	WIND	36.00	24	1	1	24
Resource 19	WIND	36.00	24	1	1	24
Resource 20	WIND	36.00	24	1	1	24
Resource 21	WIND	36.00	24	1	1	24
Resource 22	WIND	21.60	24	1	1	24
Resource 23	WIND	33.12	24	1	1	24
Resource 24	WIND	24.48	24	1	1	24
Resource 25	GEOTHERMAL	85.00	24	1	1	24
Resource 26	GEOTHERMAL	85.00	24	1	1	24
Resource 27	NATURAL GAS	200.00	24	1	1	24
Resource 28	WATER	129.60	24	1	1	24
Resource 29	WATER	407.00	24	1	1	24
Resource 30	NATURAL GAS	47.00	11	0	13	24

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14
	0.00	0.00	0.00	0.00	0.00	0.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00	407.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	47.00



- We expect a common "tool" would be used by LSE's for their showing
  - SCE built it's own tool for proof-of-concept
- Expect to eliminate MCC buckets given hourly requirements

Benefits of 24-hourly Slices

- Effectively addresses challenges related to solar, wind, and storage resources and load variability
  - Doesn't strand capacity that doesn't fit nicely into a multi-hour block
- Administratively and contractually implementable
  - Multi-hour slices could result in endless tweaking and adjusting to meet the changing fleet and load
  - 24-hourly slices naturally evolve as load and resource profiles change over time and will work with diverse LSE load shapes and resource portfolios
- Works largely within the existing RA QC framework without creating new products
- Works largely within the CAISO existing backstop processes
- Appears to avoid over-procurement associated with larger slices and seasons
- Meets gross and net load peaks regardless of where they fall and how they evolve over time
- Demand and supply vary considerably throughout the month and seasons—larger slices aggregating disparate load/supply conditions lead to greater inefficiencies
- Any slice construct will likely require hourly level demand, solar and wind forecasts

Conclusion: 24-Hourly Slices Deserves Consideration

CPUC's Guiding Principles	Hourly Slices
1. Balance ensuring a reliable electrical grid with minimizing costs to customers	• Ensures sufficient capacity for each hour of the day while reducing risk of over-procurement • Preserves value of resources that do not fit neatly into the pre-defined slices
2. Balance addressing hourly energy sufficiency for reliable operations with advancing California's environmental goals	• LSE requirements match hourly load+PRM • Allows all resources (including renewables) to count at their expected hourly capacity • Incorporates additional capacity needed to charge storage
3. Balance granularity and precision in meeting hourly RA needs with a reasonable level of simplicity and transactability	• Retains existing transactions and products where possible • Single showing (Pass/Fail)
4. Be implementable in the near-term (2024)	• Existing contracts and resource types can be used in showings • Measures to standardize showing can be implemented in the near term
5. Be durable and adaptable to a changing electric grid	• Robust to peak and net peak needs • Robust to changes in grid resource mix • Eliminates need to update slice definition as grid evolves

Backup

Summary of 24-Hourly Slices Relative to Today

#	Description	Today	24 1-Hour Slices
1	RA Showing Requirements	Single gross peak hour; annual and monthly	Single showing of gross load and capacity in each hour on the "CAISO's worst day"; annual and monthly
2	Establishment and Allocation of Requirements	Top-down based on forecasted peak load	Based on forecasted worst day shape. Can be top down, bottom up, or some combination tbd
3	Resource Counting	Resource/technology dependent (Pmax, exceedance, ELCC)	Resource/technology dependent capacity profile; Hourly wind and solar capacity profile; expected capacity for other resources; up to Pmax for other dispatchable resources
4	Energy Market Obligation	24/7 (up to plant capability)	24/7 (up to plant capability)
5	RA Requirements Related to Energy Storage Charging	None	LSE is obligated to show capacity to meet charging needs
6	Daily Use-limitations	MCC Buckets Min 4-hour daily output availability requirement	Use-limited 24-hour allocation Retain min 4-hour daily output availability requirement