Energy Division Monthly ELCC Proposal for 2020 RA Proceeding

Energy Resource Modeling Team
Energy Division
California Public Utilities Commission

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Purpose and Objective

- Present CPUC staff's methodology and results for calculating Effective Load Carrying Capacity (ELCC) percentages for these four resource groups:

Study Number	Study Name	Study Type
1	Wind	Standalone
2	Storage (including batteries and pumped storage)	Standalone
3	Solar	Standalone
4	Wind, Storage, and Solar together	Portfolio

- Objective – show results to parties, propose a change to the diversity adjustment to handle energy storage, propose ELCC values for wind and solar generators for 2020 RA year, **not ELCC for storage**

Background and Definitions

ELCC equals the comparative value of a generator in terms of reducing Loss of Load Expectation (LOLE) compared to a Perfect Generator (PCap)

- ELCC % = (MW of PCap) / (MW of wind/solar generator)
- PCap would have ELCC equal to 100%; ELCC of 50% is half as good at reducing LOLE as a Perfect Generator
- In order to correctly account for the capacity value of a generator for RA counting purposes, must adjust for resource diversity

What is new for this proposal relative to December 2018 ELCC proposal?

- In December, staff allocated diversity adjustment to storage, wind, and solar, in Step 5, noticed storage ELCC exceeded 100%, then reallocated some excess ELCC back to solar after Step 6.
- For this proposal, staff simply allocated diversity to wind and solar, with none allocated to storage in Step 4
- Storage ELCC is capped at 1,200 MW of PCap – 100% ELCC
- Methodology for diversity adjustment is detailed in the next slides

ELCC Diversity Adjustment

- Groups of different generating resources provide more LOLE reduction than resources individually. Solar generates during the day, and wind blows more in the early evenings, reducing LOLE at these respective times. Combined, the two resources provide reliability benefits that complement one another.

- The diversity adjustment accounts for the fact that the sum of each resource type's standalone ELCC is different from the portfolio ELCC. It is defined as the perfect capacity added in the portfolio study, less the sum of the perfect capacity added in the standalone studies. This adjustment varies by month. Because days are longer, load varies due to weather effects, solar and wind create benefit each month.
- Adjustment can be positive or negative because standalone studies may give too much or too little LOLE reduction value to an individual group in that month.

- CPUC staff proposed a generally agreeable method to calculate diversity adjustment in February 2018. The stages of this analysis are detailed in the next slide

Monthly ELCC calculations: Process

0. Surface Monthly LOLE in a given system by removing or adding generating resources until overall LOLE in each month is within a range of 0.02 and 0.03 LOLE reliability target. This yields a "Calibrated LOLE" grid to be used in the next steps.

1. Remove Portfolio of Resources of a given resource type (or set of resources types in the case of Portfolio ELCC studies) from the grid.

2. Calculate MW of Perfect Capacity (PCap) that must be added by month and resource type for all four studies (wind, solar, storage, portfolio), to return to the range of 0.02 and 0.03 LOLE per month.

3. Calculate total MW of diversity adjustment by subtracting the sum of individual resource classes' PCap MW equivalent from total Portfolio PCap MW

4. Allocate the diversity adjustment (MW) to the different resource types based on PCap MW added in each standalone study / sum of PCap added across all standalone studies (note: denominator is NOT PCap added in portfolio study).

5. Add the diversity adjustment to the appropriate PCap from step 2 to get each resource type's diversity-adjusted PCap value.

6. Calculate final diversity-adjusted ELCC %: Divide the results of Step 5 by total nameplate of the resource type

Note: Step 0 is a "pre-step" to the process of calculating effective load carrying capacity (because all ELCC studies start from the Calibrated LOLE grid) and will not be described in detail in these slides.

Handling storage resources in ELCC analysis

- Energy storage must be handled differently than supply-side solar and wind resources studied in traditional ELCC analysis because:
  - Storage offsets LOLE directly when it discharges, but solar provides more value when excess energy can charge a battery
  - Charging storage absorbs excess generation from other resources (like solar), which increases the usefulness of that generation for reducing LOLE and increasing its ELCC.
  - This is seen in the Portfolio ELCC step. A portfolio that does not include storage will have less diversity benefit. Storage itself doesn't generally provide more than 100% value. Storage just allows other types of resources (that produce energy) to offset more LOLE than otherwise when the extra energy is not as useful.

Policy Question: How to treat storage in ELCC analysis?

1. How should CPUC staff handle diversity adjustments for resources that already are 100% ELCC? Should CPUC cap ELCC at 100% and allocate diversity (positive or negative) to another resource?

2. CPUC staff proposes to allocate the diversity adjustment created by storage to solar resources, because storage often charges during the middle of the day, absorbing solar energy.

3. **CPUC staff are not proposing an ELCC value for storage, instead proposing to give storage a NQC of 100% of nameplate.**

4. CPUC staff is seeking input from parties on this proposal.

Different resources contribute to reducing LOLE at different times of the day

Total Expected Unserved Energy (EUE) MWh, by study and hour ending

Study Name	HE 16	HE 17	HE 18	HE 19	HE 20	HE 21	EUE MWh between 3 - 9 PM	Total EUE MWh, all hours	% EUE between 3-9 PM	MW of resource removed	EUE MWh / MW removed in ELCC study
LOLE	0	5	19	77	75	15	190	206	92%	N/A	N/A
Solar ELCC	14	54	61	66	41	8	243	260	94%	13,785	0.02
Storage ELCC	0	2	15	68	55	9	149	165	90%	1,187	0.14
Wind ELCC	0	0	14	68	76	25	183	195	94%	10,522	0.02

- The table above shows the hours with the majority of EUE. Most EUE (90%+) occurs between 3 PM and 9 PM in all studies (Hour Ending 16 to Hour Ending 21).
- The colors represent the magnitude of EUE, with red being the largest, followed by orange, yellow, and green. In the base LOLE study, loss-of-load is heavily concentrated between 5 PM and 8 PM.
- The table shows the following effects when these resources are removed from the grid and replaced with perfect capacity to return to the 0.02-0.03 LOLE monthly reliability target.
  - Solar**:** More unserved energy earlier in the day (beginning at 3 PM).
  - Storage: More unserved energy later in the day (6-8 PM). Solar energy fills all the needs earlier in the day.
  - Wind: more unserved energy later in the day (until 9 PM). Similar to the storage study, solar is still in the study, so energy is provided in the middle of the day.
- Takeaways:
  - In the Solar ELCC study, removing solar shifts the hours of loss-of-load to earlier in the day.
  - Removing storage and replacing it with perfect capacity results in a higher EUE MWh / MW removed than with solar and wind, implying that a MW of storage has a higher ability to prevent unserved energy than wind or solar.

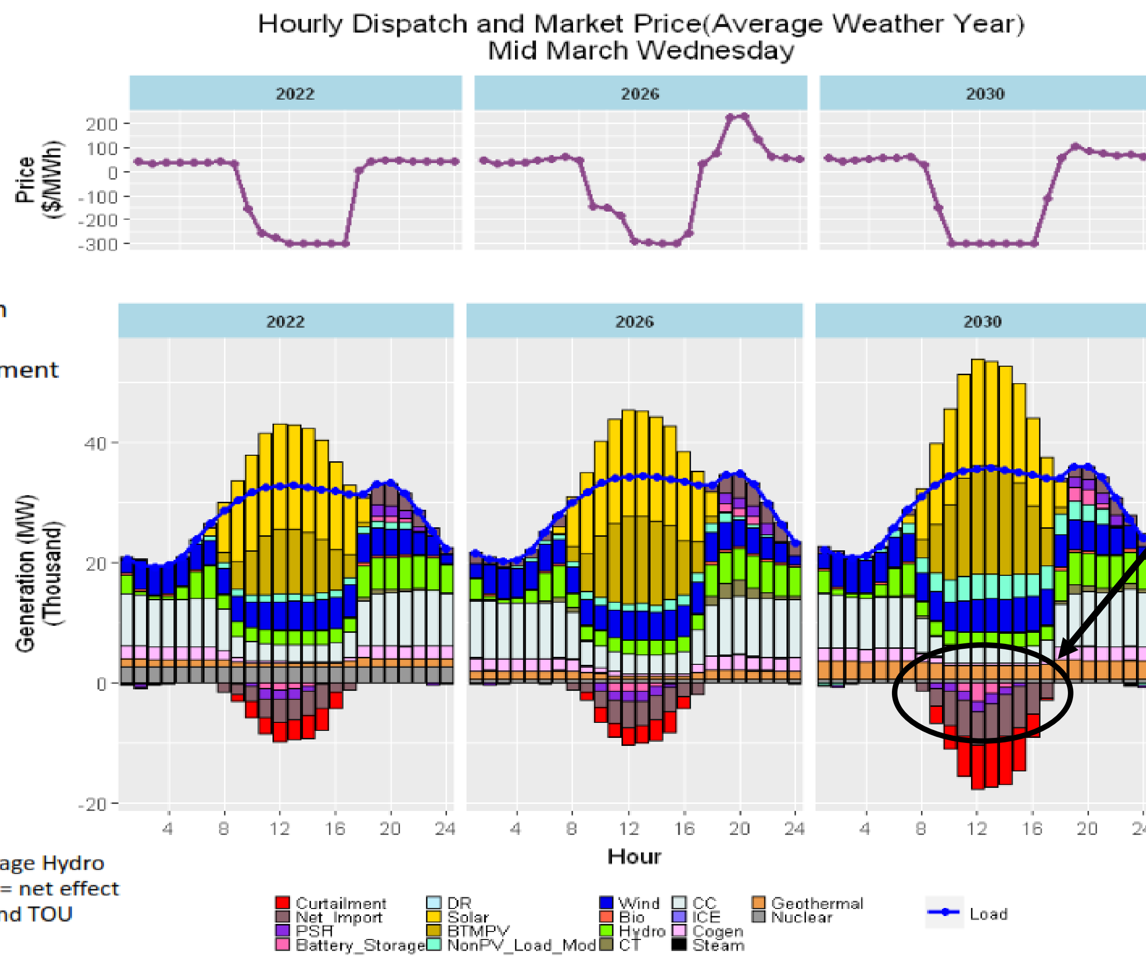
CPUC staff explored alternatives to allocate storage diversity adjustment to other resources

- Three options:
  1. "Split method:" Split storage diversity benefit between wind and solar resources based on that resource's installed capacity / total wind + solar installed capacity
  2. Allocate storage diversity benefit all to wind resources
  3. Allocate storage diversity benefit all to solar resources
- Effects on ELCC are greatest in the spring, with some significant effects in summer as well.
- Which method is the most appropriate for allocating storage's diversity benefit? Parties are invited to comment on this proposal.

CPUC staff proposal – allocate storage diversity benefit to supply side solar. Solar is the chief driver of overgeneration that is used to charge storage

50th percentile March weather (1989, case 43 of 175)

A spring day with negative midday price and curtailment in all years



Battery charging (pink bars) corresponds to time of excess solar production (yellow bars)

PSH = Pumped Storage Hydro
NonPV_Load_Mod = net effect of AAEE, EV load, and TOU

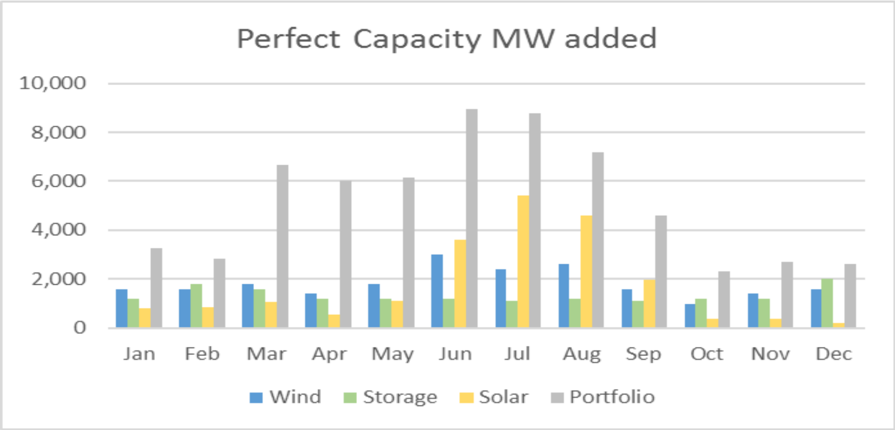
Step 1: Remove Portfolio of Resources

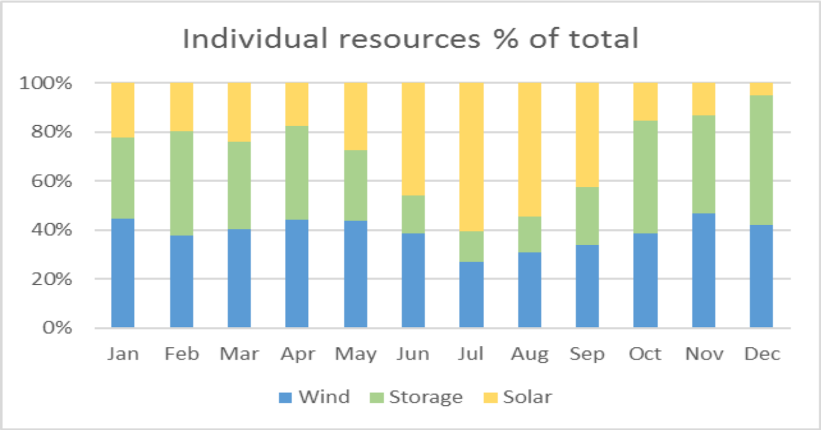
Study Number	Study Name	Study Type	MW CapMax
1	Wind	Standalone	10,522
2	Storage	Standalone	1,187
3	Solar	Standalone	13,785
4	Wind, Storage, and Solar together	Portfolio	25,495

Notes:

- Storage includes about 770 MW of batteries and about 400 MW of pumped storage hydro, but does not include Helms.
- These values do not include about 9,900 MW of BTM PV, which also affects reliability by moving the peak later in the day. Both BTM PV and Supply Side Solar have increased in penetration, with 4,500 MW of BTMPV and about 3,000 MW of Supply Side Solar added since the previous ELCC study in 2017.

Step 2: Calculate Standalone ELCC





Total Perfect Capacity MW Added to maintain LOLE target, by month

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind (10,522 MW CapMax)	1,600	1,600	1,800	1,400	1,800	3,000	2,400	2,600	1,600	1,000	1,400	1,600
Storage (1,187 MW CapMax)	1,200	1,800	1,600	1,200	1,200	1,200	1,100	1,200	1,100	1,200	1,200	2,000
Solar (13,785 MW Capmax)	800	839	1,084	554	1,128	3,594	5,400	4,594	1,994	400	400	200
Portfolio (25,496 MW CapMax)	3,257	2,839	6,684	6,000	6,128	8,936	8,794	7,200	4,600	2,300	2,700	2,600

% of Pcap added of each resource (individual resource Pcap / sum of standalone studies)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind	44%	38%	40%	44%	44%	38%	27%	31%	34%	38%	47%	42%
Storage	33%	42%	36%	38%	29%	15%	12%	14%	23%	46%	40%	53%
Solar	22%	20%	24%	18%	27%	46%	61%	55%	42%	15%	13%	5%

Storage initial studies are all about 100%, except for three months where PCap added was more than the MW of storage removed (blue cells). This is likely due to imprecision in where PCap was added relative to storage removed or where LOLE events occurred. These results are likely anomalous but small in impact. The excess PCap in those three months was removed from diversity adjustment calculation in the next step (i.e. PCap in those months was set to storage's capmax of 1200).

Steps 3 and 4: Calculate Diversity Benefit and allocate to resource types to get diversity-adjusted PCap MW

Calculate Total Diversity Adjustment, MW - *

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total MW PCap added: Portfolio	3,257	2,839	6,684	6,000	6,128	8,936	8,794	7,200	4,600	2,300	2,700	2,600
Total MW PCap added: Sum of Standalone studies	3,600	3,639	4,084	3,154	4,128	7,794	8,900	8,394	4,694	2,600	3,000	3,000
Difference = Total Diversity Adjustment MW	-343	-800	2,600	2,846	2,000	1,142	-106	-1,194	-94	-300	-300	-400

Split diversity adjustment into individual resources.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind	-152	-352	1,146	1,263	872	440	-29	-370	-32	-115	-140	-213
Storage	-114	-264	764	1,083	581	176	-13	-171	-22	-138	-120	-160
Solar	-76	-184	690	500	547	527	-64	-653	-40	-46	-40	-27
TOTAL	-343	-800	2,600	2,846	2,000	1,142	-106	-1,194	-94	-300	-300	-400

Apply wind's diversity adjustment to wind to get proposed Wind Pcap values. Add solar's diversity adjustments AND the battery diversity adjustment to solar to get ED's proposed Pcap values for solar. As stated previously, Pcap for storage set to 1200 MW.

Proposed Values	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind	1,448	1,248	2,946	2,663	2,672	3,440	2,371	2,230	1,568	885	1,260	1,387
Storage	1,200	1,200	1,200	1,200	1,200	1,200	1,100	1,200	1,100	1,200	1,200	1,200
Solar	609	391	2,538	2,137	2,256	4,296	5,323	3,770	1,932	215	240	13

- Blue cells using adjusted storage values carried forward from the previous step
- Notice – some of the diversity adjustments are negative (August for example)

Steps 5 and 6 - Different Diversity Allocations

The tables below show results from allocating storage diversity to wind or solar resources

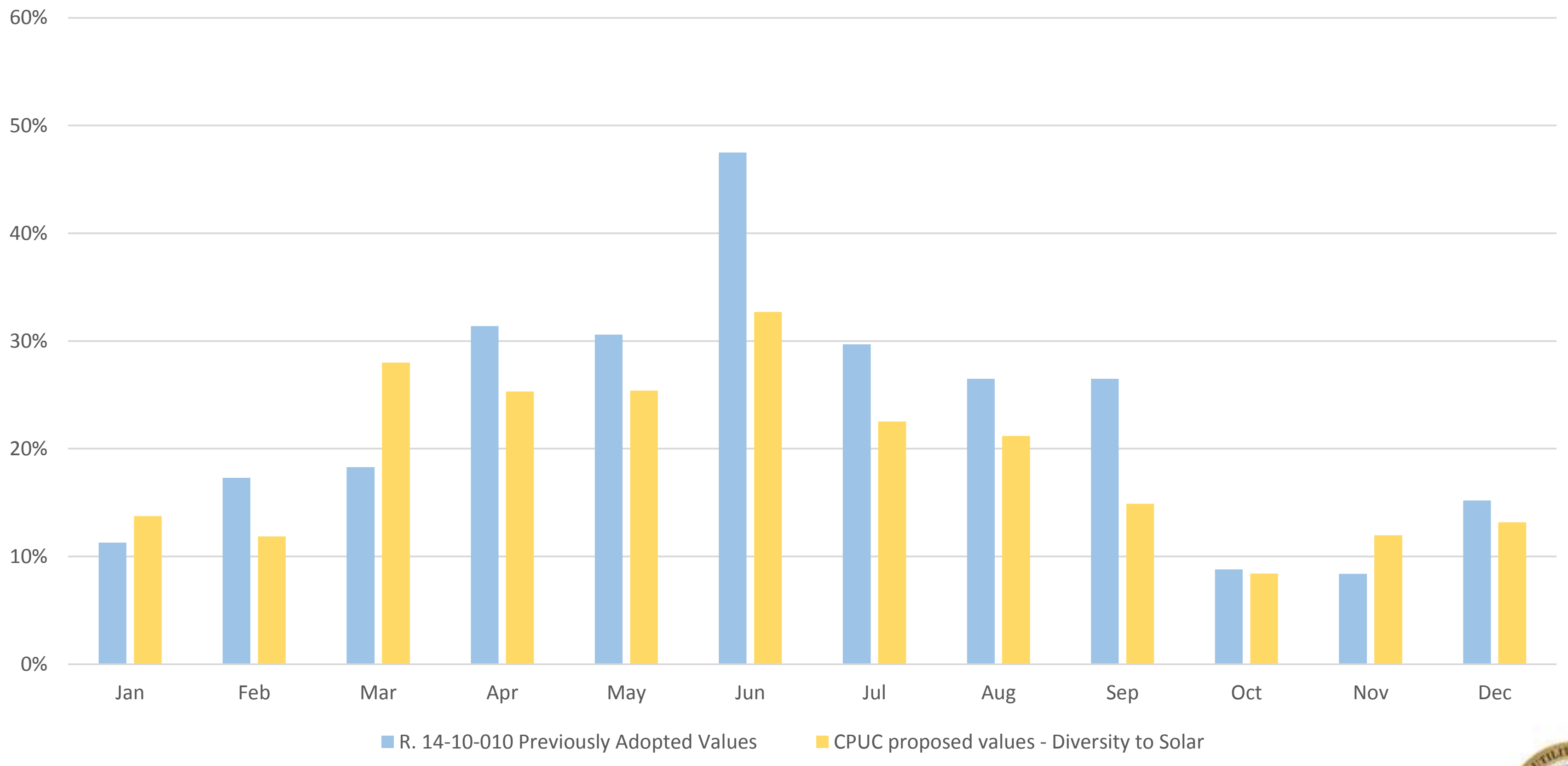
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R. 14-10-010 Previously Adopted Values	**Wind**	11%	17%	18%	31%	31%	48%	30%	27%	27%	9%	8%	15%
CPUC proposed values - Diversity to Solar		14%	12%	28%	25%	25%	33%	23%	21%	15%	8%	12%	13%
Split storage diversity btwn wind/solar		13%	11%	31%	30%	28%	33%	22%	20%	15%	8%	11%	13%
Allocate storage diversity to wind		13%	9%	35%	36%	31%	34%	22%	20%	15%	7%	11%	12%

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R. 14-10-010 Previously Adopted Values	**Solar**	0%	2%	10%	33%	31%	45%	42%	41%	33%	29%	4%	0%
CPUC proposed values - Diversity to Solar		4%	3%	18%	15%	16%	31%	39%	27%	14%	2%	2%	0%
Split storage diversity btwn wind/solar		5%	4%	16%	12%	15%	31%	39%	28%	14%	2%	2%	1%
Allocate storage diversity to wind		5%	5%	13%	8%	12%	30%	39%	29%	14%	3%	3%	1%

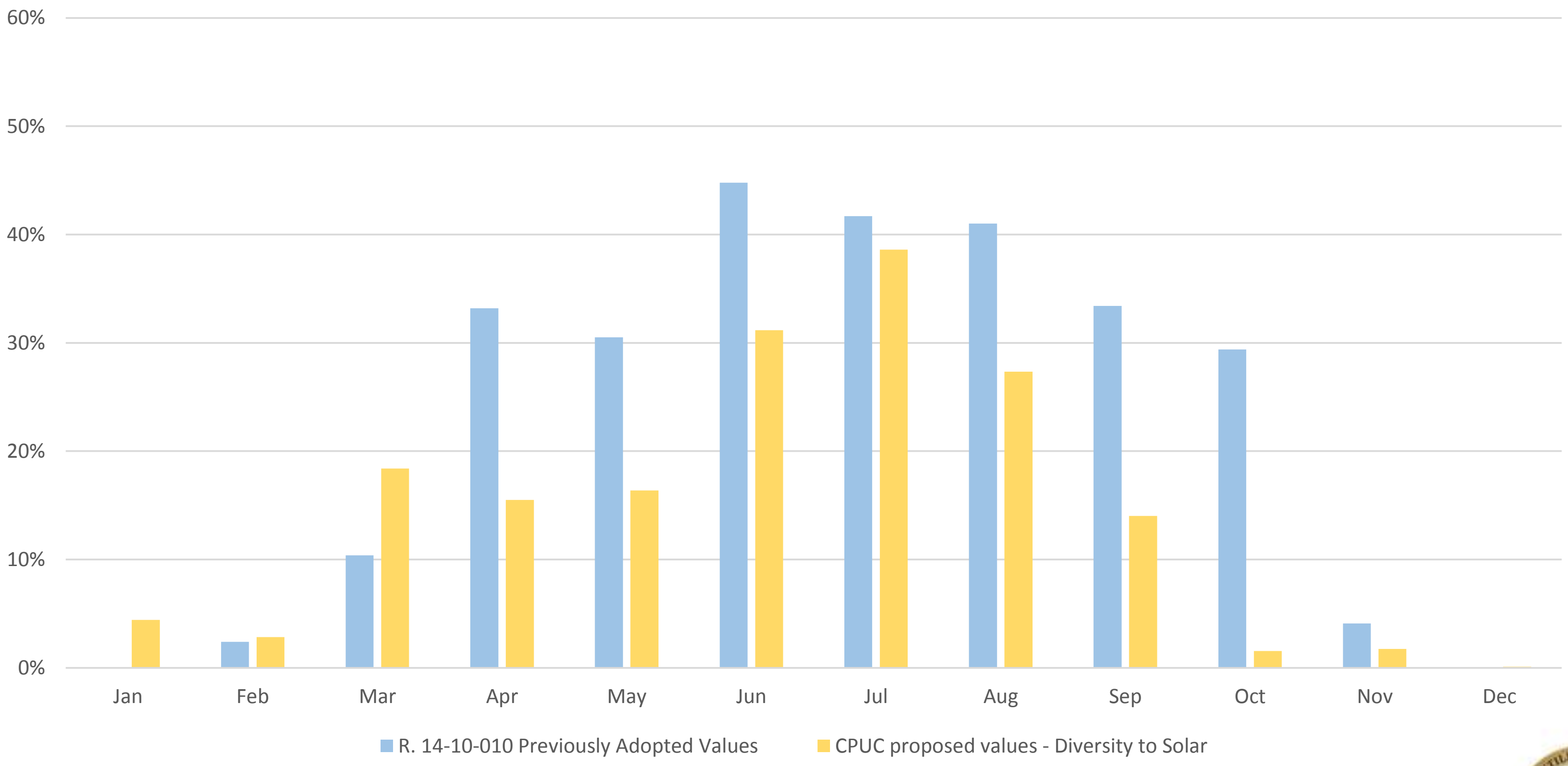
Notes:

- Values changed on this slide relative to December 2018 proposal
- Blue text represents currently adopted 2018 ELCC percentages, orange rows represent Energy Division proposed ELCC percentages for 2020 compliance year.
- Solar ELCC values decline relative to 2018 values due to significant increase in solar penetration. About 3,000 MW of supply side solar increase since 2018.
- Staff also didn't remove BTM PV for ELCC study, treated as demand modifier. About 9,900 MW of BTMPV included in 2020, which is 4,500 MW increase since 2018 and also has effects on ELCC, as the LOLE events are moved later in the day.
- When diversity adjustment is negative, solar gets lower ELCC than if diversity were allocated to wind. (August for example)

Proposed Monthly Wind ELCCs: previously adopted vs proposed percentage



Proposed Monthly Solar ELCCs: previously adopted vs proposed percentage



Conclusion and Next Steps

- CPUC staff presents results for ELCC studies that include wind, supply side (not BTM) solar, and storage. Staff also proposes ELCC values for supply side solar and wind.
- CPUC staff highlights the effects of the CPUC's current method of allocating diversity – as storage's standalone ELCC equals 100%, diversity adjustments would raise it over 100%. Thus CPUC staff proposes to allocate the diversity adjustment to other resources.
- CPUC staff proposes to set storage ELCC at 100% of nameplate, and to allocate diversity adjustments (positive and negative) to supply side solar in light of how storage is expected to be charged.
- Parties are invited to comment on CPUC staff's ELCC results and proposal to change the allocation of diversity adjustment.

Thank you!

For Additional Information:

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