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ATTACHMENT

Energy Division Monthly ELCC Proposal for 2020 RA Proceeding

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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

- Show CPUC staff proposed results of resource-specific ELCC percentages (for studies 1-3 above) to use in the RA proceeding for capacity counting purposes in the 2020 RA compliance year
- Objective – inform party input on these results as well as the best way to handle energy storage

Background and Definitions

- Effective Load Carrying Capability (ELCC) equals the comparative value of a generator in terms of reducing Loss of Load Expectation (LOLE) compared to a Perfect Generator
  - ELCC % = (MW of Perfect Generator, or PCap) / (MW of generator being studied)
  - Perfect Generator would have ELCC equal to 100%
  - A generator with 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 take each of the effects of diversity into account (a single resource type, such as wind, can be more or less effective at reducing LOLE depending on its interaction with other resources that are on the grid)
    - Methodology for diversity adjustment is detailed in the next slides

ELCC Diversity Benefits

- Groups of different resources can provide more benefit in terms of reducing LOLE than resources individually. It is difficult to separate out individual resource value individually from other non-dispatchible resources.
- As an example, solar generates during the day, covering LOLE events at peak time. Thus LOLE events predominate in other times, such as early evening, when wind blows more. Thus wind offsets LOLE events more due to presence of solar, and the two resources provide diversity benefit to each other.
- This diversity benefit varies by month, because some resources are more effective in certain months (e.g. solar produces more energy in summer months, due to longer days and increased insolation).
- CPUC staff proposed a generally agreeable method to calculate diversity benefit in February 2018, which required three stages of analysis.
  1. Test ELCC of portfolio as aggregate.
  2. Test ELCC of individual resource groupings
  3. Compare and adjust individual resource ELCC upwards or downwards so total of individual groups matches ELCC of whole grouping
- The stages of analysis are detailed in the next slide

Monthly ELCC calculations: Process

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

2. **Surface Monthly LOLE in a given system** by removal or addition until overall LOLE in each month is within a range of 0.02 and 0.03 LOLE reliability target.

3. **Calculate total Portfolio ELCC** as the equivalent 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.

4. **Calculate total MW of diversity benefit** by subtracting individual resource class PCap MW equivalent from total Portfolio PCap MW

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

6. **Add the diversity benefit** to the appropriate PCap from step 1 to get each resource type's diversity-adjusted PCap value.

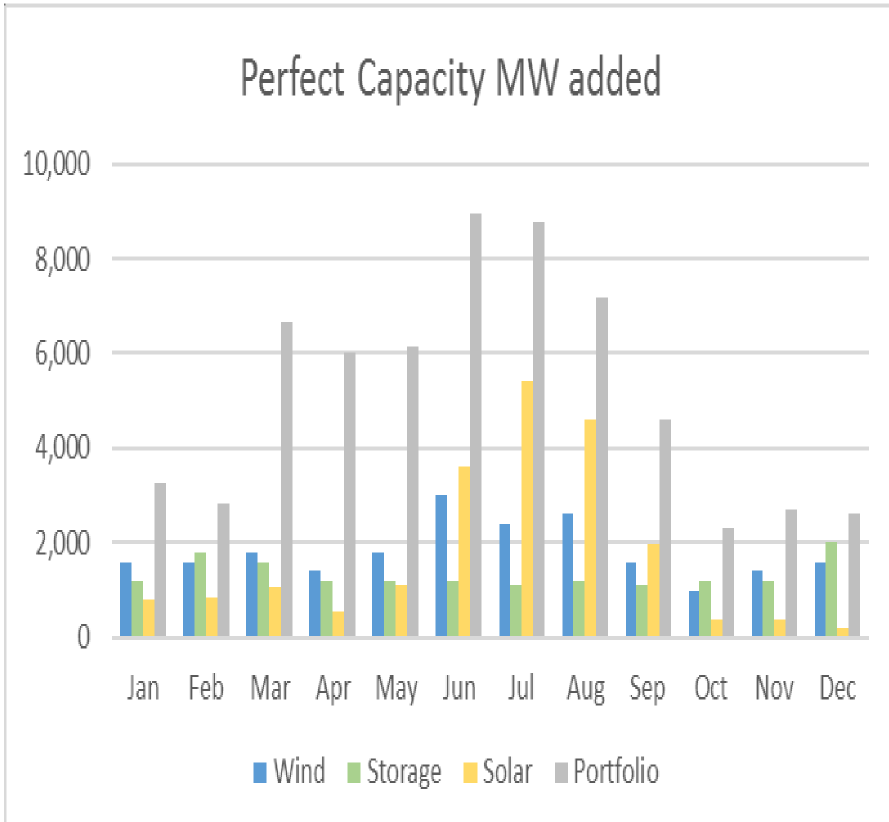
7. **Calculate final diversity-adjusted ELCC %:** Divide the results of Step 5 by total nameplate of the resource

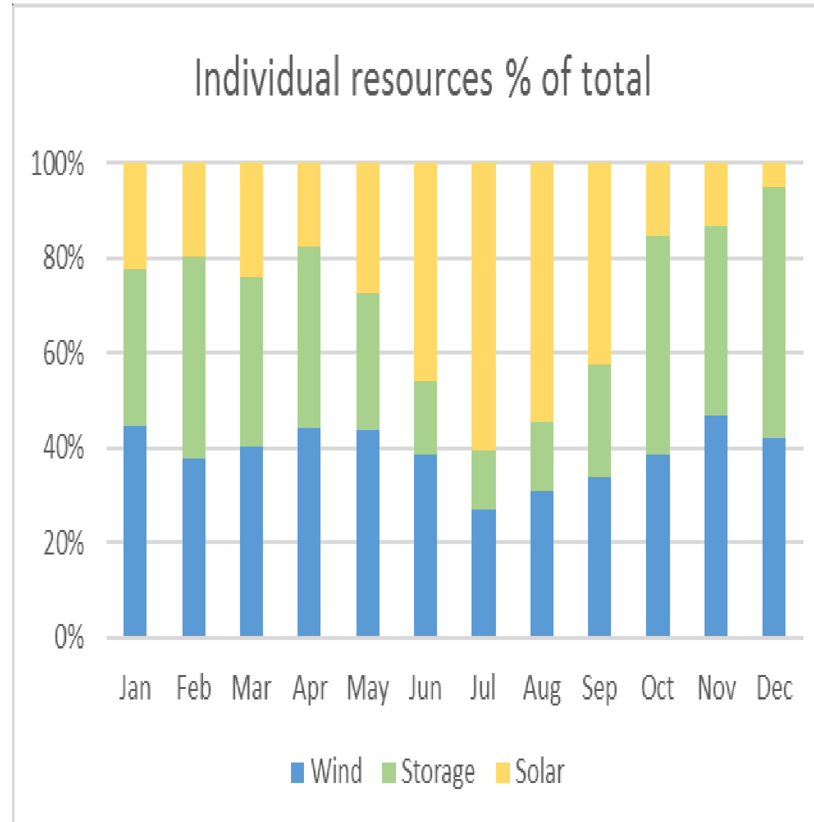
Step 1: Remove Portfolio of Resources

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

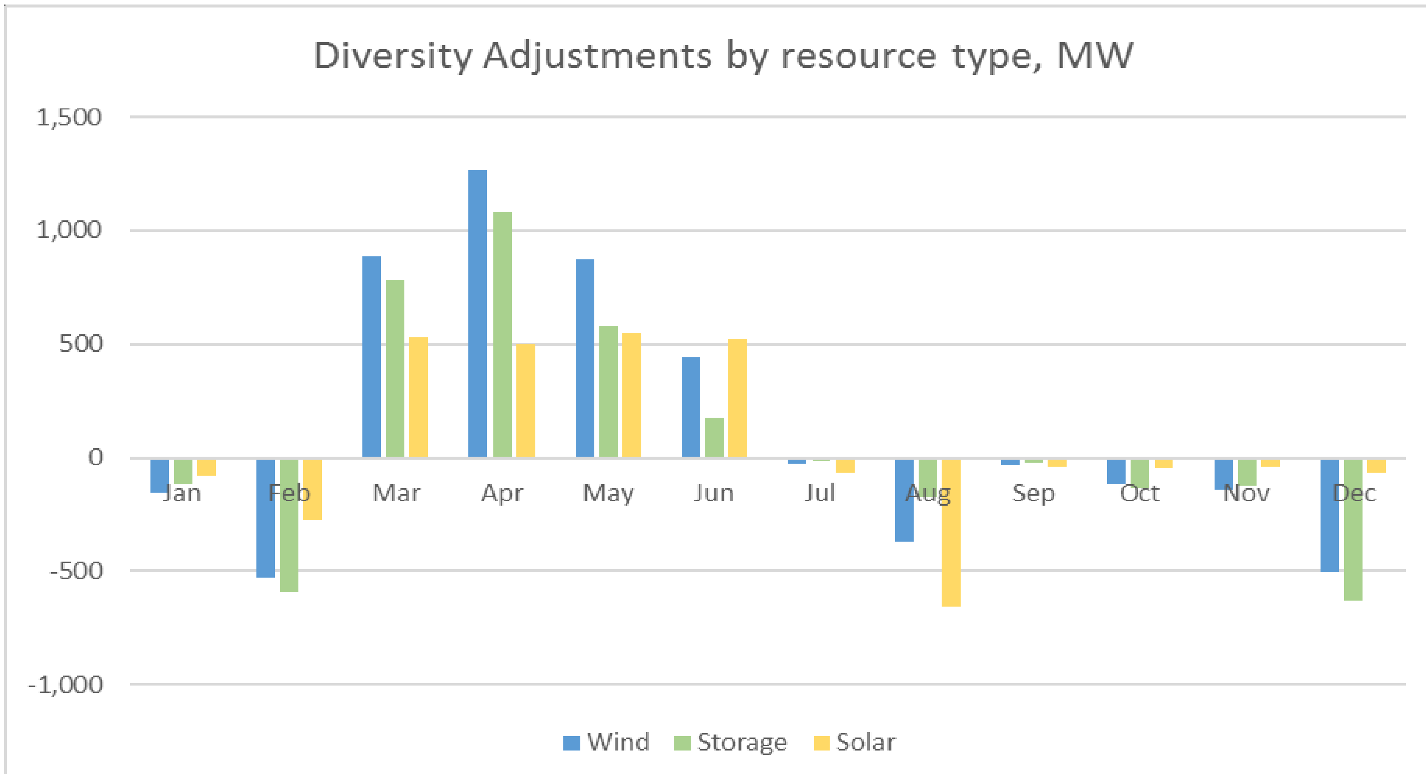
Note: Storage includes about 770 MW of batteries and about 400 MW of pumped storage hydro, but does not include Helms.

Step 2: Calculate total PCap added





Steps 3 and 4: Calculate Diversity Benefit and allocate to resource types



Steps 5 and 6: Use diversity-adjusted PCap MW to calculate ELCC %

Add the diversity benefit to each resource type's PCap to calculate diversity-adjusted PCap MW

Diversity adjusted Pcap MW	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind	1,448	1,072	2,683	2,663	2,672	3,440	2,371	2,230	1,568	885	1,260	1,095
Storage	1,086	1,206	2,385	2,283	1,781	1,376	1,087	1,029	1,078	1,062	1,080	1,368
Solar	724	562	1,616	1,054	1,675	4,121	5,336	3,941	1,954	354	360	137

Calculate final diversity-adjusted ELCC % = Diversity-adjusted PCap MW / Total Nameplate.

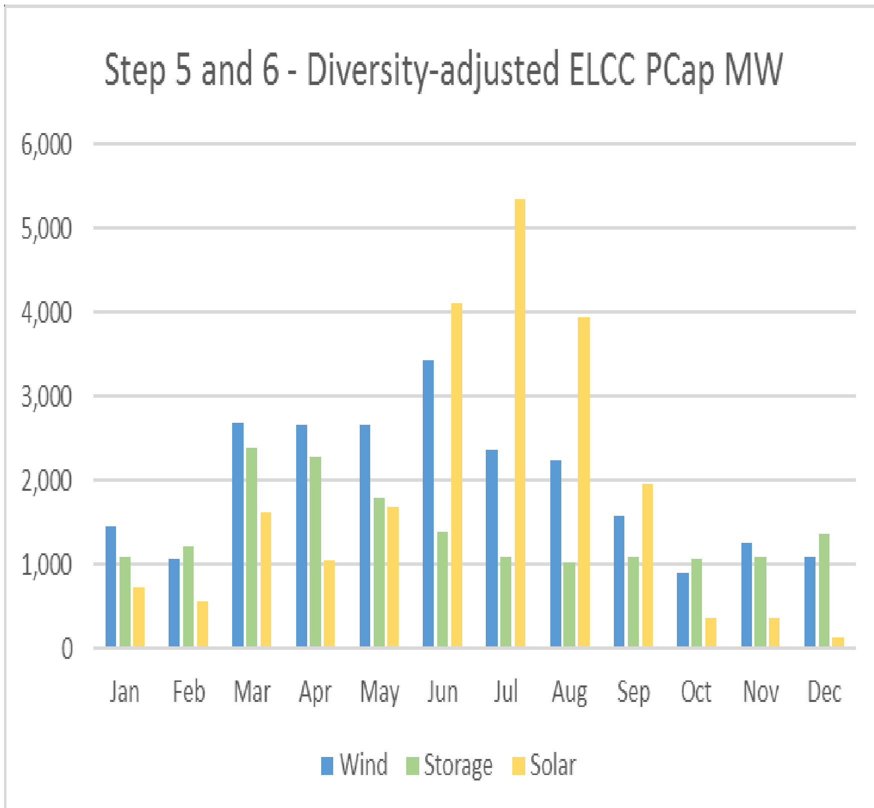
Solar ELCC values decline relative to 2018 values because of increase in solar penetration. About 3,000 MW of supply side solar increase since 2018.

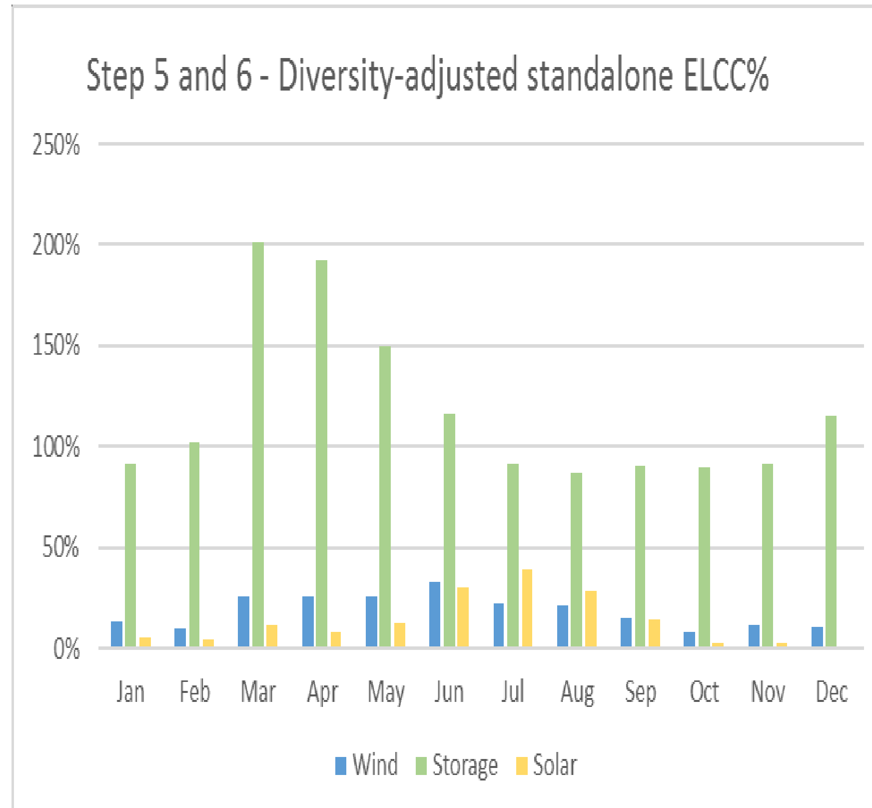
Staff also didn't remove BTM PV for ELCC study, treated as demand modifier. About 9,900 MW of BTMPV included in 2020, which is 4,500 MW increase since 2018

Diversity adjusted ELCC %	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind	14%	10%	25%	25%	25%	33%	23%	21%	15%	8%	12%	10%
Storage	91%	102%	201%	192%	150%	116%	92%	87%	91%	89%	91%	115%
Solar	5%	4%	12%	8%	12%	30%	39%	29%	14%	3%	3%	1%

	Total Nameplate
Wind	10,522
Storage	1,187
Supply Side Solar	13,785

Steps 5 and 6: Use diversity-adjusted PCap MW to calculate ELCC %





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 provides value to the grid both when it charges and when it discharges
    - Charging storage absorbs excess generation from other resources (like solar), which increases the usefulness of that generation for reducing LOLE and increasing it’s ELCC.
    - Because storage can be started and ramped up and down instantaneously, it acts as an optimal generator.
  - Conceptually, the total value of storage is equal to the sum of the value it provides itself, and the interactive value other resources have when storage is present.
  - This is seen in the observed amount of PCap needed to replace storage when it is removed, as removing storage also removes the interactive value other resources have in the presence of storage. Thus the ELCC of storage appears to be over 100%, but that value should be reallocated to the other resource that interacts with storage.

CPUC staff explored alternatives to allocate excess storage ELCC between other resources

- Three alternatives:
  1. Allocate 0% of excess storage ELCC to that resource
  2. “Split method:” Split excess storage ELCC to wind and solar based on that resource’s installed capacity / (wind + solar installed capacity)
  3. Allocate all excess storage ELCC (over 100%) to either all wind or all solar resources
- Effects on ELCC are greatest in the spring, with some significant effects in summer as well

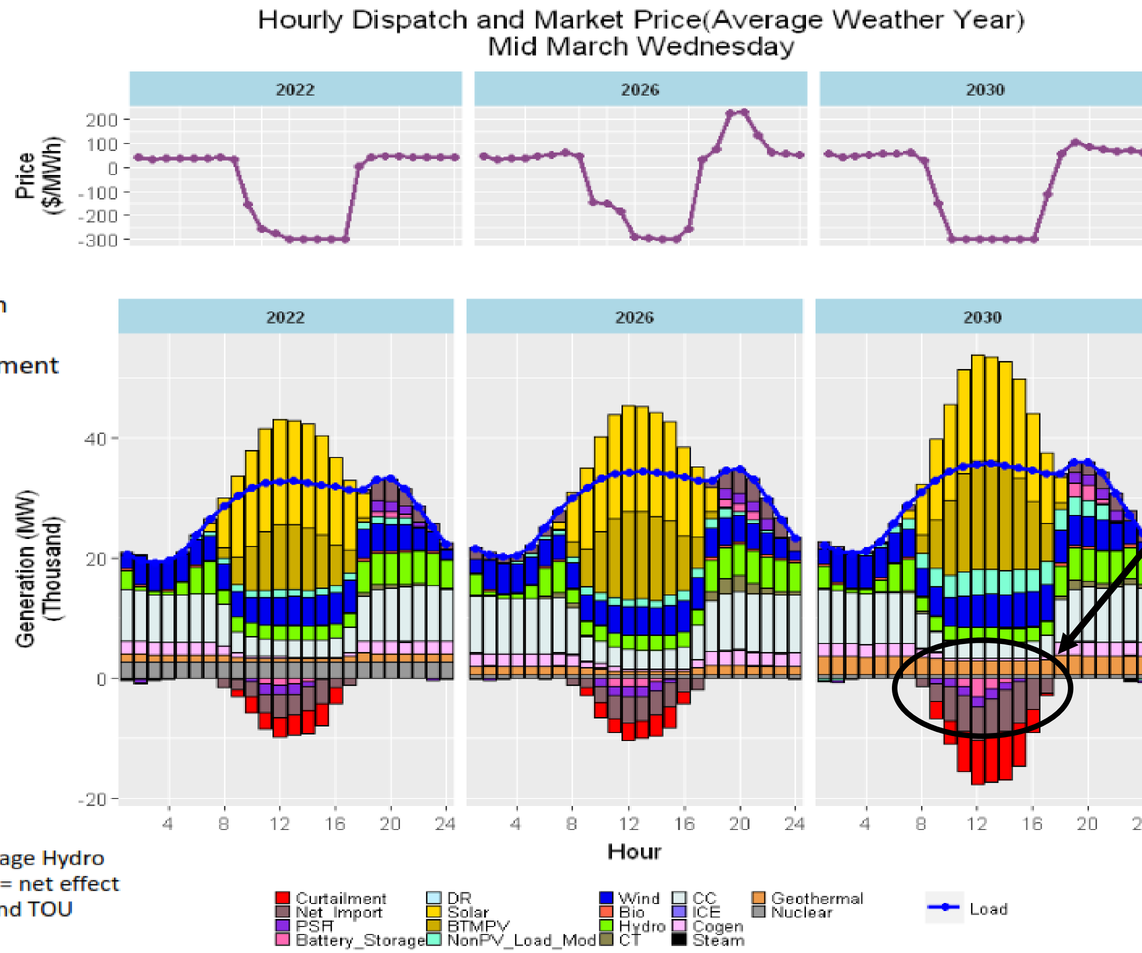
Policy Question: How to treat storage in ELCC analysis?

1. When the ELCC value of storage exceeds 100%, should CPUC staff reallocate the excess (i.e. above 100%) ELCC value of storage to wind and solar? If so, how?
2. Should CPUC staff consider a diversity adjustment method? If so, what should that method be?
3. CPUC staff proposes to allocate excess to solar, because of when the storage often charges (during the middle of the day) and give storage an NQC equal to 100% ELCC.
4. CPUC staff is seeking input from parties on this proposal.

CPUC staff recommends allocating all excess storage value to solar, as 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

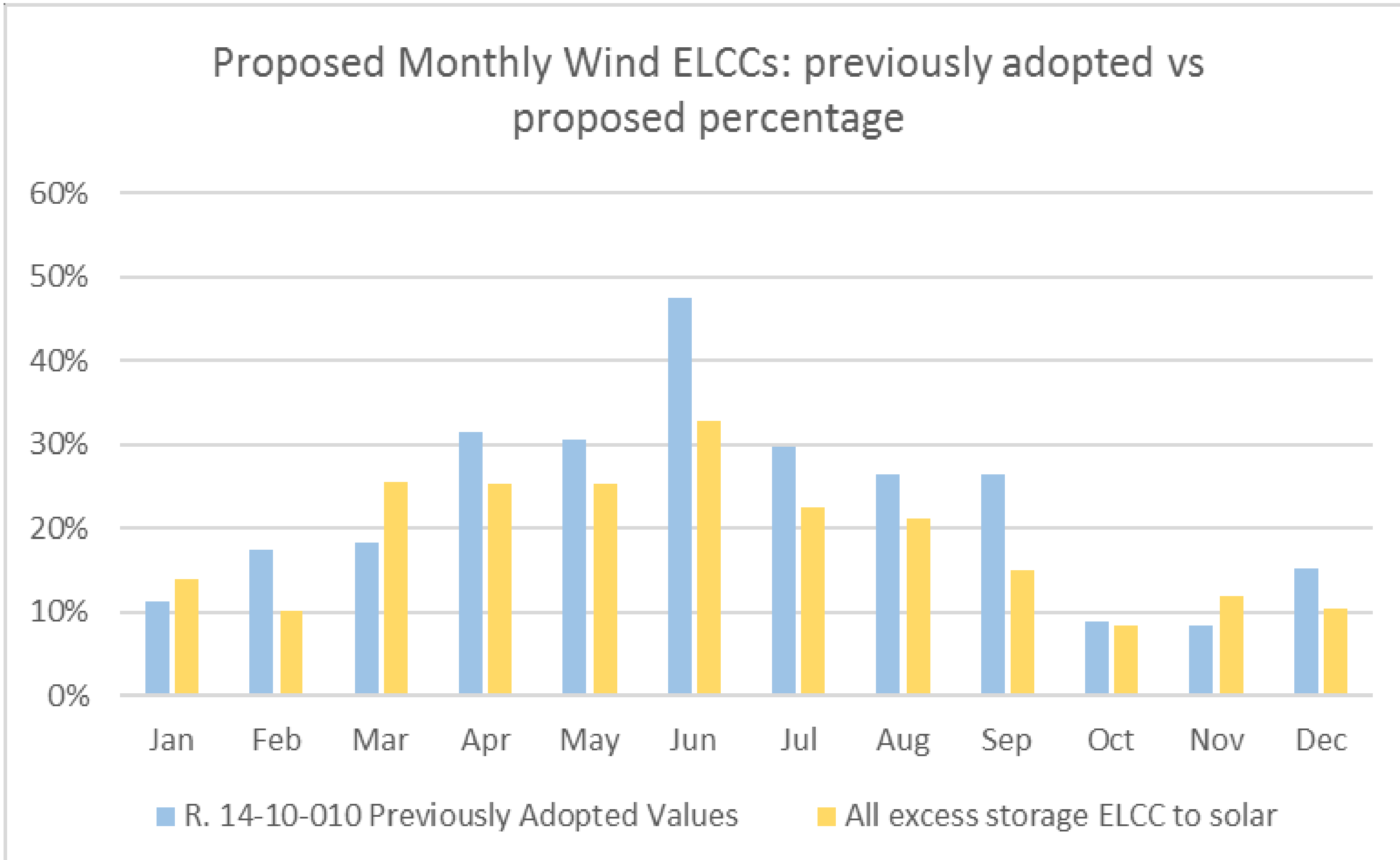
Effects on wind and solar of different allocation methods

		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%
All excess storage ELCC to solar	Wind	14%	10%	25%	25%	25%	33%	23%	21%	15%	8%	12%	10%
Split excess storage ELCC btwn wind/solar	Wind	14%	10%	30%	30%	28%	33%	23%	21%	15%	8%	12%	11%
All excess storage ELCC to wind	Wind	14%	10%	37%	36%	31%	34%	23%	21%	15%	8%	12%	12%
Standalone ELCC value	Storage	91%	102%	201%	192%	150%	116%	92%	87%	91%	89%	91%	115%
All excess storage ELCC to solar	Storage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Split excess storage ELCC btwn wind/solar	Storage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
All excess storage ELCC to wind	Storage	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

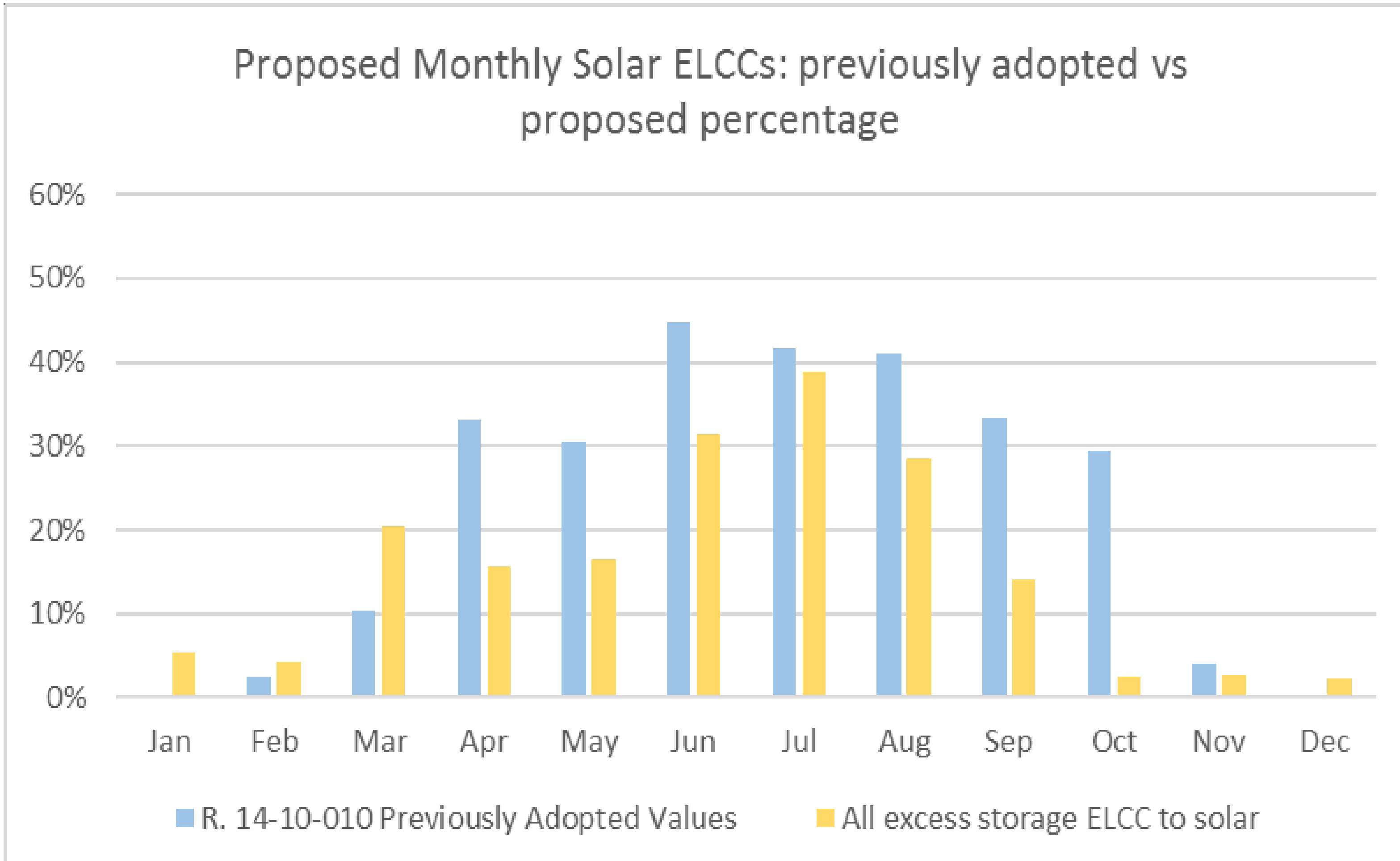
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R. 14-10-010 Previously Adopted Values	Solar	0%	2%	10%	33%	31%	45%	42%	41%	33%	29%	4%	0%
All excess storage ELCC to solar	Solar	5%	4%	20%	16%	16%	31%	39%	29%	14%	3%	3%	2%
Split excess storage ELCC btwn wind/solar	Solar	5%	4%	17%	12%	15%	31%	39%	29%	14%	3%	3%	2%
All excess storage ELCC to wind	Solar	5%	4%	12%	8%	12%	30%	39%	29%	14%	3%	3%	1%

Blue text represents currently adopted 2018 ELCC percentages, orange rows represent Energy Division proposed ELCC percentages for 2020 compliance year.

Monthly Wind ELCCs under different excess storage ELCC allocation methods



Monthly Wind ELCCs under different excess storage ELCC allocation methods



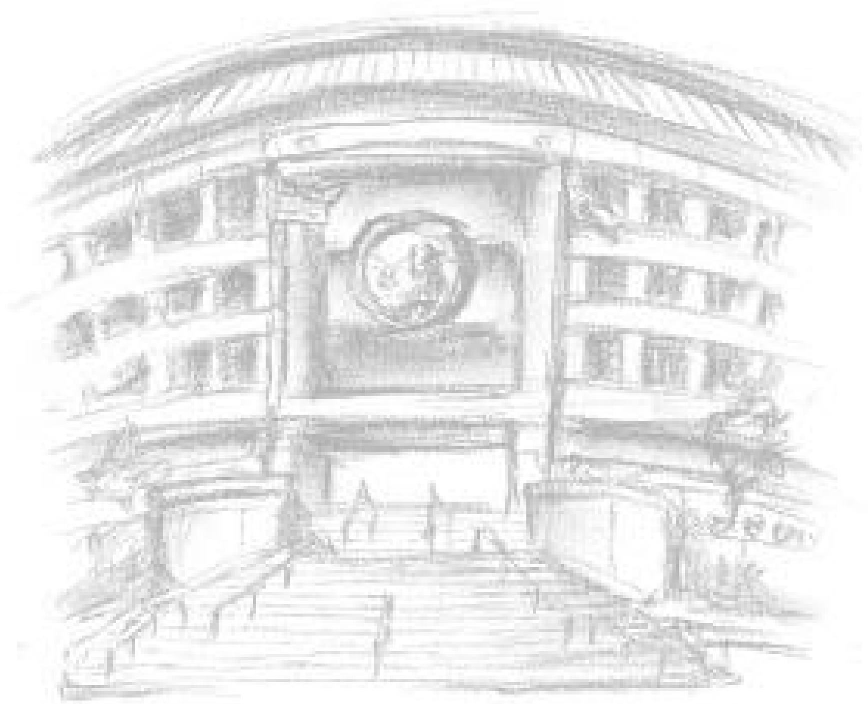
Conclusion and Next Steps

- CPUC staff presents results for ELCC studies that include wind, supply side (not BTM) solar, and storage.
- CPUC staff highlights the diversity benefit between particularly solar and storage.
- CPUC staff proposes to allocate excess ELCC benefit from storage to supply side solar.
- Parties are invited to comment on CPUC staff ELCC results and proposal about allocation of excess ELCC benefits.

Thank you!

For Additional Information:

www.cpuc.ca.gov



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