Solar Cost Sensitivity Modeling

CPUC Staff Analysis

February 21, 2020

Purpose & Outline

- Purpose: CPUC staff analysis to support the resource-to-busbar mapping process in the 2019-2020 IRP cycle

- Outline:
  - Background
  - Analytical approach
  - Results
  - Conclusion

Solar Sensitivity Modeling: Background

- Throughout the course of IRP capacity expansion modeling, CPUC staff, consultants, and stakeholders have observed that the location of solar resources selected in IRP modeling can be sensitive to small cost and performance differences between solar resources
  - California has many areas of high solar resource quality
  - Other resource types, including wind and geothermal, have more distinct location-specific characteristics
- Transmission constraints provided by CAISO help to guide the location of solar resources in IRP modeling, but many iterations of IRP modeling have suggested that solar resources typically "fill in" around other renewable resources (wind and geothermal)
  - Even though the RESOLVE model deploys all resources simultaneously, results have suggested that, at least conceptually, RESOLVE usually uses system-wide economic factors to determine the capacity of wind and geothermal resources, and then deploys the least cost solar resources "next" using any available transmission
- The location-specific cost information available to IRP analysis is not as granular as that available to project developers and therefore may not accurately capture local cost differences

Solar Sensitivity Modeling: Analytical approach

- This analysis tests the hypothesis that small cost differences can cause large shifts in the location of solar resources, but will result in minimal changes in the overall resource portfolio (solar vs. wind vs. battery, etc.) and accordingly, minimal differences in the expected cost, reliability, and emissions performance of the portfolio
- Two sets of RESOLVE model runs were performed, in which solar costs were reduced by either 5% or 10% relative to base case assumptions
  - 5% and 10% were chosen because they represent a small perturbation to the original solar capital cost, potentially on the order of magnitude of locational cost differences observed in the real world
- Two model runs were performed for each CAISO solar resource. In these runs, the cost was reduced by either 5% or 10% for only one solar resource at a time
  - For example, the 5% Carrizo sensitivity reduces only the cost of Carrizo solar by 5% and leaves all other assumptions unchanged
- Results for 2023 and 2030 were examined to detect potential differences between near and long-term effects
- The analysis uses a Base Scenario that is similar to, but not aligned completely with, the Reference System Portfolio in the Proposed Decision
  - The inputs and assumptions are broadly consistent with the 2019 Reference System Portfolio, however the analytical approach focuses on changes relative to the Base Scenario
  - The applicability of the analytical approach to different portfolios (e.g., with 30 MMT by 2030 GHG target) is discussed

- **In general, the analysis confirms the hypothesis. This suggests that, for the purpose of providing inputs to the TPP, it may be appropriate to post-process RESOLVE solar location results to consider non-modeling factors (for example, alignment with commercial interest)**

MW selected in solar sensitivities

	Base Scenario		Cost reductions applied for each solar resource one-by-one: 5% Reduction		10% Reduction	
Solar Resource Name	2023	2030	2023	2030	2023	2030
Carrizo_Solar	-	-	-	-	44	44
Central_Valley_North_Los_Banos_Solar	-	-	-	-	-	-
Mountain_Pass_El_Dorado_Solar	248	248	248	248	248	248
Greater_Imperial_Solar	-	548	867	867	867	867
Inyokern_North_Kramer_Solar	97	97	97	97	97	97
Kern_Greater_Carrizo_Solar	72	72	155	855	1,137	1,137
Kramer_Inyokern_Ex_Solar	-	-	-	-	-	-
North_Victor_Solar	300	300	300	300	300	300
Northern_California_Ex_Solar	-	-	-	-	-	-
Riverside_Palm_Springs_Solar	-	-	1,834	2,352	2,479	2,479
Sacramento_River_Solar	-	-	-	-	-	-
SCADSNV_Solar	-	198	-	330	3,133	3,230
Solano_Solar	-	-	-	-	57	622
Southern_California_Desert_Ex_Solar	862	862	862	862	862	862
Southern_Nevada_Solar	-	-	596	596	596	596
Tehachapi_Ex_Solar	-	-	-	-	-	-
Tehachapi_Solar	3,402	4,202	4,202	4,202	4,202	4,202
Westlands_Ex_Solar	818	818	1,779	1,779	1,779	1,779
Westlands_Solar	-	-	155	155	442	442
Arizona_Solar	1,487	2,352	2,394	2,394	2,585	2,585

Green = no change from base case

Red = increase in resource deployment resulting from solar cost decrease

The available transmission capacity of the existing transmission system is typically a more limiting factor for solar deployment in RESOLVE than the solar resource potential. Consequently, the MW values in the table above frequently "plateau" at the amount of transmission available to solar resource.

MW selected in solar sensitivities: explanations

Solar Resource Name	Base Scenario 2023	Base Scenario 2030	5% Reduction 2023	5% Reduction 2030	10% Reduction 2023	10% Reduction 2030
Carrizo_Solar	-	-	-	-	44	44
Central_Valley_North_Los_Banos_Solar	-	-	-	-	-	-
Mountain_Pass_El_Dorado_Solar	248	248	248	248	248	248
Greater_Imperial_Solar	-	548	867	867	867	867
Inyokern_North_Kramer_Solar	97	97	97	97	97	97
Kern_Greater_Carrizo_Solar	72	72	155	855	1,137	1,137
Kramer_Inyokern_Ex_Solar	-	-	-	-	-	-
North_Victor_Solar	300	300	300	300	300	300
Northern_California_Ex_Solar	-	-	-	-	-	-
Riverside_Palm_Springs_Solar	-	-	1,834	2,352	2,479	2,479
Sacramento_River_Solar	-	-	-	-	-	-
SCADSNV_Solar	-	198	-	330	3,133	3,230
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Southern_California_Desert_Ex_Solar	862	862	862	862	862	862
Southern_Nevada_Solar	-	-	596	596	596	596
Tehachapi_Ex_Solar	-	-	-	-	-	-
Tehachapi_Solar	3,402	4,202	4,202	4,202	4,202	4,202
Westlands_Ex_Solar	818	818	1,779	1,779	1,779	1,779
Westlands_Solar	-	-	155	155	442	442
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Color scheme:

Cost reduction doesn't result in more resource deployment because resource is already selected up to transmission limits in the base case

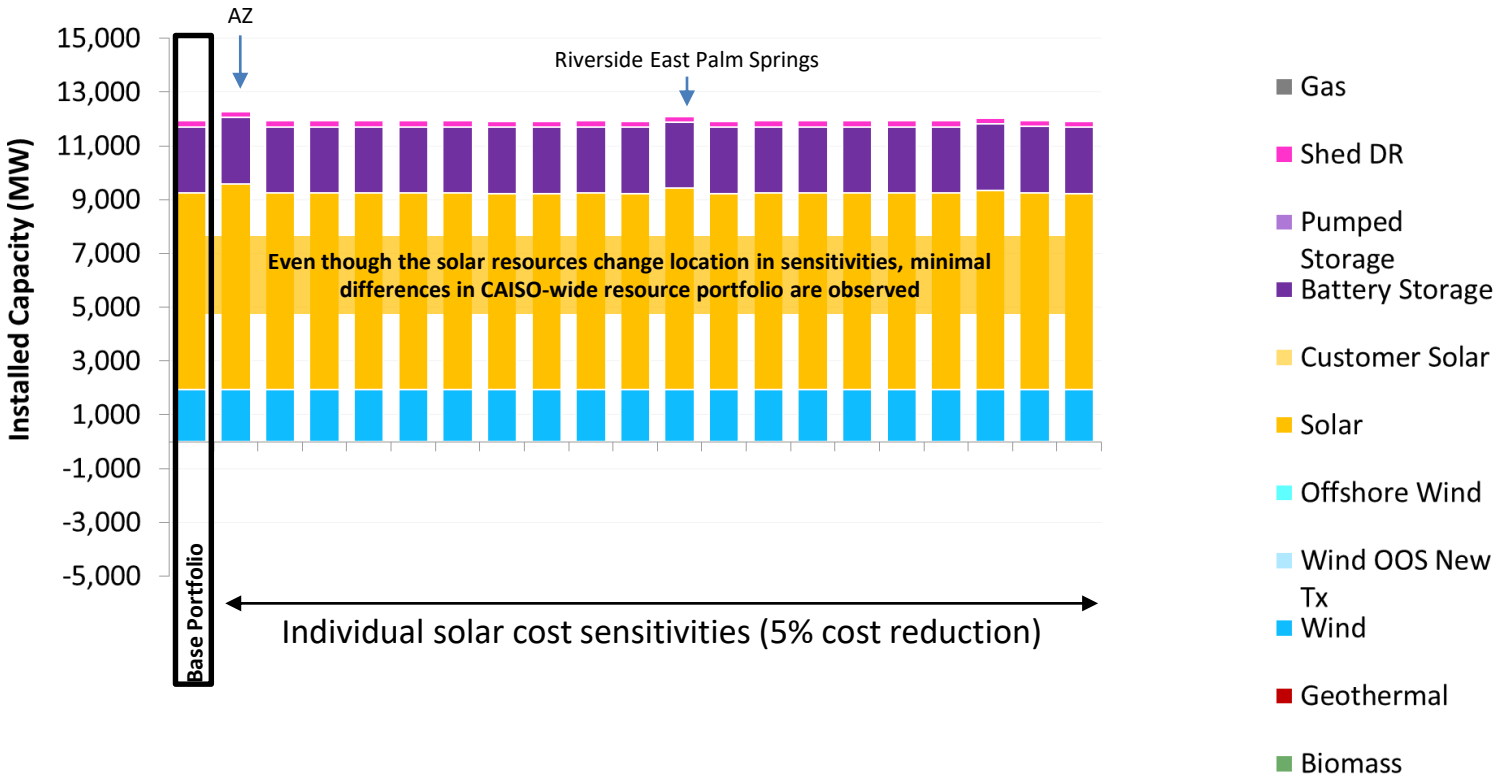
Small (5% cost reduction) results in most of the available resource being selected

Larger (10% cost reduction) results in most of the available resource being selected

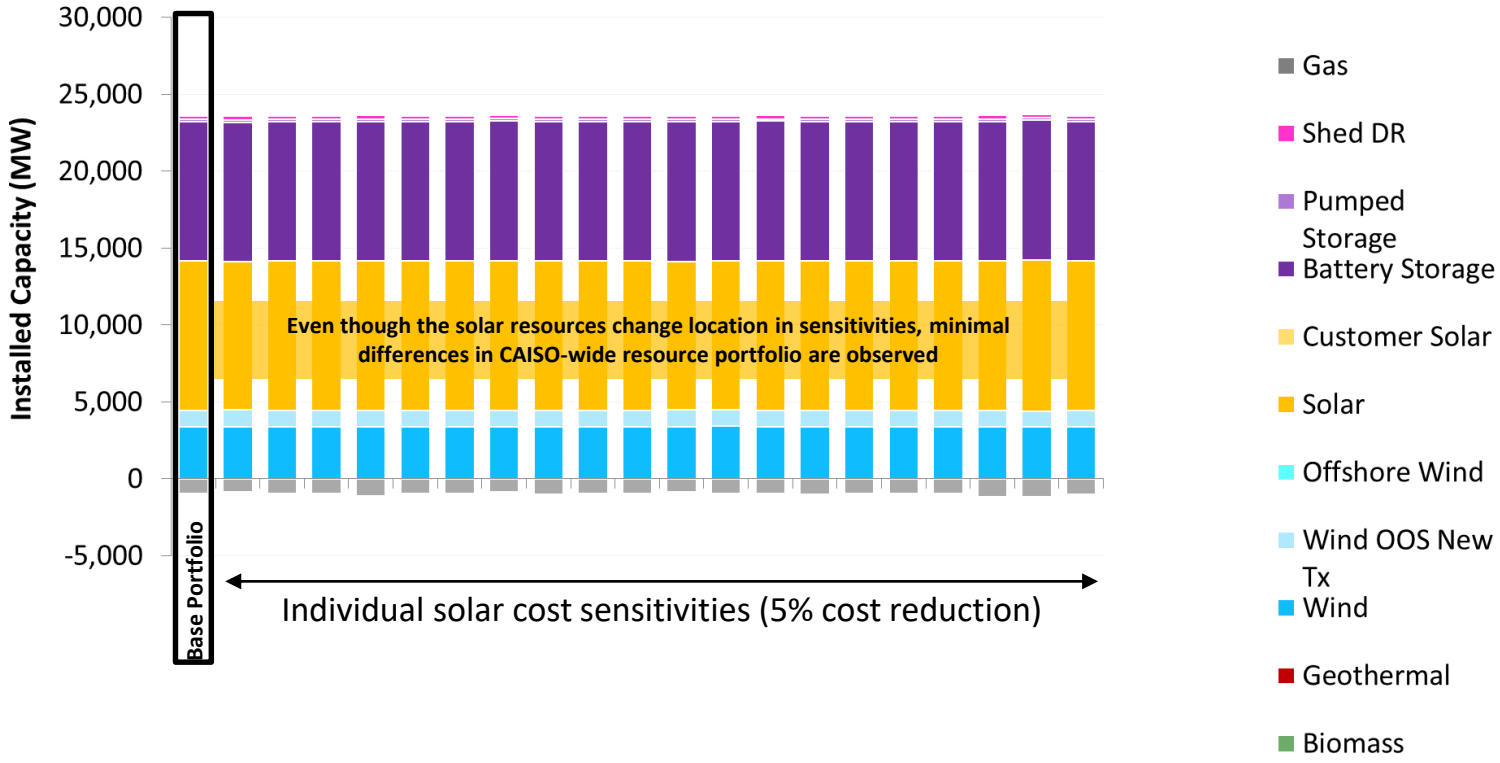
Conclusion: Almost all CAISO solar resources are within 10% of cost-effective, and are therefore likely to be sensitive to local cost information

2023, 5% solar cost reduction

Lower costs for areas with significant available transmission can result in slightly more system-wide solar build than the base case.

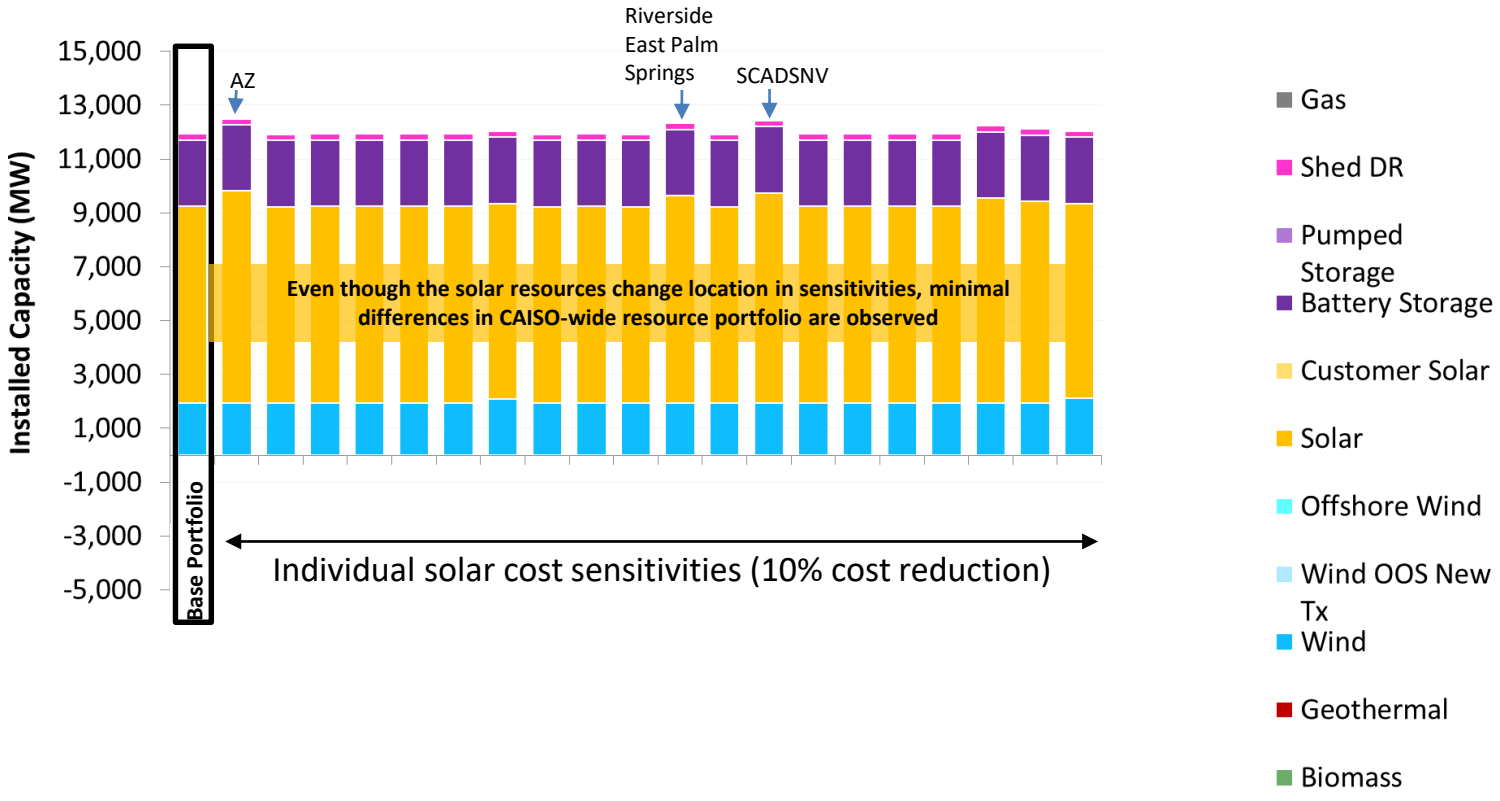


2030, 5% solar cost reduction

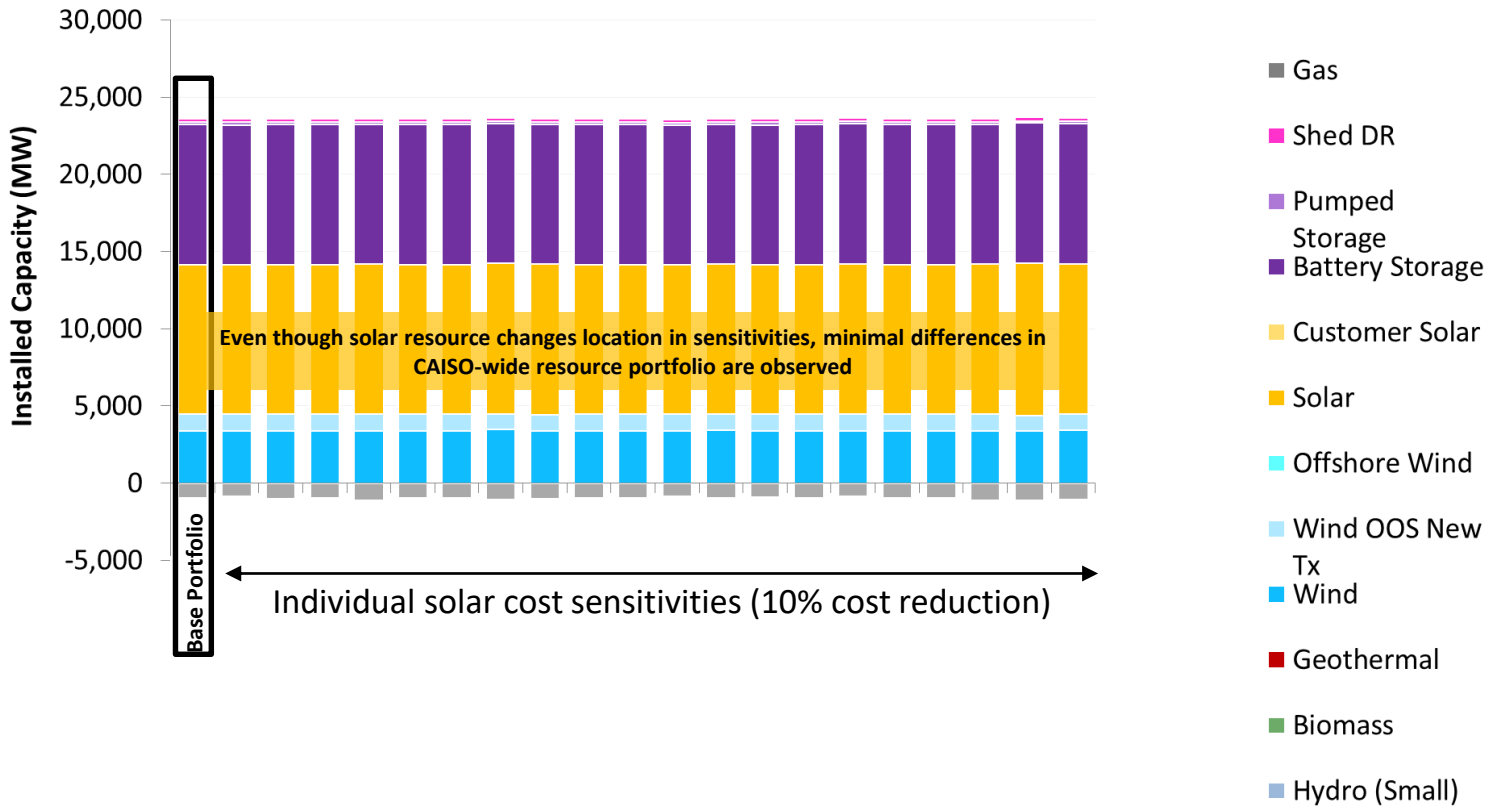


2023, 10% solar cost reduction

Lower costs for areas with significant available transmission can result in slightly more system-wide solar build than the base case.



2030, 10% solar cost reduction



Conclusion

- This analysis tests the hypothesis that small cost differences can cause large shifts in the location of solar resources, but will result in minimal changes in the overall resource portfolio (solar vs. wind vs. battery, etc.) and accordingly, minimal differences in the expected cost, reliability, and emissions performance of the portfolio
- In general, the analysis confirms the hypothesis. This suggests that, for the purpose of providing inputs to the TPP, it may be appropriate to post-process RESOLVE solar location results to consider non-modeling factors (for example, alignment with commercial interest)
- From experience analyzing numerous IRP scenarios, staff expect this conclusion to have broad relevance to a wide range of portfolios with a similar GHG target
  - Note that as the GHG target is reduced, the scale of new resources selected generally increases
    - Given the relatively homogenous nature of California's solar potential, RESOLVE selects solar with a priority on not triggering new transmission
    - As the GHG target is reduced, there will be a point where solar is selected up to its limit in each transmission zone and accordingly the significance of this analysis recedes