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2024 ACC Staff Proposal: Response to Joint IOU's Data Request #2

October 12, 2023

Questions related to the Integrated Calculation of Generation Capacity and GHG Avoided Costs ("Gen Capacity/GHG Optimization):

2.1. There are only two resources, Generic Solar and Generic Four-Hour Storage, in the "Summary of Costs & Revenues" tab of the "2024 ACC Staff Proposal Inputs Workbook for Gen Cap & GHG Model" file. Please explain why only two resources are included in the Gen Capacity/GHG Optimization. In general, shouldn't all resources selected through RESOLVE be included in the Gen Capacity/GHG Optimization, not just the marginal resources selected in RESOLVE to meet the Gen Capacity and GHG constraints, respectively?

The optimization solves for the GHG and generation capacity avoided costs of resources selected by RESOLVE such that the net present value (NPV) of total avoided costs (energy, AS, GHG and generation capacity) is greater than or equal to the NPV of resource revenue requirement. The resources providing marginal GHG and generation capacity value will reflect the largest avoided cost value needed to make a resource whole. At these levels, the NPV of avoided costs attributed to resources that are inframarginal will exceed the NPV of their revenue requirement.

Solar and four-hour battery storage have been used to demonstrate the methodology of the Integrated Calculation of Generation Capacity and GHG Avoided Costs model because, based on the set of resources included in the 2022 IRP modelling, these resources are reasonable choices as marginal GHG and generation capacity resources. The analysis in the Staff Proposal is intended to be illustrative of the proposed methodology, and this methodology can be applied to any number of additional resources. This could include resources that will be modelled in the 2024 IRP, such as different durations of storage, that were not included in past cycles. The 2024 ACC will include resources in the model that are reasonably expected to provide marginal GHG and capacity value.

2.2. The Joint IOUs observe abnormal storage charge and discharge patterns in the "Storage Dispatch" tab of the "2024 ACC Staff Proposal Inputs Workbook for Gen Cap & GHG Model." Please clarify why the roundtrip efficiency for storage is not maintained, such that the "discharge" energy exceeds the "charge" energy. For example, for the year 2025, the total charge energy (Column E) is 690 MWh, but the

total discharge energy is 1,162 MWh (Column F). The storage charge and discharge patterns from SERVM are critical inputs to determine the energy revenue and emission factors and should thus be carefully examined.

Thank you for identifying this error. The storage dispatch is based on modelling in E3's storage dispatch model RESTORE. The incorrect charge and discharge data were copied into the Inputs Workbook and subsequently used in the optimization model. The charge and discharge values included in the Inputs Workbook incorrectly reflect only the charge and discharge related to energy market dispatch and do not include charge and discharge related to ancillary services. This partial view of the dispatch shows an efficiency of greater than 100%, whereas the efficiency of the modelled battery should be approximately 84%. This error resulted in a lower modelled marginal emissions rate for storage because total discharge energy is being modelled as greater than total charge energy which likely resulted in lower avoided GHG and generation capacity costs. This error will be corrected in the implementation of the 2024 ACC.

2.3. Slide 19 of the workshop slides explains the "minimum generation capacity avoided cost is equal to fixed O&M cost of existing gas fleet." Similarly, Staff explained verbally that it implemented a GHG avoided cost "floor" equal to the cap and trade price. In instances where the Gen Capacity/GHG Optimization calculation results in one of the components being zero, thus triggering the floor price condition, is the other component adjusted correspondingly to net out that floor price? For example, assume in year X the optimization model finds the GHG component to be zero and the generation capacity value to be $140/kW-year. If the GHG avoided cost is set at the cap-and-trade price floor, is the generation capacity avoided cost of $140/kW-year adjusted downward so that the total value provided by the resource is equal to its cost?

The "floor" values for both generation capacity and GHG avoided costs are included within the constraints of the optimization model, as opposed to being implemented in a post-processing step. This ensures that avoided costs are at least equal to resource costs even when generation capacity and/or GHG reach the "floor" values. In other words, the model would find the optimal combination of GHG and capacity avoided costs that meet all constraints, including the price floor constraint.

2.4. What is the value for the mixed-integer programming (MIP)/duality gap (measure of solution quality) in SERVM?

We measure reliability solution quality in SERVM via convergence tests. The model is configured to run enough iterations such that the coefficient of variation of various reliability metrics is less than 5%. As far as economic optimization, SERVM does not use a MIP for commitment and dispatch, but rather dynamic programming algorithms. As such there is no gap tolerance setting. SERVM is frequently benchmarked for other clients against various commercial solvers including CPLEX and Gurobi and produces comparable economic results to solvers configured with a 2% relative MIP gap tolerance. Thus for this ACC run, the way we will confirm our reliability modeling is accurate is through convergence with sufficient iterations.

2.5. The Joint IOUs understand the hourly emission factors in the "Marginal Emissions" tab of the "2024 ACC Staff Proposal Inputs Workbook for Gen Cap & GHG Model" are based on the 2022 SERVM production cost modeling of the No New DER scenario. Please confirm the hourly emission factors are marginal values. Additionally, please explain in more detail how the marginal GHG factors were determined based on the SERVM production cost simulations. Specifically, is a step change of demand introduced in the sensitivity case to help determine the marginal value of emission factors? Is the size of step change validated and ensured to be reasonable compared to the MIP gap of solution? Or are marginal GHG factors calculated directly from marginal heat rates using the methodology used for SGIP evaluations?

The hourly emissions factors are marginal values and are derived from marginal heat rates. Please see Section 5.1.1 in the ACC Documentation for explanation of the calculation of implied marginal heat rates.

2.6. Please confirm the same SERVM model run will be used for the following inputs: avoided costs of energy and ancillary services, hourly emissions factors (used to allocate the annual avoided cost of GHG across the hours), and the "energy value" (rents) and "GHG Impact" value in the Gen Capacity/GHG Optimization calculation. Is the same SERVM model run used to develop the ELCC values for the Gen Capacity/GHG Optimization calculation? If not, please explain.

The same SERVM run is used to determine the hourly energy and emissions rates which are used in the Integrated Calculation of Generation Capacity and GHG Avoided Costs and the ACC Electric Model. Please see Section 6.1 of the ACC Documentation for an explanation of the development of ancillary services prices. The ELCC values are taken from the IRP RESOLVE inputs and these RESOLVE inputs come from SERVM modelling of the same case.

Questions related to the Staff Response to the SEIA Data Request

2.7. In its response to question 3, Staff explains "[t]he proposed method does not assume equilibrium in every year as the question suggests. Instead, the proposed method creates an equilibrium condition over the time horizon of the optimization by considering the net present value (NPV) of resource costs and value." The Joint IOUs' understanding is that the independent optimization for each year yields the same result as the combined optimization for all the years at once because the years are uncoupled. Thus, the Joint IOUs understand the statement above to mean that the proposed method does a single optimization for all the years considered at once based on the NPV of the resource costs and values and subject to equilibrium constraints for each year; however, the avoided cost decision variables for each individual year are all still independent of other years' decision variables. In other words, the calculated annual GHG and GC avoided costs are the same regardless of whether optimization is performed on an NPV basis for all the years at once or on a nominal basis for each individual year independently. Please confirm. If this understanding is incorrect, please elaborate and provide the supporting files and detailed calculation for the optimization.

The Joint IOU's understanding that the GHG and generation capacity avoided costs "are the same regardless of whether the optimization is performed on an NPV basis for all the years are once or on a nominal basis for each individual year independently" is not correct. The constraint that the NPV of avoided costs must be greater than or equal to the NPV of resource costs is ***not*** the same as the avoided costs being greater than or equal to the resource costs in every single year. For example, if the optimization is performed on an NPV basis, the avoided costs could be higher than resource costs in year 1, lower in year 2, higher in year 3 etc. while maintaining the contraint that the NPV of avoided costs is greater than or equal to the NPV of resource costs.

Other questions:

2.8. Please provide citations or references to the sources of all loss factors shown in the "Losses" tab, cell ref D9:F19, of the 2022 Electric ACC. The documentation for 2022 shows T&D loss factors by division for PG&E, please explain how the systemwide factors were derived from these estimates by division.

The sources for the loss values are not readily available but will be provided for the 2024 ACC update.