



**Hawaiian
Electric**

Integrated Grid Planning

Solution Evaluation & Optimization Working Group Meeting

February 26, 2021



Agenda

- ◆ Discuss summary of feedback on Grid Needs Assessment



Ground Rules

- ◆ Chatham House Rules will apply – no personal or organizational attribution will be made to any comments/feedback provided during the meeting by any participant nor in written documentation.
- ◆ Working group meetings, and other information exchanges are intended solely to provide an open forum or means for the expression of various points of view in compliance with antitrust laws.
- ◆ Under no circumstances shall engagement activities be used as a means for competing companies to reach any understanding, expressed or implied, which tends to restrict competition, or in any way, to impair the ability of participating organizations to exercise independent business judgment regarding matters affecting competition or regulatory positions.
- ◆ Proprietary information shall not be disclosed by any participant during any industry engagement meeting or information exchange. In addition, no information of a secret or proprietary nature shall be made available to industry engagement participants.
- ◆ All proprietary information which may nonetheless be publicly disclosed by any participant during any industry engagement meeting or information exchange shall be deemed to have been disclosed on a non-confidential basis, without any restrictions on use by anyone, except that no valid copyright or patent right shall be deemed to have been waived by such disclosure.



Updated Grid Needs Assessment Deliverable

- ◆ A draft of the Grid Needs Assessment document formerly known as the SEOWG deliverable was provided to stakeholders in June 2020
- ◆ Forecasts provided as part of the SEOWG deliverable have been re-located to the Input and Assumptions document
- ◆ Focus of the updated Grid Needs Assessment document is to address stakeholder comments



Stakeholder Feedback Summary

- Over 230 comments were received from stakeholders during the development of the GNA:
 - SEOWG meetings and discussions
 - Written comments on the June 2020 GNA draft
- Key Stakeholder comment themes:
 - Greater clarity and better understanding of grid service definitions & methodologies for defining those requirements
 - Understanding the purpose and need for sensitivity analysis and clarification on the approach and methodology to address those sensitivities
 - Greater clarity and better understanding of the modeling used to generate the GNA
 - Clarification on the resource characteristics & how they are used in the modeling
 - Better understanding of how the Grid Services are modeled⁽¹⁾ and clarification on how the least cost portfolio produces expected quantity, timing and avoided cost for each Grid Service
 - Better understanding of how transmission needs are determined



(1) Grid Services are defined in RESOLVE & PLEXOS as mathematical constraints

Stakeholder Feedback Summary

Summary of GNA Stakeholder Feedback Category⁽¹⁾ & Responses

| No. | Category | Clarification | Incorporated | Total |
|-----|---|---------------|--------------|-------|
| 1 | Edit or format suggestions to improve clarity | 8 | 43 | 51 |
| 2 | Grid Services Definition Methodology | 30 | 15 | 45 |
| 3 | Grid Services | 20 | 7 | 27 |
| 4 | Sensitivity Analysis | 24 | 3 | 27 |
| 5 | GNA Modeling Process | 12 | 5 | 17 |
| 6 | Resource Characteristics | 12 | 2 | 14 |
| 7 | Avoided Cost of Service | 10 | 3 | 13 |
| 8 | Model Mechanics | 4 | 7 | 11 |
| 9 | Transmission Needs | 4 | 5 | 9 |
| 10 | IGP Solution Sourcing Process | 3 | 1 | 4 |
| 11 | Modeling Inputs | 3 | 1 | 4 |
| 12 | Solution Evaluation Method | 3 | 1 | 4 |
| 13 | Stakeholder Feedback | 3 | 1 | 4 |
| 14 | Sol Eval Methodology - Avoided Cost Screen | 4 | 0 | 4 |
| 15 | Grid Services Scenario Analysis | 1 | 2 | 3 |
| 16 | Other Modeling Outputs | 1 | 0 | 1 |



1) "Clarification" means Stakeholder feedback that was a question/comment and was responded to for clarification only and is not directly reflected in the I&A or GNA documents. "Incorporated" means Stakeholder feedback resulted in (i) a direct change to the I&A or GNA documents, AND/OR (ii) feedback resulted in a change or modification of an analysis or assumption, which then informs the I&A or GNA documents

Stakeholder Feedback Summary

Selected GNA Stakeholder Feedback – Grid Services Definition Methodology

| No. | Stakeholder Question/Comment | Response |
|-----|--|---|
| 1 | <ul style="list-style-type: none"> On the definition of Regulating Reserve –“The reason for the different time-intervals was due to the different generator characteristics on the different islands. The change was then divided by the aggregated installed capacity, or the peak load, to normalize it” <p>What does this mean? What was done for Molokai/Lanai? Are these supposed to be the same things (aggregated installed capacity vs. peak load)? Or different ways to calculate?</p> | <p>Document was modified to make clearer.</p> <ul style="list-style-type: none"> Different islands consist of different types of thermal generators with different characteristics. Hawaii Island, Molokai, and Lanai have more flexible generators, and therefore, a 20-minute window was used for these islands. Oahu and Maui have less flexible generators, and therefore, a 30-minute window was used. The change in renewable energy was normalized by dividing by the aggregated installed capacity. The change in load was normalized by dividing by the peak load. |
| 2 | <ul style="list-style-type: none"> On Regulating Reserves – “Grouping of the minute data into positive and negative values. Positive changes in generation (negative changes in load) represent a need for downward regulation. Negative changes in generation (positive changes in load) represent a need for upward regulation” <p>This is a seemingly reasonable approach for reserves. 3 sigma may be a rather tight objective. Is the rationale for that given somewhere? It is unclear that adequate consideration is given to the well behaved down capability of utility connected solar PV and wind.</p> | <ul style="list-style-type: none"> Document was modified to add the rationale for using 3-sigma. The methodology is similar to ERCOT, and while ERCOT uses the 95th percentile when calculating their reserve requirement, given our islanded system and high renewable penetration, a more stringent requirement was used. The intent was to cover most needs but not all, which lead to a 3-sigma requirement. Sensitivity analyses were performed to examine less stringent requirements at one and two sigma. |
| 3 | <ul style="list-style-type: none"> On the Regulating Reserves - Results O’ahu <p>Could use some context on this methodology and data from other jurisdictions. Is that available?</p> | <ul style="list-style-type: none"> Document was modified. A background section was added which discusses the methodology used by ERCOT, which is similar to the methodology being proposed here. |



Stakeholder Feedback Summary

Selected GNA Stakeholder Feedback – Grid Services Definition Methodology

| No. | Stakeholder Question/Comment | Response |
|-----|---|--|
| 4 | <ul style="list-style-type: none"> On Resource Diversification – “For example, if an island becomes more heavily weighted towards Grid-Scale Solar than Grid-Scale Wind, we want to be sure that we can accurately capture the unique reserve requirements associated with Grid-Scale Solar versus Grid-Scale Wind, and in order to do that, it is better to calculate the reserve required due to each resource separately” <p>Why is it better?</p> | <ul style="list-style-type: none"> Document was modified to make this clearer. Document explains that the reserves were calculated for each resource separately to ensure that as the portfolio changes, the reserve requirement represents the unique volatility and reserve needs that are associated with the various resources especially if the portfolio becomes solar heavy. Because the volatility of one resource may not be coincident with the volatility of another, defining the requirements as an aggregated portfolio may result in a lower requirement for the current portfolio of resources but may not be valid when the portfolio mix in the future skews specifically toward one resource e.g. solar dominant portfolio in 2045. |
| 5 | <ul style="list-style-type: none"> On Resource Diversification: Time Interval – “To capture both the regulation needed by our operators to bring units online, as well as, the regulation needed to manage short-term fluctuations associated with variable renewable generation, it was decided that for Oahu and Maui, requirements based on both the 1-minute and 30-minute interval would be used. For Hawaii Island, requirements based on both the 1-minute and 20-minute interval would be used”. <p>Please clarify with a little more discussion</p> | <ul style="list-style-type: none"> Document was modified to address this comment. The 1-minute requirement would ensure that there is enough generation on the system to meet any short-term fluctuations in variable energy i.e. ramp requirement, while the 20 to 30-minute requirement would ensure that there is enough reserve for our operators to bring additional units online if needed. |
| 6 | <ul style="list-style-type: none"> On the the Load Build and Load Reduce: Methodology – “The avoided cost for each grid service will be calculated every 5 years, consistent with the planning horizon used in RESOLVE.” <p>Does the avoided cost change over the 5 year period? Is this granular enough to be used as capacity value?</p> | <ul style="list-style-type: none"> Document was modified. The planning horizon was revised to be annual over the next 10 years from 2025, then every 5 years thereafter. This will capture avoided cost impacts in more detail over the near term. |



Stakeholder Feedback Summary

Selected GNA Stakeholder Feedback – Sensitivity Analysis

| No. | Stakeholder Question/Comment | Response |
|-----|--|--|
| 1 | <ul style="list-style-type: none"> On the DER Program Freeze as a sensitivity – “In this sensitivity, DER adoption would be frozen at existing 2020 levels to understand the impact of the market DER uptake assumed in the core scenarios.” <p>This is a great idea; suggest rewording to avoid negative perception. Maybe call it “DER Program Valuation” and describe it as “a sensitivity would be conducted without additional DER adoption to understand the impact...”</p> | <ul style="list-style-type: none"> Document was modified. An appendix was created to list the various sensitivities that will be analyzed, and one of the sensitivities is the “Market DER” sensitivity, which will analyze the value of the forecasted DER uptake. |
| 2 | <ul style="list-style-type: none"> On DER sensitivity analyses – <p>HECO should consider testing the sensitivity of models and resulting portfolios by running bookend scenarios that utilize the cumulative potential high and low load forecasts for each layer.</p> | <ul style="list-style-type: none"> Document was modified. The approach suggested was adopted and Appendix E was added to provide more detail on the sensitivities performed. |
| 3 | <ul style="list-style-type: none"> On DER sensitivity analyses – <p>HECO should ensure that subsequent modeling tasks include sensitivities for time-of-use flexibility and/or random variation in the daily load profiles of DER and EV loads, rather than using a static load profile across modeling tasks.</p> | <ul style="list-style-type: none"> Approach adopted. The managed EV charging profile that was developed with E3 can address TOU for EV. We can also incorporate any new TOU programs that emerge from the DER docket. |



Stakeholder Feedback Summary

Selected GNA Stakeholder Feedback – GNA Modeling Process

| No. | Stakeholder Question/Comment | Response |
|-----|--|--|
| 1 | <ul style="list-style-type: none"> On how RESOLVE and PLEXOS are used in the evaluation of grid needs RFPs – “RFPs are evaluated through another round of RESOLVE and PLEXOS modeling to create the optimal portfolio of solutions that the utility should procure, while maintaining system reliability at a reasonable cost. In addition, the modeling considers other IGP objectives described in Section 1.2.” <p>How?</p> | <ul style="list-style-type: none"> Document was modified. Section 4.2.1 was updated to provide more details on the avoided cost screening approach and optimal portfolio approach that will be used in combination for the RFP evaluation. |
| 2 | <ul style="list-style-type: none"> On the models used to identify grid needs – “The two models used to identify and verify the system needs are the RESOLVE model and the PLEXOS model.” <p>Limitations of tools will limit the identification of system needs – these tools will not identify system stability needs like inertia, grid strength, or the spec of FFR, which is mentioned below.</p> | <ul style="list-style-type: none"> Document was modified. RESOLVE will produce a resource plan that will meet the various Grid Needs. This plan, with consideration of the results of the sensitivity analyses, will be run through PLEXOS. The PLEXOS results will then inform other models like PSSE to perform the system security analyses. |
| 3 | <ul style="list-style-type: none"> On the Modeling Process – “Following the initial modeling to determine system needs is the Grid Service Needs RFP step. The process iterates during this step, as the solutions bid into the RFP are evaluated through another round of RESOLVE and PLEXOS modeling to create the optimal portfolio of solutions that the utility should procure, while maintaining system reliability and system security at reasonable cost.” <p>Some aspects of system security should be pulled forward and evaluated at the same time as the other services, rather than after. This has a major impact on how the synchronous machine fleet is handled. For instance, grid needs like voltage support/SC/inertia that are not identified in Plexos/RESOLVE and show up later in sys security could lead to must-run or sub-optimal commitment and dispatch of resources.</p> | <ul style="list-style-type: none"> Document was modified. The process figure was updated to show the feedback loop from the system security analyses to PLEXOS to address any changes to the plan that are needed to ensure reliability. |



Stakeholder Feedback Summary

Selected GNA Stakeholder Feedback – Resource Characteristics

| No. | Stakeholder Question/Comment | Response |
|-----|--|---|
| 1 | <ul style="list-style-type: none"> On the resource operating characteristics – “Operating characteristics (e.g., minimum/maximum capacity, variable operations and maintenance (O&M) cost, fixed O&M cost, heat rate, ramp rate).” <p>Is this all the operating characteristics or is this an exemplary list?</p> | <ul style="list-style-type: none"> For clarification, the characteristics used in the modeling are more fully detailed in the inputs assumptions workbook that is currently being developed. |
| 2 | <ul style="list-style-type: none"> On the resource operating characteristics – “Location of resources (transmission/distribution constraints.” <p>What does this mean here? Is HECO characterizing a resource’s ability to reduce T&D constraints?</p> | <ul style="list-style-type: none"> Document was modified. Location of resources refers to transmission/distribution constraints such as interconnection limits, as well as, additional transmission/distribution costs to interconnect additional resources. The intent was to consider limits such as export limits at the point of interconnection due to the location of a project. |
| 3 | <ul style="list-style-type: none"> On the Resource Cost Forecast – <p>Where is the cited summary table?</p> | <ul style="list-style-type: none"> Document was modified. The information was moved to the Inputs and Assumptions document as that is the more appropriate place for this data to be presented and discussed. |
| 4 | <ul style="list-style-type: none"> On a resource’s capability to provide regulating reserve – <p>How are curtailed renewables counted towards regulation requirement? Curtailed renewables are not variable so they shouldn’t require regulation -AND- they can provide regulation...iterative approach?</p> | <ul style="list-style-type: none"> For clarification, resources that can be controlled are not included in the downward regulation requirement. It is assumed that operators would be able to control these resources if the need arises. These resources are included in the upward regulation requirement. There is no adjustment made for actual taken energy. Resources that are controllable can provide both up and down regulation. |



Stakeholder Feedback Summary

Selected GNA Stakeholder Feedback – Grid Service Model Mechanics

| No. | Stakeholder Question/Comment | Response |
|-----|---|--|
| 1 | <ul style="list-style-type: none"> On Modeling Inputs – “Operation Inputs” <p>How is weather modeled? Does the “weather” change each year? Plexos not able to model a curtailable DER?</p> | <ul style="list-style-type: none"> Document was modified. PLEXOS is able to model curtailable DER. Weather is not explicitly modeled in RESOLVE or PLEXOS. |
| 2 | <ul style="list-style-type: none"> On Modeling Inputs – “Optional DER & PLEXOS inputs” <p>Need additional detail</p> | <ul style="list-style-type: none"> Document was modified. Added Optional DERs, which consist of Flexible Load and Demand Response. |
| 3 | <ul style="list-style-type: none"> On Input Definitions – “DEFINITIONS FOR VARIOUS MODEL INPUTS” <p>Does this list match the text in the main body of the document. Are there any other inputs or outputs that will be utilized? Can the full list be documented</p> | <ul style="list-style-type: none"> Document was modified. Added links/references to the inputs workbook being developed that provides more detailed information |
| 4 | <ul style="list-style-type: none"> On Appendix A / Table 10: Fuel blending <p>This can be done in PLEXOS also.</p> | <ul style="list-style-type: none"> Document was modified. Fuel blending can be done in PLEXOS. |
| 5 | <ul style="list-style-type: none"> On Appendix A / Table 10: Must Run/Must Commit <p>Why aren’t these reflected in PLEXOS as well?</p> | <ul style="list-style-type: none"> Document was modified. Must-run was added as an input in PLEXOS. |
| 6 | <ul style="list-style-type: none"> On Appendix A / Table 10: Spinning Reserve <p>Why not include this in PLEXOS as well. This quantity will depend on the amount of Frequency response you have, no?</p> | <ul style="list-style-type: none"> Document was modified. Regulating reserve, FFR, and inertia reserve requirements are being modeled in PLEXOS. |



Stakeholder Feedback Summary

Selected GNA Stakeholder Feedback – Transmission Needs

| No. | Stakeholder Question/Comment | Response |
|-----|--|---|
| 1 | <ul style="list-style-type: none"> On determining Transmission Needs – <p>HECO should acknowledge in this section that the PLEXOS and System Security work may illuminate new transmission needs.</p> | <ul style="list-style-type: none"> Document modified: HECO acknowledges that PLEXOS and System security work may illuminate new transmission needs. Edits were made to describe the feedback loop with System Security that may iterate on those transmission needs. |
| 2 | <ul style="list-style-type: none"> On determining Transmission Needs – “...the output of the transmission needs analysis will serve as inputs to the RESOLVE model.” <p>How does this interplay with distribution needs?</p> | <ul style="list-style-type: none"> Document was modified. Figure 3.1 shows that transmission needs and distribution needs feed into the RESOLVE modeling to determine the Grid Needs. |
| 3 | <ul style="list-style-type: none"> On Transmission Needs – “...renewable energy zone.” <p>An appendix on this survey would be very helpful. Want to know more about this.</p> | <ul style="list-style-type: none"> Document was modified. Footnote was added to point to the document from NREL titled "Renewable Energy Zone (REZ) Transmission Planning Process: A Guidebook for Practitioners" |
| 4 | <ul style="list-style-type: none"> On Transmission Needs – “6) High-level evaluation of grid stability services” <p>HECO must provide clearer explanation of their grid services requirements. In addition, it is essential that the analysis provide sufficient depth of results to identify degree and causality of limitations.</p> | <ul style="list-style-type: none"> Document was modified to provide additional information on the definition of grid service requirements for FFR and inertia. |
| 5 | <ul style="list-style-type: none"> On Transmission Needs – “Identifying the cost of potential major & minor transmission upgrades will allow RESOLVE to determine whether generation and transmission buildout decisions are least-cost compared to non-wires alternatives or alternate sites.” <p>This document (or IGP WG) could provide more information here on methodology. I suspect this could alter the availability or location of different resources, which is sure to draw scrutiny from developers and other stakeholders.</p> | <ul style="list-style-type: none"> Document was modified. Additional detail about the Renewable Energy Zone concept was added. |



Next Steps

- ◆ Issue second draft of the Grid Needs Assessment document
- ◆ Issue comment tracker with disposition and response to feedback received
- ◆ Any additional comments or questions?

