

Hawaiian Electric Integrated Grid Planning Technical Advisory Panel: Progress Update

Presentation to IGP Stakeholder Council

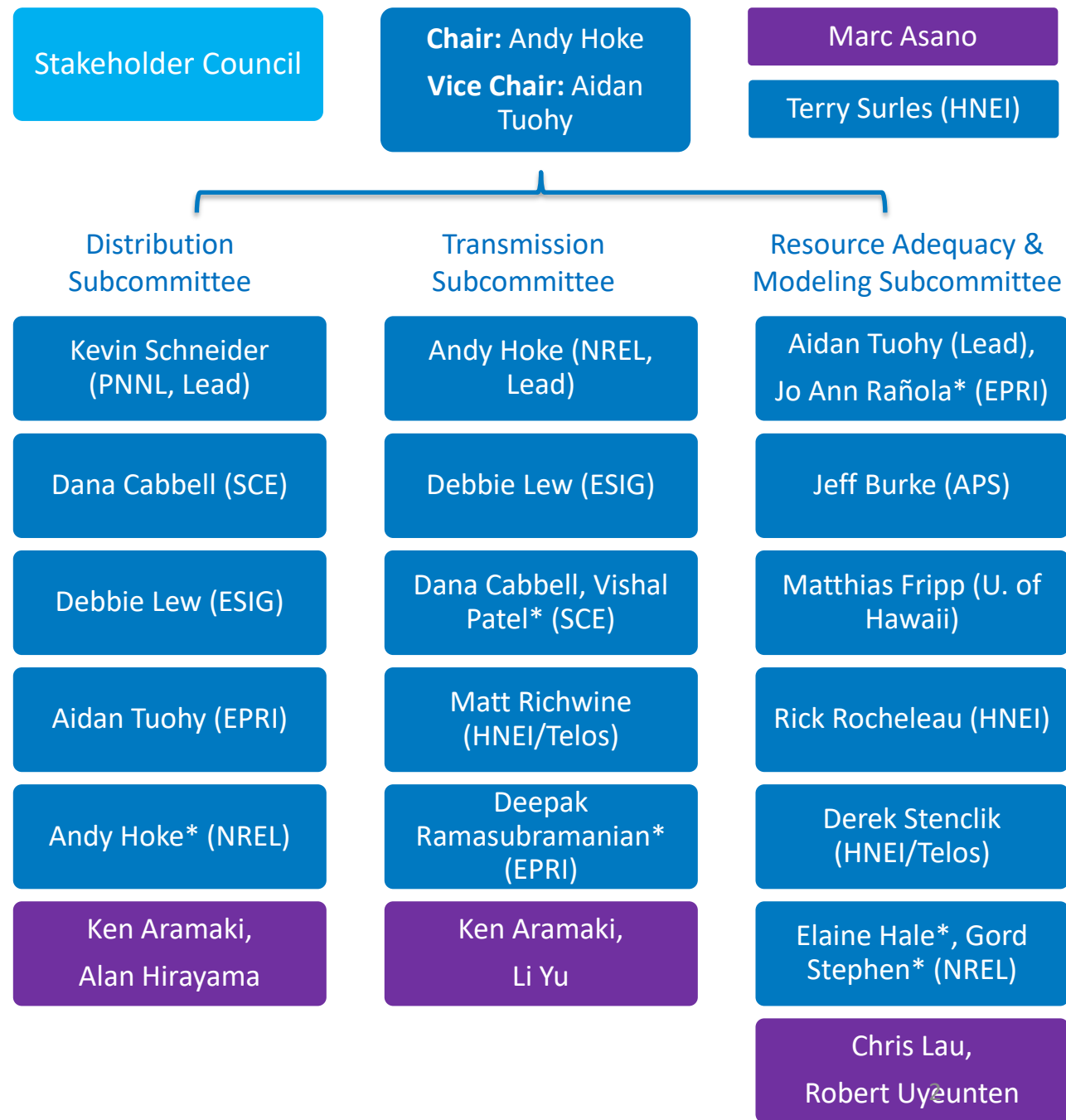
May 18, 2022

Andy Hoke, NREL; Aidan Touhy, EPRI; Kevin Schneider PNNL

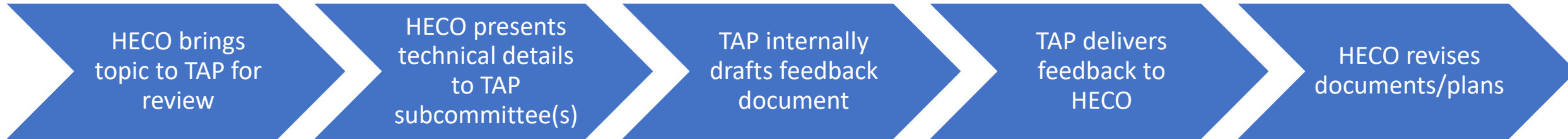
IGP TAP Structure

- Technical Advisory Panel (TAP) purpose:
 - Provide technical review of HECO's Integrated Grid Planning (IGP) plans, methods, and results
- TAP divided into three subcommittees in September 2021
 - Distribution
 - Transmission
 - Resource Adequacy and Modeling
- Allows each TAP member to focus on area(s) of expertise
- Each subcommittee has HECO POCs

*Some ad hoc TAP members brought in by existing members; more SMEs may be consulted as topics arise



IGP TAP Feedback Process



- Process for TAP feedback summarized above
 - TAP open to input to improve process
- HECO presentations to TAP and TAP feedback documents (as written by TAP) available to public:
 - <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/technical-advisory-panel>
- New aspects, based on PUC feedback:
 - Regular TAP leadership meetings with STWG to provide update on TAP activities and opportunity for questions
 - HECO increasing communication of how TAP comments are addressed
- TAP continuing to balance need for detailed technical review with need to move IGP process forward in a timely manner by grouping feedback into three categories:
 1. Informational – no action necessarily needed
 2. **Suggest revising before PUC review point**
 3. **Consider revising in future steps or iterations of the IGP process**
- As always, TAP’s role is to provide recommendations and feedback, not to direct

Summary of TAP activity since November 2021

- TAP activity summarized by group
 - Transmission Subcommittee
 - Distribution Subcommittee
 - Resource Adequacy Subcommittee
 - Full TAP

TAP Transmission Subcommittee Update

- Four meetings held since November 2021
- Most Transmission Subcommittee members signed NDAs with HECO to allow sharing of sensitive information
- **System stability study** was focus of three meetings
 - Highly detailed study of future dynamic stability of all islands with projected 2028 resource mix
 - Follows on similar 2021 study, with updated assumptions
 - Focuses on system's ability to continue to serve customer load following faults, loss-of generation, and other contingencies
 - Scenarios with very high wind, solar, and battery generation (“inverter-based resources”, IBRs) present new grid stability challenge that has not been addressed for systems the size of Hawaii's 3 main islands
- Study plans and initial results presented in December and January meetings; interim feedback delivered
- Third meeting held last week; TAP feedback in progress

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TAP Transmission Subcommittee Update

Summary of system stability study feedback to date

- Make clear how cases studied relate to production cost simulations; provide basic statistics of each scenario
 - TAP asked about any must-run rules in scheduling. HECO removed minimum inertia rule from planning criteria
- Conventional transient stability software (e.g. PSSE) does not capture some important dynamics in high-IBR, high-DER system. Electromagnetic transient software (e.g. PSCAD) can capture necessary dynamics, but major challenge to simulate entire islands; hours to run one simulation on high-end 50+ core computer
 - This is a known problem facing systems like Hawaii's
- Grid-forming inverters are emerging as a solution some of the problems facing Hawaii, but are not a fully mature technology
 - PSSE models of grid-forming inverters are beginning to exist in the research domain, but not yet available commercially, and ability to capture key dynamics is an open question

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TAP Transmission Subcommittee Update

Summary of system stability study feedback to date

- Uncertainties in DER models and UFLS relay models identified as major risk factor
 - HECO working with NREL to address through laboratory testing
 - HECO running sensitivity study on DER momentary cessation
- To validate IBR events in the field, digital fault recorder (DFR) data (or other time-synced waveform-level data) is essential.
- HECO using one specific IBR model to represent future grid-forming resources. TAP suggested future work incorporate other models
- TAP suggested adding additional detail to PSCAD model. Challenge is that additional detail further increased computation time.

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TAP Transmission Subcommittee Update

Summary of system stability study feedback to date

- TAP suggests investigating levels of unbalanced voltage seen on single-phase DER trips, and possibility of unintended protection tripping. HECO studied and found no issues so far.
- TAP agrees obtaining grid-forming IBRs is very important to stability of HECO's planned operating scenarios and encourages HECO to look for ways to obtain grid-forming IBRs as soon as possible
- TAP provided feedback on potential benefits of synchronous condensers. HECO performed sensitivity study on synchronous condensers. TAP reviewing results.
- TAP requested additional detail on many aspects of HECO's models and assumptions. HECO provided. TAP generally found reasonable.

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TAP Transmission Subcommittee Update

Summary of system stability study feedback to date

- Overall, HECO has addressed or is addressing the highest-priority TAP comments
- Many longer-term TAP comments remain to be addressed in future work
- Ensuring the stability of high-IBR grids is one of the major industry-wide challenges today. HECO is near the front of this challenge, especially given the very high levels of DERs. HECO needs to obtain operational experience with grid-forming IBRs.
- Additional feedback to be delivered this month

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TAP Transmission Subcommittee Update

Summary of system stability study feedback to date

- Overall, HECO has already addressed or is addressing the highest-priority TAP comments
- Many longer-term TAP comments remain to be addressed in future work
- Ensuring the stability of high-IBR grids is one of today's industry-wide challenges and is a major research topic. HECO is near the front of this challenge, especially given the very high levels of DERs. HECO needs to obtain operational experience with grid-forming IBRs.
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TAP Transmission Subcommittee Update

February meeting: **Underfrequency load-shedding (UFLS) study plans**

- HECO presented proposed plan for UFLS study
 - Near term, study for all large plants should include ensuring plant is not behind UFLS breaker
 - UFLS is an essential system protection. In Hawaii, it is also used as a form of frequency control due to small system sizes and economic considerations
 - Consider potential future forms of FFR, and how they could trade off with the use of UFLS technically and economically
 - TAP recommends surveying customers to understand the relative priorities of cost versus reliability of electricity
 - Study impacts of UFLS on FFR1 and FFR2 resources
 - When considering fast-responding resources to reduce UFLS use, proportional responses are preferable
 - Adaptive ULFS on Hawaii appears effective. Consider for all islands
 - Consider equity aspects of adaptive UFLS in a high-DER system
 - UFLS study can include PSCAD simulations, but they should not be the focus
 - No need to repeat work already done in other studies
- TAP expects to review results of UFLS study when ready

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TAP Distribution Subcommittee

- 1 meeting: March 2022
 - HECO requested clarification of TAP concerns **on distribution protection** for periods with very high peak levels of wind, solar, and battery generation (Inverter-based resources, IBRs)
 - TAP clarified that at very high levels of IBR generation, available fault current is reduced, potentially to a level that could lead to reduce ability to clear typical overcurrent-based breakers, relays, and fuses
 - This is an open research question to which the TAP does not know the answer
 - HECO stated they will look into this for future TAP meetings
 - HECO asked which of three load forecasts is appropriate for use in evaluating capital projects or non-wire alternatives
 - The TAP is not aware of an establish approach. Suggest looking for least-regret approaches; evaluate risk of incorrect assumptions
 - HECO presented example of NWA for Waiiau substation (high-MW, short-fuse need)
 - HECO released RFI on Waiiau NWA feasibility
 - TAP feedback did not contain any high-priority items

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Ken Aramaki,
Alan Hirayama

TAP Resource Adequacy & Modeling Subcommittee

- 4 meetings since late 2021, plus interactions over email
- November 2021
 - ERM (Energy Reserve Margin): Full probabilistic resource adequacy analysis is still necessary as an additional step to verify the ERM for future portfolios as these are being developed
 - HECO have since implemented this with probabilistic RA studies
 - ERM can help determine resource mixes, backed up by full RA study
 - Hourly dependable capacity (HDC) requires additional consideration and justification which can be addressed in the future, provided that the full resource adequacy analysis is utilized in the near-term.
 - Further look at various options within HDC has helped shed additional light

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TAP Resource Adequacy & Modeling Subcommittee

- January 2022
 - Further discussion and review of results related to HDC analysis performed by HECO
 - Different methods proposed (percentiles, use of daily metrics, etc.), which HECO have considered in recent analyses
- March 2022
 - Stochastic modeling proposed is a good approach that incorporates recent feedback, with discussion and debate focused on specific aspects like number of samples needed for both weather years and outage rates.
 - New metrics, or combinations of existing metrics, could be examined further, for example EUE, and HECO should also work to identify the best way to set criteria
 - TAP suggested follow up topics to allow HECO to continue to refine the work, with the overall approach being reasonable and justified for the first IGP cycle
 - HECO have done a good job of gathering input from the TAP, researching the topic and coming up with a proposal that provides additional modeling detail needed to address adequacy issues.

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TAP Resource Adequacy & Modeling Subcommittee

- April 2022
 - Draft results for probabilistic RA testing for O’ahu’s proposed renewable firm RFP.
 - General agreement that good progress has been made on the modeling, with adoption of many previous recommendations for TAP.
 - Time series weather data should be further explored – longer datasets may be useful and several TAP members will follow up with datasets or sources.
 - For outage rates - further examination may be needed, TAP suggested some potential methods to address the uncertainty in outage rates - additional sensitivities for 2029 cases with the increased outage rates observed in recent years.
 - TAP also suggested that outage periods could be used to understand thermal contribution to ERM and include that as a contributor to ERM rather than including in the need for ERM.
 - HECO were requested to clarify EUE normalization and compare with other regions as well as compare results with HNEI.
 - Potential need for examining long duration storage as the system becomes more energy constrained.
- May 2022 (broader TAP meeting)
 - Further discussion on probabilistic RA modeling and outage rates/weather data
 - Follow up needed on specific items to address additional cases with renewables as well as thermal plan

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TAP Resource Adequacy & Modeling Subcommittee

- General: TAP feedback has been incorporated in several key ways
 - Probabilistic RA assessment is being carried out
 - Further examination on HDC and ERM was carried out (e.g. daily percentiles)
 - Updated some of the wind/solar data and clarified aspects such as demand response
- Further work identified
 - Different ERM levels
 - Outage rates
 - Changes to HDC approach
 - Different resource portfolios to be examined

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Full TAP

- Two-day full-TAP meeting held in May
- Topics:
 - Summary of each TAP subcommittee's topics addressed and HECO's actions in response
 - Preliminary results of grid needs assessment including probabilistic resource adequacy
 - Summary of results of 2028 system stability study and its sensitivities
- TAP feedback document in progress
- Next full-TAP meeting likely in August

Summary (November-May)

- Overall TAP met in May; first since fall 2021 re-org
- Resource adequacy subcommittee held 4 meetings. HECO has made significant changes to Grid Needs Assessment methodology in response to TAP feedback
- Distribution subcommittee held 1 meeting. (Distribution planning criteria previously vetted)
- Transmission subcommittee held 4 meetings. Provided extensive input to system stability study and UFLS study. HECO has adapted various study plans in response
- In many cases, there is no generally accepted best approach to resource adequacy, transmission planning, or distribution planning for power systems based largely on wind, solar, and batteries
- Need to find a balance between study/discussion/planning and action

Questions? Comments?



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