Meeting Agenda

- Welcome and Ground Rules
- Fuel Forecast Update
- Resource Cost Forecast Update
- Grid Needs Assessment Review
- Next Steps
Ground Rules

- Chatham House Rule 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.
SEOWG Deliverables and Schedule

- Draft of SEOWG deliverable reviewed by stakeholders
- Draft of Sensitivities appendix routed for stakeholder review
  - No comments received
- SEOWG methodology to evaluate proposals that address multiple grid needs under development
  - Due 6/1/2020 (to be informed by Stage 2 RFP)
Objectives for Today’s Meeting

- Review Fuel Forecast for IGP
- Review Resource Cost Forecast for IGP
- Review updates for Grid Needs Assessment
Fuel Forecast for IGP
2020 Fuel Price Forecast

- Similar process to 2019 forecast. Correlation developed between historical actual fuel prices and Brent North Sea Crude Oil Benchmark (Brent) from 1983-2019.
- R^2 for petroleum fuels > 0.93.
- Dramatic changes since the beginning of the year
  - Global oil demand is expected to decrease over 2MMbbls/day due to COVID-19.
  - Production cuts and capital spending and overall drop in prices. Demand is expected to increase in 2021-2025, outpacing production which will result in a rebound of prices.
- EIA forecast released in January. Brent forecast provided by Facts Global Energy (FGE) in February, revised in March due to COVID-19 and OPEC’s recent pricing disagreements.
- Hawaiian Electric’s 2020 forecast is based on FGE’s revised Brent price forecast with near term lower prices reflecting current oil situation
Hawaii Island Fuels Forecast
Maui County Fuels Forecast
Resource Cost Forecast for IGP
Updates to Resource Costs

Stakeholder feedback received
- Feedback on current forecast
- Proposed technologies

Updates made to cost forecasts
- Storage
- PV
- Off-shore wind
- Distributed wind
- Pumped storage hydro
Feedback: Land cost component may vary depending on the location
Update: Land costs were removed to treat all resources the same regardless of location

Feedback: Concentrated solar should be added as a potential resource
Update: Concentrated solar was added to the cost forecast

Feedback: Consider an updated NREL study as the cost basis for off-shore wind
Update: A hybrid forecast was developed to use the NREL study and ATB projections

1 https://www.nrel.gov/docs/fy20osti/75618.pdf
Generating Resource Cost Forecast ($/kW)

*Grid-Scale PV cost does not include land cost component

*The location-specific interconnection costs are not included

*Off-Shore wind estimate includes minimal run of 1 kilometer (km) on dry land.
Storage Resource Cost Forecast ($ / kW)
Levelized Resource Cost Estimates (Variable Resources)

- Grid Scale PV Levelized (¢ / kWh)
- On-Shore Wind Levelized (¢ / kWh)
- Distributed Wind Levelized (¢ / kWh)
- Off-Shore Wind Levelized (¢ / kWh)
- Levelized Stage 1 projects (lower bound)
- Levelized Stage 1 projects (upper bound)

Year
2020 2025 2030 2035 2040 2045 2050
Nominal ¢ / kWh
0.00 3.00 6.00 9.00 12.00 15.00 18.00 21.00 24.00 27.00 30.00 33.00 36.00
Grid Needs Assessment
Grid Needs Assessment Overview
## Grid Service Values

<table>
<thead>
<tr>
<th>Grid Service</th>
<th>Quantity Units</th>
<th>Time Granularity</th>
<th>Avoided Cost Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>MWh</td>
<td>Hourly</td>
<td>$ /MWh</td>
</tr>
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<tr>
<td>Regulating Reserves</td>
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<tr>
<td>RPS</td>
<td>MWh</td>
<td>Annual</td>
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Voltage Support, Inertia, and Short-Circuit Current will be evaluated in the system security analysis.
Grid Service Quantity

- The amount of grid service required to support the grid
- Provided as a megawatt-hour or megawatt-year

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Grid Service Timing

- The timing of when a grid service is needed
- Provided as an hourly or annual value
- Certain services may indicate a seasonal or monthly need

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Grid Service Avoided Costs

- The marginal cost of each grid service
- Defined on an hourly or annual basis, aligns with grid service timing
- Similar to the approach proposed by the California PUC in their Integrated Distributed Energy Resources proceeding

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Resource Cost and Benefit

- **Costs**
  - Calculated using resource cost forecasts for the capacity identified in the resource plans

- **Benefits**
  - Calculated as the sum of each grid service provided by and taken from the resource multiplied against its avoided cost
Example – Resource Service Provision for Typical Day in Month

Service Required: The MWh or MW-year of service that is required.

Service Offered: The MWh or MW-year that is provided by the proposed resource.

Service Taken: The amount of service that is provided by the resource and taken on the system.
The hourly avoided cost is set by the marginal resource that is committed to provide a grid service and meet a grid need.
Example – Resource Capable of Meeting Grid Need

Not all resources in the portfolio may be capable of providing all grid services.

For the incremental resources that can provide a particular grid service, the amount of grid service taken will be multiplied by the avoided cost to calculate the potential benefit.
Example – Resource Benefit

Total Services Taken

Hourly Avoided Cost

Total Benefit
Example – Resource Cost and Benefit for Typical Day in Month
Example – Resource Annual Costs and Benefits

Annual Cost
Benefit from Service 1
Benefit from Service 2

Year

1
2
3
4
5
6
7
8
9
10

Dollars ($)

-1500000
-1000000
-500000
0
500000
1000000
1500000
2000000

-1000000
-500000
0
500000
1000000
1500000
2000000

-1500000
-1000000
-500000
0
500000
1000000
1500000
2000000
Example – System Total Services Taken

Service 1

Service 2

Service 3

Total Services Taken

Service 3 Taken
Service 2 Taken
Service 1 Taken
Next Steps

◆ Feedback may be submitted to Chris Lau at christopher.lau@hawaiianelectric.com and IGP@hawaiianelectric.com