Integrated Grid Planning

Joint Competitive Procurement and Solution Evaluation & Optimization Working Group Meeting

December 9, 2019

Hawaiian Electric
Maui Electric
Hawai‘i Electric Light

Agenda

- Welcome & Introductions
  - WG Ground Rules
  - Objectives for today's meeting
- Review latest draft of the proposed IGP Solution Sourcing process
- Discuss decomposition of Capacity, Energy & AS Needs process step
- Review of RESOLVE and PLEXOS
- Discuss CEAS needs sensitivities
- Provide updates on CPWG & SEOWG process description outlines
- 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.

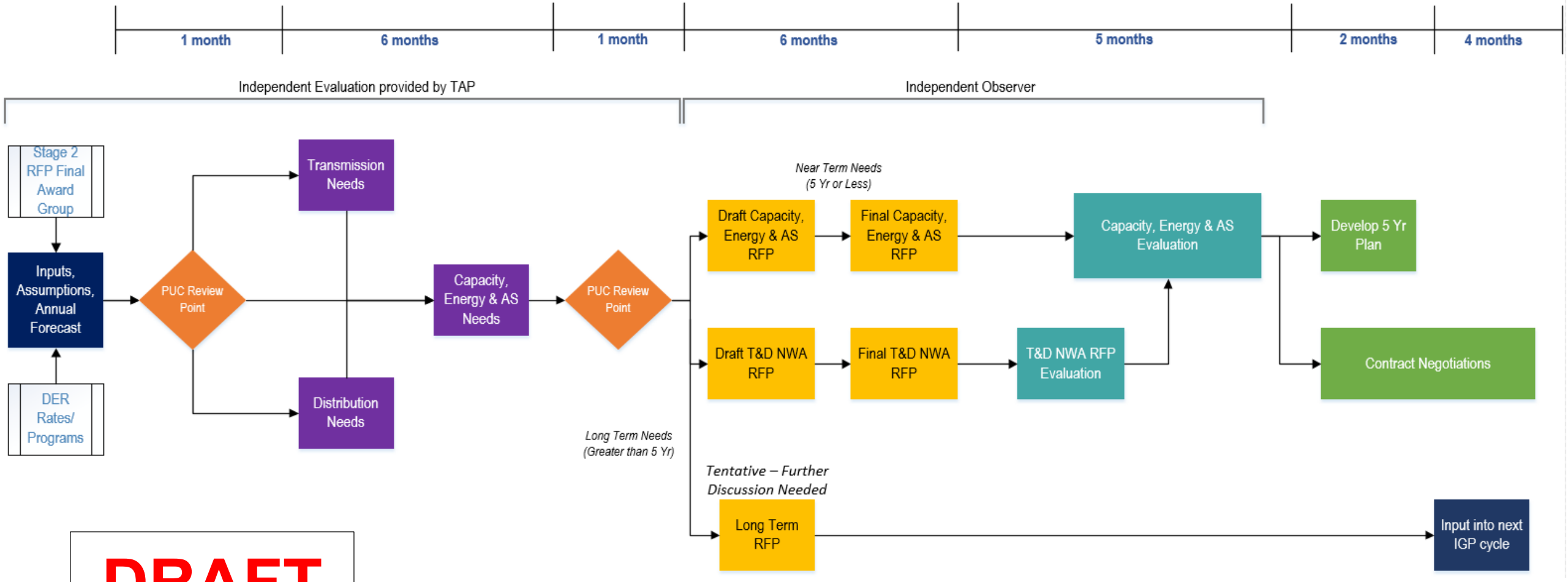
Objectives for Today's Meeting

- Clarify and agree on next steps regarding feedback received from stakeholders on:
  - CEAS needs analysis
  - Forecast scenarios v. RESOLVE sensitivity tests
  - Linkages to & potential dependencies on developments in other dockets (i.e. ARDS, DER)
- Clarify and receive feedback on updated IGP Solution Process
- Develop deeper understanding of proposed CEAS needs methodology and use of modeling tools
- Clarify SEOWG & CPWG Deliverables, schedule and dependencies within IGP

Stakeholder Input

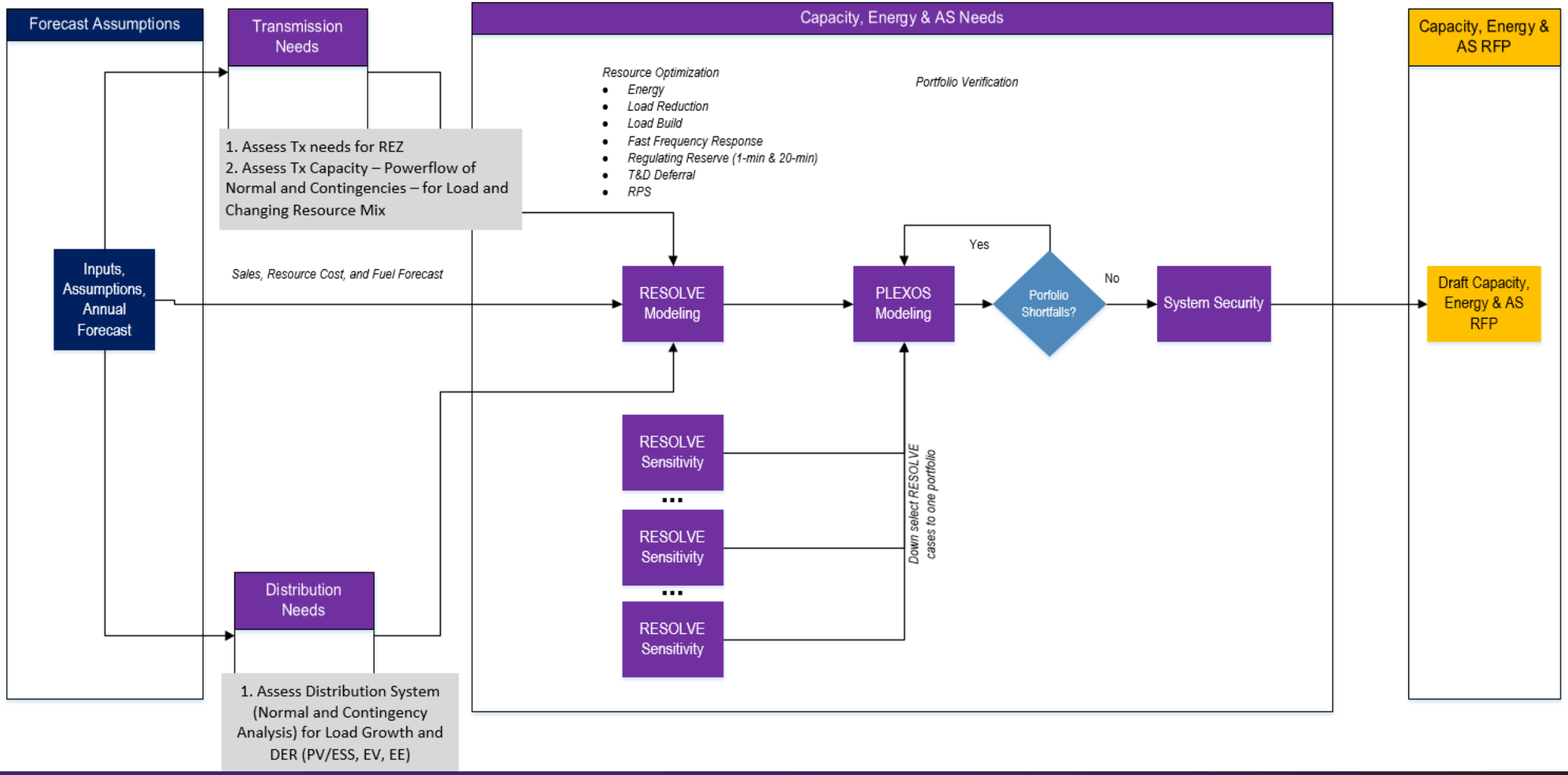
- Thank you for the feedback
- We will talk about the specific suggestions later today
  - Some clarifications
  - Group discussion and shared understanding of proposed use cases
- We are working with FAWG & DPWG to consider and develop an approach which will :
  - Develop a small set of appropriate scenarios (e.g. DER adoption, electrification, etc.)
  - Identify best step in the process (e.g. forecasting, needs assessment) to run scenarios
  - Use of scenarios and sensitivities (forecasting and RESOLVE/PLEXOS)
- Proposed scenario and analysis approach will be the main topic for January SEOWG meeting

Updated IGP Solution Sourcing Process



DRAFT

Capacity, Energy & AS Needs Process



Inputs for Solution Evaluation Process

1. **Major & minor transmission upgrades**
   - Identify the locational value of siting different resources on each island (i.e., reliably harnessing high renewable energy areas)
2. **Timing of CEAS Needs aligned with long-term planning targets**
   - As discussed in previous SEOWG meeting, CEAS Needs are developed based on planning criteria subject to load forecasts, unit operating characteristics, and resource potentials
   - HECO will use RESOLVE & PLEXOS to (1) identify CEAS Needs timing and (2) perform subsequent solution evaluation

RESOLVE/PLEXOS Model Comparison

Overview

Review of RESOLVE & PLEXOS

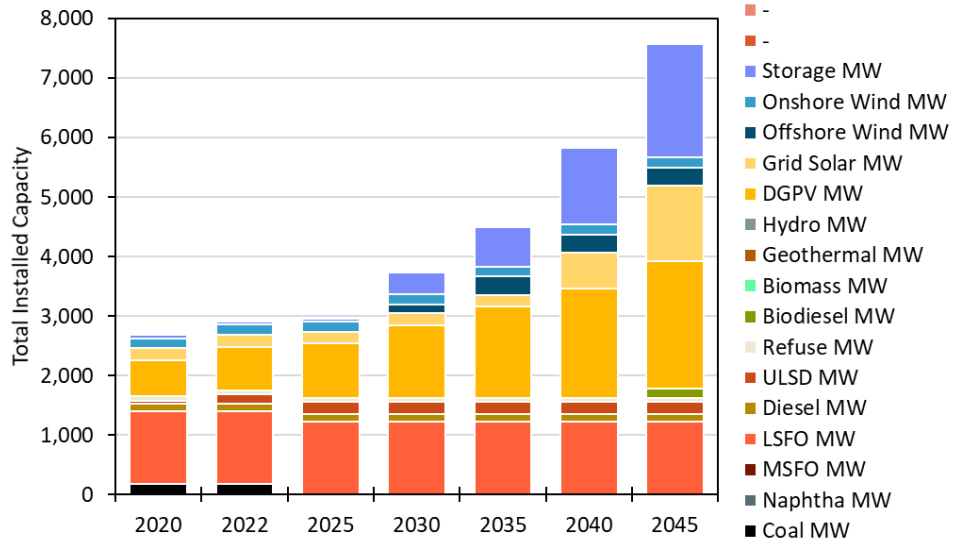
RESOLVE
Proactive Capacity Expansion Model

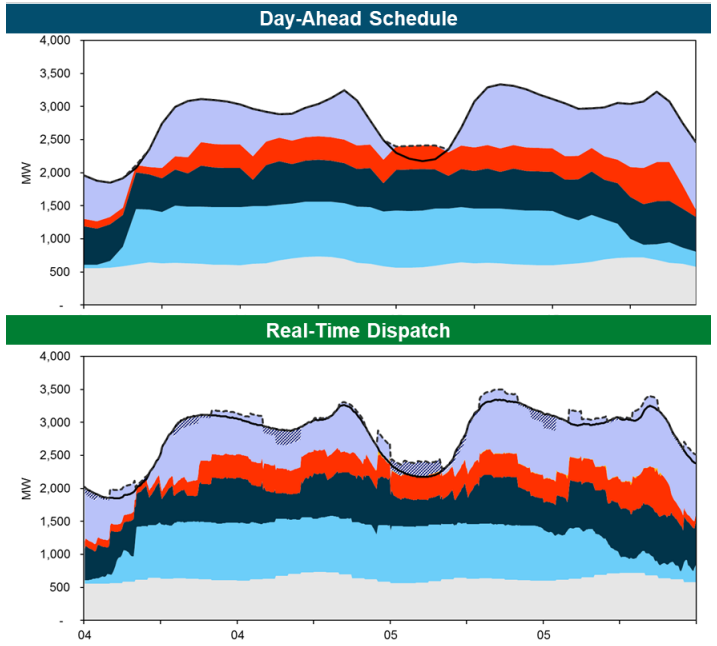
+ What resources can we select that result in a least-cost portfolio to meet long-term planning goals?

PLEXOS
Detailed Production Simulation Model

+ What is the least-cost operational dispatch of a resource portfolio on an hourly basis?

Total Installed Capacity (MW)

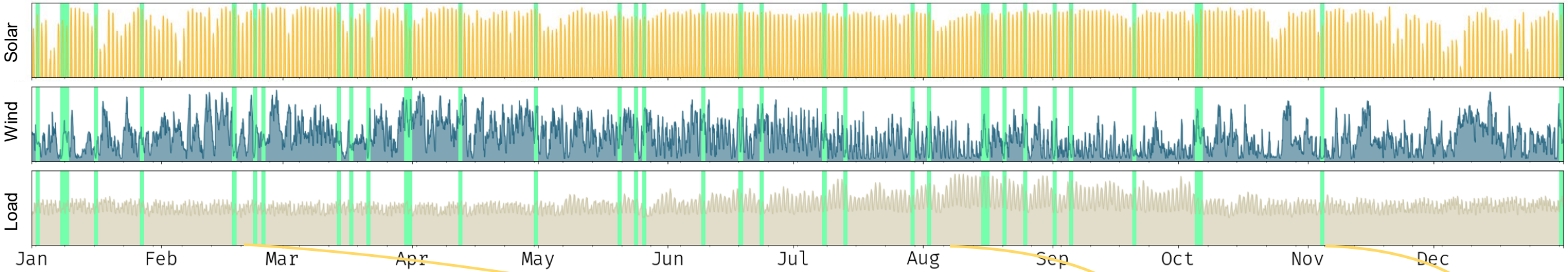


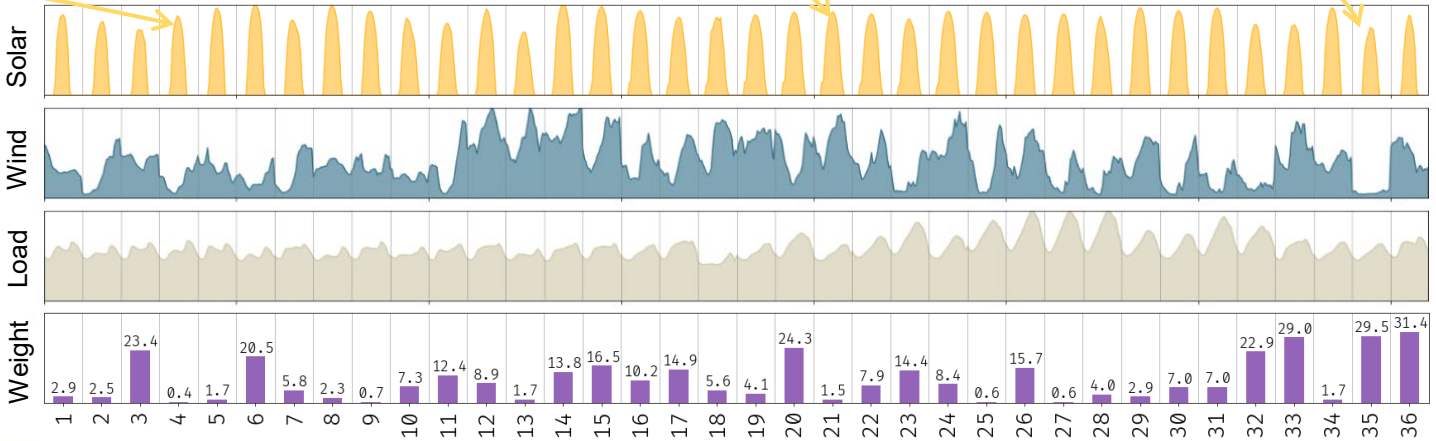


RESOLVE Day Sampling

Estimating Annual Operating Costs in Capacity Expansion Planning Context

- PLEXOS simulates every hour in its production cost simulation
- RESOLVE uses a statistical sampling to downscale annual data to ~40 representative days

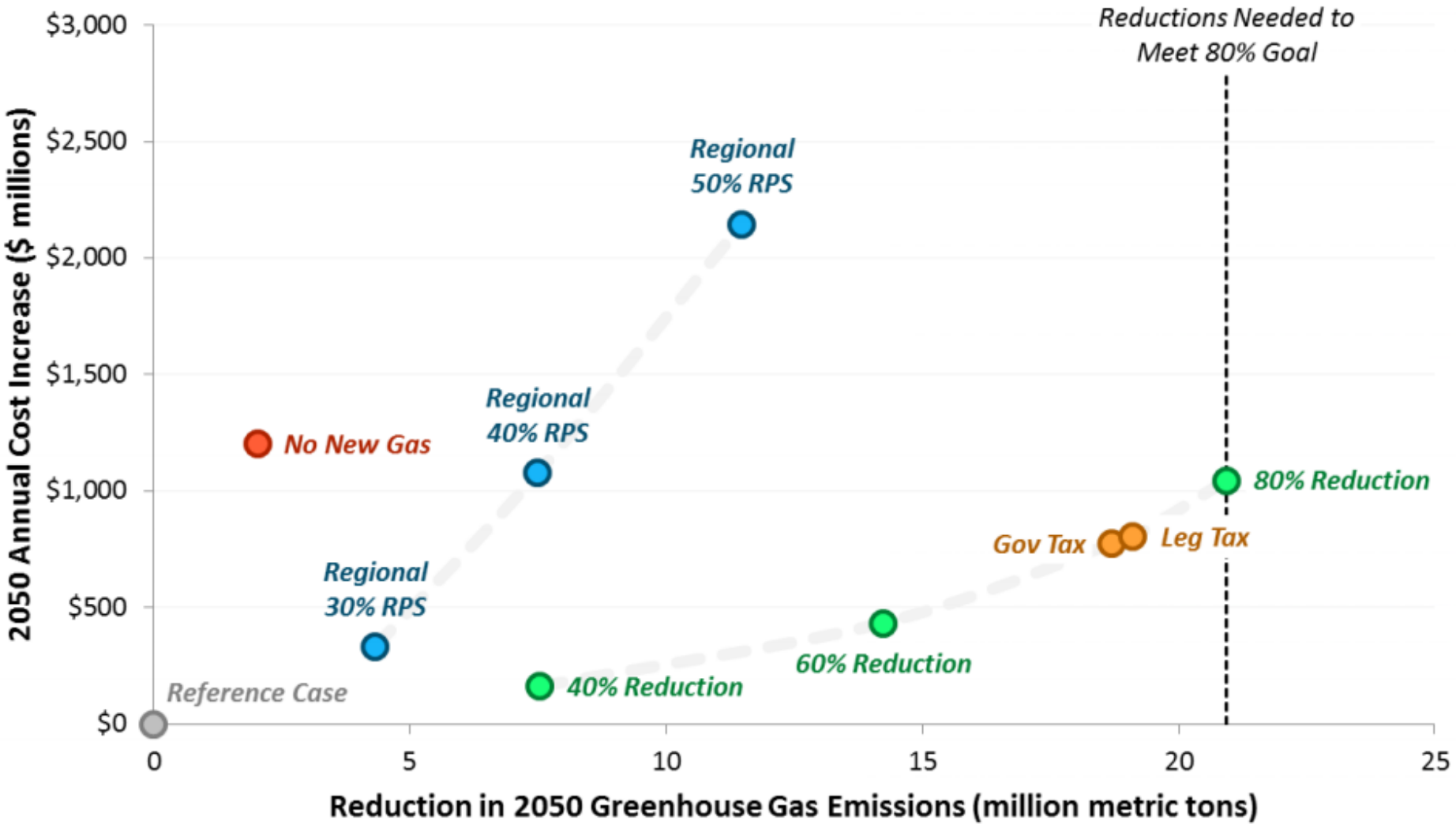




RESOLVE representative dispatch days are **downsampled and weighted** based on historical data to accurately estimate operational costs under most conditions

Using Scenario Analysis with RESOLVE

Comparing Different Policy Pathways on Cost & GHG Emissions Reductions



Source: E3 Pacific Northwest Low Carbon Scenario Analysis

Modeling Inputs

Overview

PLEXOS Generator Inputs

Property	Description	Unit
Minimum and Maximum Power Output	Minimum operating capacity of a resource. Maximum rated capacity of a resource unit.	MW
Heat Rate	Fuel efficiency	MMBtu/MWh
Rating Factor	Percentage of a unit's rated output, ranges 0 – 100%	%
Ramp Rate	Flexibility of a resource to increase or decrease its power output over time	MW/minute
Minimum Up/Downtime	Required on/off time for a unit	Hours
Start Cost	Cost to start a unit	$
Start Cost Time	Used in combination with Start Cost to define cooling states of a unit	Hours

PLEXOS Generator Inputs Continued

Property	Description	Unit
Maintenance Outage Rate (MOR)	Scheduled outage for unit maintenance	%
Forced Outage Rate (FOR)	Unexpected or unplanned outages, resulting in partial or complete loss of generating capacity for a period of time	%
Operational Costs (Variable/Fixed/ Running)	Costs associated with operating the generator units	$
Regulation Up/Down	How much up/down spin needs to be provided by generator spare capacity	MW

RESOLVE Generator Inputs

Property	Description	Unit
Resource Build	Maximum capacity of existing generators and capacity targets for new, renewable generators	MW
Resource Cost	Cost of existing resources and the current market value of new renewable resources	$/kW-year
Physical Zone	Where the Resource is located (e.g. island, etc.)	N/A
RPS Eligible	Does the unit contribute to RPS?	Yes/No
Unit Retirement	Can the unit be retired?	Yes/No
Reserves	Does the unit contribute to spinning, regulation or load following reserves?	Yes/No
Frequency Response	Ability to provide Total or Partial Frequency Response	Yes/No

PLEXOS Generator Operating Constraints

Property	Description	Unit
Operating Hours	Time when a unit can/cannot operate	Hours
Must-run	Indicator for when a unit must operate	N/A
Curtailment Order	Priority order for unit curtailment	N/A
Capacity/Energy Factor Limit	Maximum capacity and energy a unit may be dispatched up to	MW and MWh, respectively

RESOLVE Generator Operating Constraints

Property	Description	Unit
Curtailment	Is the resource curtailable?	Yes/No
Hourly Pmax	Limits the operational capacity of a unit that may be on a maintenance outage, or may operate at a percentage of max capacity	%/hour

PLEXOS Energy Storage Inputs

Property	Description	Unit
Max Power	Rated maximum power of a unit	MW
Max Capacity	Rated maximum energy output (duration)	MWh
Charge/Discharge Efficiency	Start and end charges of a battery for one cycle (roundtrip efficiency)	%
Capacity/Energy Factor Limit	Maximum capacity and energy a unit may be dispatched up to	MW and MWh, respectively
O&M Cost	Battery operational and maintenance costs	$

RESOLVE Energy Storage Inputs

Property	Description	Unit
Resource Build	Maximum capacity and energy of existing storage and capacity targets for new storage	MW and MWh
Resource Cost	Cost of existing storage units and the current market value of new energy storage	$/kWh-year
Paired Resource	Can the storage be paired to a renewable generator?	Yes/No
Reserves	Does the storage contribute to spinning, regulation or load following reserves?	Yes/No
Frequency Response	Ability to provide Total or Partial Frequency Response	Yes/No

PLEXOS Energy Storage Operating Constraints

Property	Description	Unit
Pairing	Ties a battery to a generator	-
Max Cycles/Time	Limits the number of cycles over time (e.g., once a day, once a day for every day of the year, etc.)	# of cycles/time
Operating Hours	How many hours the battery is allowed to run	hours
Degradation	Percentage of capacity degradation per cycle	%
Min/Max State of Charge	Define the minimum and maximum charge within a battery at any given time	%

Fuel

Property	Description	Unit
Type	Non-renewable, renewable, and blended fuel types	
Price	Fuel price by forecast	$/barrel

Constraints

Able to use various coefficients to do different things with the fuel including:

- Limiting how much MMBTU of a certain fuel a unit uses.
- Use a different fuel under designated conditions

Sales

Property	Description	Unit
Load	Load of the Node/System	MW
DER	DER modeled as a generating unit	Generating Unit

EXAMPLE:

A 50 MW DER program would have:

Max Capacity: 50 MW
Rating: A profile in the form a .csv file
Mark-up: -X $/MWh (Negative mark-up to make it taken earlier. Will not affect actual cost)
Reserves: X MW (How much of this resource can contribute to reserves)

Model Outputs

Overview

PLEXOS Outputs

Generators

- Most model inputs
  - i.e. Unit Capacity (MW)
- Generation (MW or MWh)
- Units Shutdown
- Fuel Offtake (MMBTU)
- Start Fuel Offtake (MMBTU)
- Hours curtailed (h)
- Capacity Curtailed (MW)
- Curtailment Factor (%)
- Marginal Fuel Cost

Battery

- Energy (MWh)
- State of Charge (%)
- Generation (MW)
- Load (MW)
- Losses (MW)
- Hours Charging/Discharging/Idle (h)
- Hours Idle
- Age (cycles)

Many more

RESOLVE Outputs

- Portfolio
  - Resource Quantity
  - Resource Timing
  - Costs
  - Comparison of other portfolios

Solution Evaluation Methodology

Overview

Grid Service Definitions

✗ Not applicable
◔ ◑ ◕ Partial representation
✓ Full representation

Grid Service	Description	Represented in Evaluation Methodology
Energy	A continuous, controllable, and predictable supply of megawatt-hours to serve system load needs in response to an AGC signal	✓
Load Reduction	Capacity that can be provided by a generator, storage or controlled load to reduce system load in the required timeframes and durations in response to an AGC signal.	✓
Load Build	Capacity that can be provided by storage or controlled load to increase system load in the required timeframes and durations in response to an AGC signal.	✓
Fast Frequency Response FFR1	An autonomous and predictable capacity to limit the frequency drop resulting from a frequency disturbance.	◑
Regulating Reserve	A reserve capacity provided by generating and load resources to allow continuous energy balance over the next 1 minute and 20 to 30 minute time interval due to the variability in renewable resources and load that can be called upon in response to an AGC signal.	✓
Distribution Capacity	A supply and/or a load modifying service that DERs provide as required via the dispatch of power output for generators and electric storage, and/or reduction in load that is capable of reliably and consistently reducing net loading on desired distribution infrastructure.	◑
Distribution Reliability	A load modifying or supply service capable of improving local distribution reliability under abnormal conditions.	◑

Grid Service Definitions

✗ Not applicable
◔ ◑ ◕ Partial representation
✓ Full representation

- Needs are defined as constraints in evaluation models based on planning criteria
- Constraint shadow prices estimate the value of each service based on available, least-cost resources on the system

Grid Service	Needs Calculation Methodology	Represented in Evaluation Methodology
RPS	% of annual retail sales forecast	✓
Transmission Deferral	Major and minor transmission upgrade thresholds & levelized costs	◑

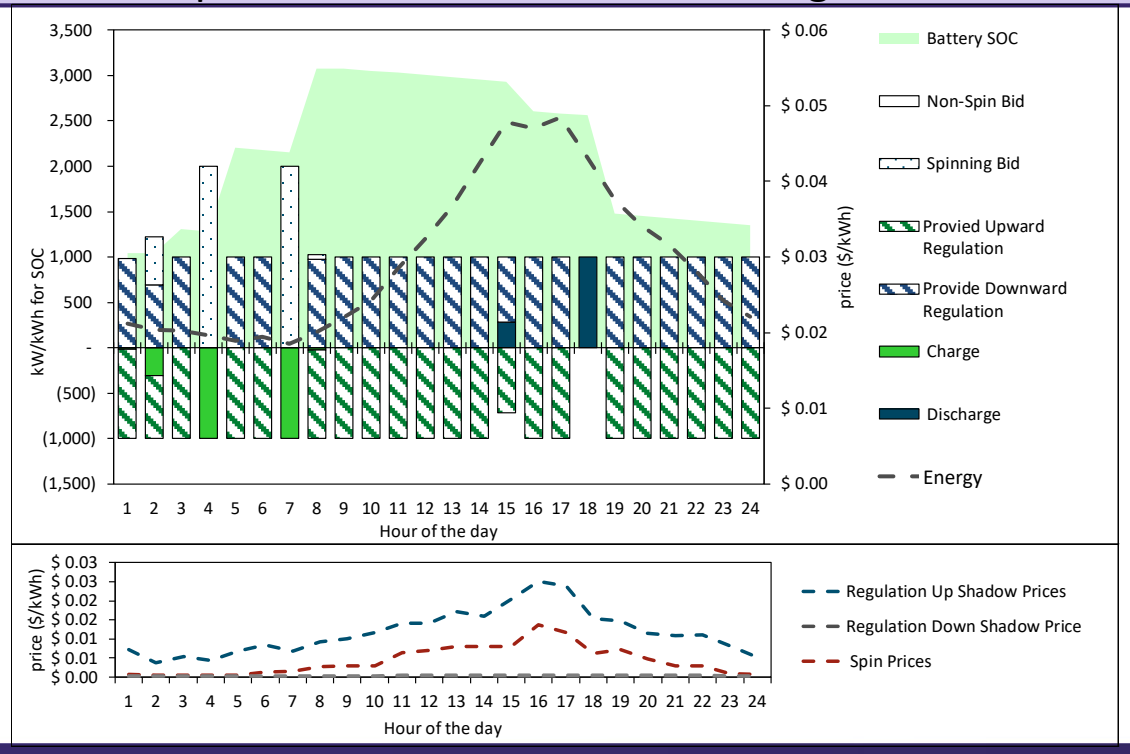
Solution Evaluation Methodology

- **Two options for solution evaluation:**
  1. Using **discounted cash-flow** allows us to estimate the value of each option individually without rerunning RESOLVE & PLEXOS
     - Assuming each resource is a price-taker in the future, we can use constraint shadow prices from CEAS Needs cases
     - Price-taker approach allows us to **quickly rank and screen options** individually
  2. We can rerun evaluation models to select **optimal resource portfolios** for 5-Year Action Plan
     - Assume each option is a price-taker on CEAS Needs constraint shadow prices as an estimate of discounted value of option to overall system in the future
     - Captures the **interactive effects** of adding new resources to the system, such as on transmission constraints and curtailment

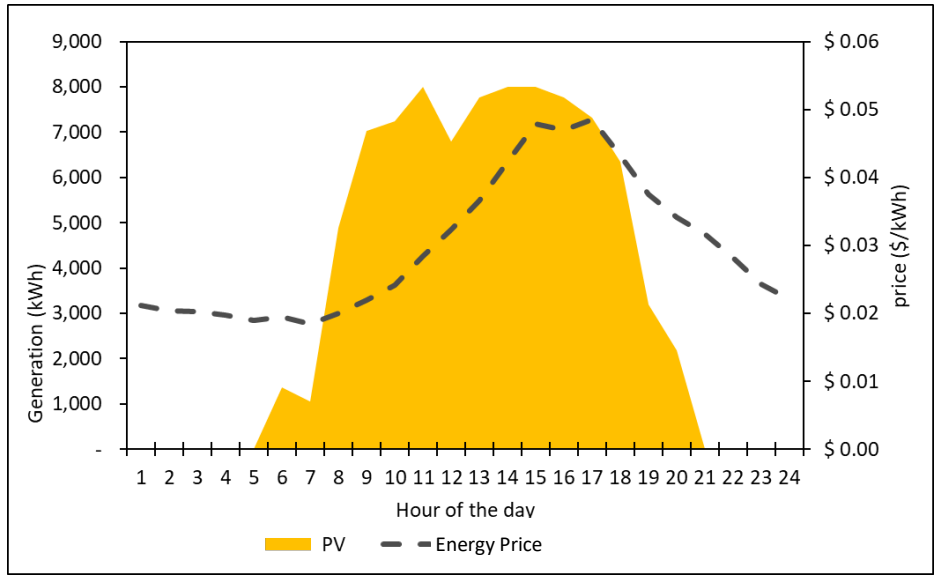
Calculating Value of Services Provided

- Constraint shadow prices are an estimate of the value of each service
- Resources generation profiles can be provided by each specific option and multiplied against constraint shadow prices to estimate value of services provided

Example of Value Streams for a Storage Resource

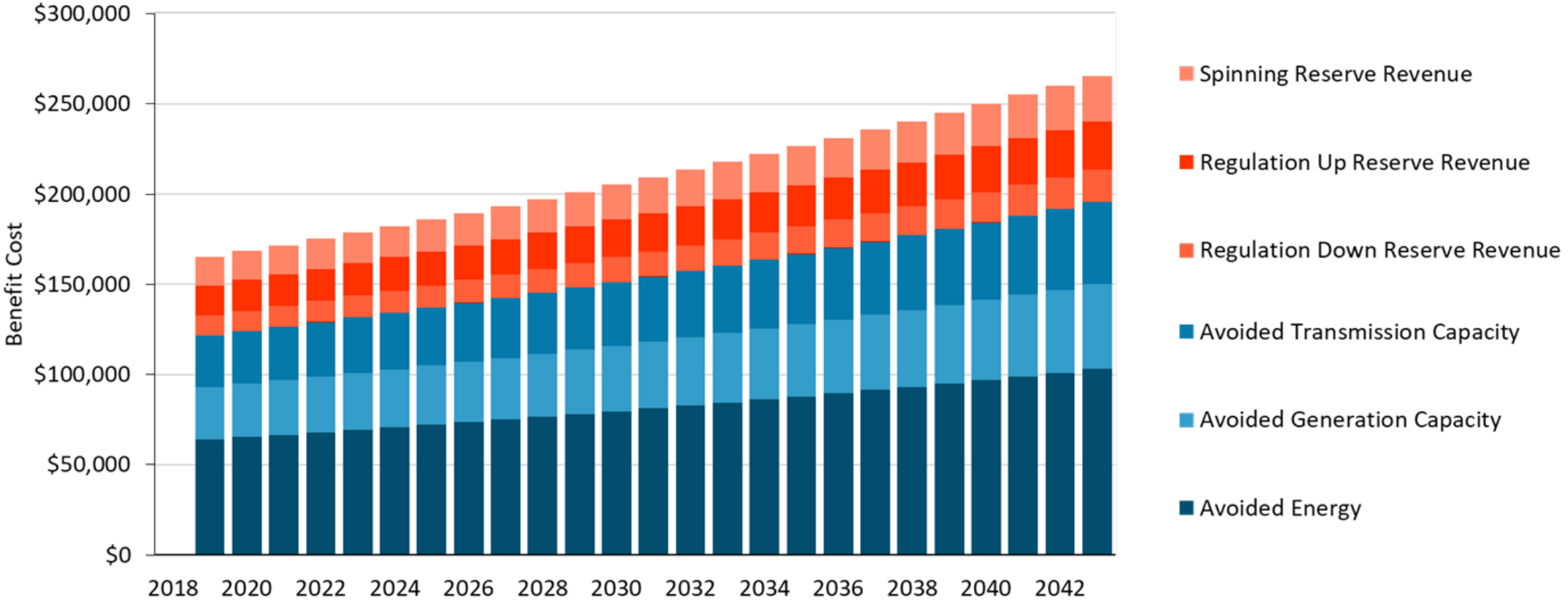


Example of Value Streams for a PV Resource



Example Annual Values for Options

- Hourly value streams can be aggregated to annual and NPV values for each resource



Solution Evaluation: Producing Optimal Portfolios

- Key differences from CEAS Needs RESOLVE runs:
  - Shorter time horizon but with higher (annual) granularity
  - Remove generic resources (select only real options)
  - Select resources based on full size of option to meet portfolio requirements
    - Alternatively, rank options based on total value to system doing in/out cases

Long-term CEAS Needs RESOLVE cases run in 5-year increments to reach 2045 policy goals

Solution Evaluation RESOLVE cases select resources for current **5-Year Action Plan.**

Out-year value estimated based on generic system values from CEAS Needs cases.

Solution Evaluation Methodology Outputs

- **Outputs can include:**
  - Ranking of options based on long-term CEAS Needs values
  - Estimated annual and NPV value of services (e.g., energy, AS) provided by each option
  - Updated CEAS Needs values based on least-cost portfolio of options
  - Potential T&D upgrades or deferred T&D upgrades

Stakeholder Feedback

Stakeholder Feedback
Pre-RESOLVE Sensitivities

- Legacy NEM self consumption load shift
- Transmission and distribution constrained
  - No new substations, poles or wires except line extensions
- EV low load factor
  - Customers primarily self supply charge with onsite batteries
- EV optimized high load factor
- High Grid Defection
- Grid charge load shift need for extended periods of low wind and solar

Stakeholder Feedback
RESOLVE Sensitivities

- Transmission constrained (land only)
- Load shift bring your own device
  - Dispatchable and passive capacity services for excess energy, ramping, peaking time domains with consideration for distribution domain services/needs when/where applicable
- DGPV excess energy capacity dispatch
  - Renewable curtailment order based on resource cost if not being dispatched for capacity services
- Frequency responsive load bank

Competitive Procurement Working Group

- Evolution of IGP CEAS procurement process has changed the needed deliverables from CPWG:
  - Adoption of Independent Observer
  - RFPs will follow more of the “traditional” process
- Competitive Bidding Framework will likely need to be modified to reflect current procurement types and environment – focus for CPWG going forward
- Plans for January CPWG Meeting
  - Provide an updated Framework for Competitive Bidding for review and comment
    - Applicability and flexibility to cover all IGP procurements
      - Generation, Grid Services, Storage, NWAs, Long Term RFPs
    - Align “PUC Review Points” in the current proposed IGP Sourcing Approach with the review process in the CBF
    - Applicability and appropriate use/need of Parallel and Contingency Plans
    - Stakeholder review and feedback

SEOWG Deliverables & Schedule

1. Description of the process methodology to be used to identify capacity, energy, ancillary service needs
   - **Due 01/15/2020**
2. Description of the evaluation methodology for T&D Non-wires RFP
   - **Due 2/1/2020**
3. Description of the evaluation methodology to be used for system resources RFP
   - **Due 3/1/2020**
4. Description of the optimization methodology to be used for proposed solutions that may address multiple resource/grid needs
   - **Due 6/1/2020**

CPWG Deliverables & Schedule

1. Review of Competitive Bidding Framework (CBF) and first draft of proposed modifications
   - **January 2020**
2. Incorporate stakeholder feedback on CBF and produce second draft
   - **February 2020**
3. Final draft of proposed modification of CBF
   - **March 2020**

Next Steps

SEOWG

- Walk through details of the RESOLVE and PLEXOS modeling
  - What planning criteria will be solved for?
  - What constraints will be incorporated into the models?
  - What grid service needs will be identified by the models? How are these services defined?
- What kind of information will be used from the CEAS needs to develop near term and long term RFPs? How specific should the RFPs be?
- Reach agreement on the CEAS needs process step by January 15, 2020

CPWG

- Develop first draft of proposed CBF update for distribution to stakeholders in advance of January work group meeting

Thank You

Hawaiian Electric
Maui Electric
Hawai‘i Electric Light