Hawaiian Electric

Integrated Grid Planning

Solution Evaluation & Optimization Working Group Meeting

May 22, 2020

Meeting Agenda

- Welcome and Ground Rules
- Quick Review – Where We Are Today
- Grid Services 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.

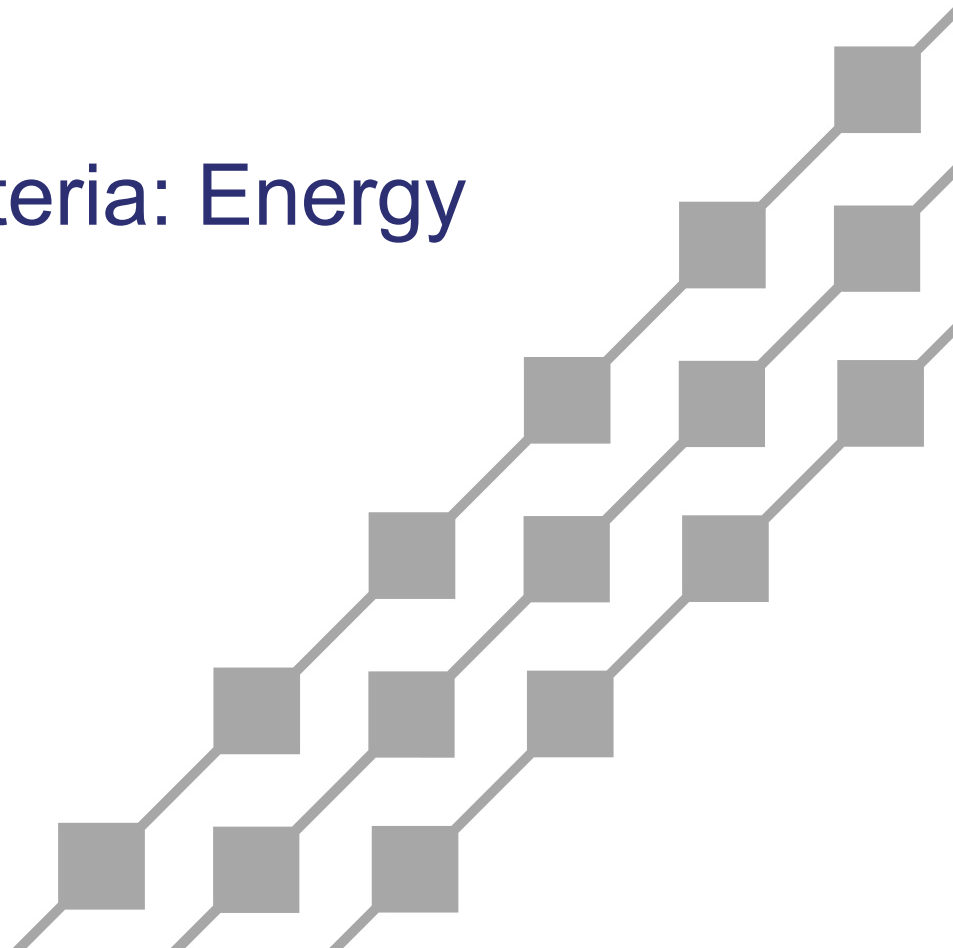
Objectives for Today's Meeting

- Summarize progress made to date
- Introduce the Energy Reserve Margin Grid Service
- Review methodology for Load Build and Load Reduce Grid Services
- Review relationship between resources and grid services

Review of SEOWG Discussions

- Needs Assessment and Solution Sourcing Process (Sept 20, Nov 13)
- Fuel and Resource Costs (Jan 23, Apr 20)
- Modeling Sensitivities (Dec 9, Jan 23, Feb 12, Mar 16)
- Grid Services/Grid Needs Assessment (Dec 9, Jan 23, Apr 20, May 22)
  - Regulating Reserve Rule (Jan 23)
  - Load Build/Load Reduce (May 22)
  - Energy & Capacity-ERM (May 22)
- Solution Evaluation Methodology (Jan 23, Feb 12, Apr 20)
- Transmission Needs (Dec. 9, Jan 23, TBD)

Capacity Planning Criteria: Energy Reserve Margin



Objectives

- Introduce a resource planning criteria that analyzes contributions from diverse generating portfolio for planning purposes.

- Illustrate the concept and use of an Energy Reserve Margin criteria for capacity planning purposes.

Regulatory Background

- “The generation capacity of the utility’s plant, supplemented by electric power regularly available from other sources, must be sufficiently large to meet all reasonably expected demands for service and provide a reasonable reserve for emergencies”

Hawaii Department of Regulatory Agencies

- Title VII – Public Utilities Commission
- Standards for Electric Utility Service in the State of Hawaii – General Order No. 7

Capacity Planning Criteria: A Metric of Reliability

- The capacity planning criteria is a metric to evaluate if a system has the appropriate amount of electrical generating capability needed to serve consumer demand and provide a reasonable reserve for emergencies.
- All generation sources are not created equal, diversity is key.

Current Capacity Planning Criteria Issues

Island	Capacity Criteria	Planning Consideration
Oahu	Loss of largest unit	4.5 yrs/day LOLP
Hawai'i	Loss of largest unit	20% reserve margin
Maui	Loss of largest unit	20% Reserve margin
Moloka'i	Loss of largest unit	
Lana'i	Loss of largest unit	

- Studies the ability to meet instantaneous peak demand.
- Challenging to properly evaluate the contributions to capacity planning from variable renewable energy resources and energy storage.
- As variable renewable and storage resources become more abundant, a reliability criteria with focus on energy rather than capacity becomes more important.

Capacity Planning Criteria Issues (continued)

Due to increasing amounts of variable generation and storage resource additions, a planning criteria must:

- Consider dynamic nature of variable resources
- Consider impacts from load shifting storage

These considerations can be achieved if evaluation and application of capacity criteria are applied to smaller periods (e.g., hourly time slices instead of one annual system peak value).

Industry Planning Criteria

	Planning Criterion	PRM
Sound Energy	LOLP: 5%	16% (2023 - 2024)
Avista Summer: 1,700 MW;	LOLP: 5%	22% (14% +operating reserves)
PacifiCorp	LOLE: 2.4 hrs/yr	13%
Arizona Public Service	One event in 10 years	15%
Tuscon Electric Power	PRM	15%
Public Service Co. of New Mexico	LOLE: 2.4 hrs/yr	Greater of 13% or 250MW
El Paso Electric	PRM	15%
Cleco	LOLE: 1 day in 10 years	14.8%
Kansas City Power & Light	1 day in 10 Years	12%
Oklahoma Gas & Electric	1 day in 10 Years	12%
South Carolina Electric & Gas	24 to 2.4days/10 years	14-20%
Tampa Electric	PRM	20%
Interstate Power & Light	PRM	7.30%
Florida Power and Light	PRM	20%
California ISO	LOLE: 0.6 hours/month	15-17%

Criteria Selection

- Any criteria will be predicated on a set of assumptions to plan for reliable operation and provide a reasonable reserve for emergencies
- The planning criteria should be flexible enough to maintain reliability, regardless of portfolio composition.

Energy Reserve Margin (ERM)

- Energy Reserve Margin is a planning criteria to satisfy load and plan for a reasonable reserve for emergencies.
- Energy Reserve Margin plans for reserves to mitigate impacts from contingency conditions such as:
  - Conventional resources
    - Unit derates
    - Forced outages
  - Variability from Interruptible load contribution
  - Variable resources
    - Fluctuations in generation capability
    - Prolonged poor weather patterns or atypical weather events
  - Storage
    - Battery degradation or failures
    - Paired renewable resource limitations
  - Forecast error, especially higher than forecasted load conditions

Energy Reserve Margin (continued)

(Firm Capability – Maintenance Units + Hourly Dependable Capacity + Shifted Load + Interruptible Load) ≥ Load Demand * (1+ERM)

- Available energy is compared to the load on an hourly basis.
- An hour in which the energy reserve margin is not satisfied is considered at-risk and may result in unserved energy.

Energy Reserve Margin (continued)

Hourly Available Energy

Firm Capability
- Maintenance
+ Hourly Dependable Capacity
+ Shifted Load
+ Interruptible Load

≥

Hourly Demand with Energy Reserve Margin

Load Demand X (1+ Energy Reserve Margin%)

Hourly Dependable Capacity (HDC) Definition

- Hourly Dependable Capacity is a statistically dependable output from a variable generation resource based on empirical data that can be reasonably counted on for capacity purposes..
- Hourly Dependable Capacity (in MW) could be calculated as follows:

  Hourly Dependable Capacity = $\chi - N * \sigma$,

  Where χ = the hourly mean of a variable generation resource,

  σ = a standard deviation,

  N = the number of standard deviations
- An hour that is two standard deviations less than the mean has an approximately 97.7% probability of availability

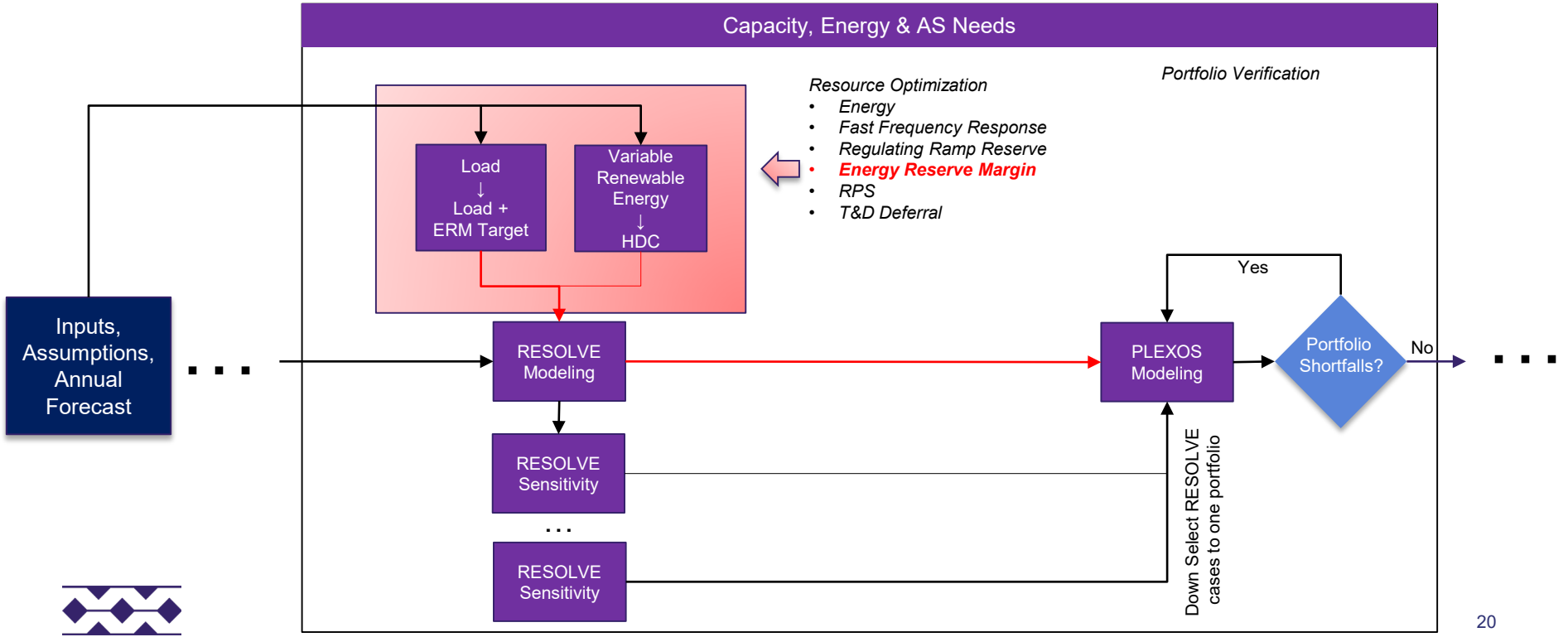
Energy Reserve Margin Target

- Plans to meet forecasted energy demands and provide a reasonable reserve for emergencies
- The Energy Reserve Margin plans for reserves to mitigate:
  - Loss of largest unit in any given hour
  - Multiple forced outages
  - Unplanned Maintenance
  - Fluctuations in generation capability from variable resources
  - Prolonged poor weather patterns or atypical weather events
  - Battery failures
  - Forecast error, especially higher than forecasted load conditions
- Target values selected to meet or exceed current capacity planning criteria

Energy Reserve Margin Target (continued)

Island	Energy Reserve Margin Target
Oahu	30%
Hawaii	30%
Maui	30%
Molokai	60%
Lanai	60%

Long Term Plan Process



Conclusion

- The ERM captures the same aspects of reliability as a traditional reserve margin, with increased granularity and flexibility to include energy availability accounting.
- An Energy Reserve Margin can be utilized for capacity planning purposes.
- Energy Reserve Margin targets plan to meet forecasted energy demands and provide a reasonable reserve for emergencies.

Load Build and Load Reduce

Grid Service Definitions

- 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 a remote dispatch signal
- Load reduce: 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 a remote dispatch signal
- The intent of these two services is to encourage more load resources to participate economically in the provision of grid services, aligned with marginal energy cost

Purpose

- In tandem, load build and load reduce grid needs would identify a potential for energy arbitrage although the capacity for and timing of these needs may not be identical.

Load reduce

- Aligned with high marginal cost hours
- Subset of the energy service for resources that can't participate in the regular provision of energy or are constrained on the number of calls for service

Load build

- Aligned with negative or low marginal cost hours
- Reduce hours of overgeneration or to serve unmet downward regulating reserves

Methodology

- A subset of hours and their marginal avoided costs for the energy service will be used to identify the need for load build / reduce
- A production simulation will be used to evaluate marginal avoided costs for energy across all hours
- Avoided costs will be calculated every 5 years, consistent with the planning horizon used in RESOLVE

Proposed Grid Services for IGP

Proposed Grid Services for IGP

Grid Service	Description	Represented in RESOLVE & PLEXOS	Represented in PSSE/PSCAD/ASPEN
Energy	A continuous, controllable, and predictable supply of megawatt-hours to serve system load needs in response to an AGC signal	✓	Not Represented
Energy Reserve Margin	A guideline to minimize risk of insufficient generation capability from a diverse mix of generating resources available to the system in long-range generation expansion studies	✓	Not Represented
Load Reduce	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 a remote dispatch signal	✓	Not Represented
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 a remote dispatch signal	✓	Not Represented
Regulating Reserves	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	✓	Not Represented

Proposed Grid Services for IGP

Grid Service	Description	Represented in RESOLVE & PLEXOS	Represented in PSSE/PSCAD/ASPEN
Inertia*	Contribution to the capability of the power system to resist changes in frequency by means of an inertial response from a generating unit, network element or other equipment that is electromagnetically coupled with the power system and synchronized to the frequency of the power system.	✓	✓
Primary Frequency Response (PFR)*	Automatic and autonomous response to frequency variations through a generator's droop parameter and governor response	◑	✓
Fast Frequency Response (FFR1)	An autonomous and predictable capacity to limit the frequency drop resulting from a frequency disturbance.	✓	✓
Voltage Support*	Ability of generators or other equipment to produce or absorb reactive power to maintain the system voltages within specified limits.	Not Represented	✓
Short-Circuit Current*	Available current under fault conditions at a given location. A minimum value is required for proper coordination of protective devices and a safe and reliable operation of protection system.	Not Represented	✓

*Work in progress descriptions

Proposed Grid Services for IGP

Grid Service	Description	Represented in RESOLVE & PLEXOS	Represented in PSSE/PSCAD/ASPEN
RPS	% of annual retail sales forecast	✓	Not Represented
Transmission Capacity*	A supply and/or a load modifying service that DERs and grid-scale resources 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 transmission infrastructure	◑	✓
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	◑	Not Represented
Distribution Reliability	A load modifying or supply service capable of improving local distribution reliability under abnormal conditions	◑	Not Represented

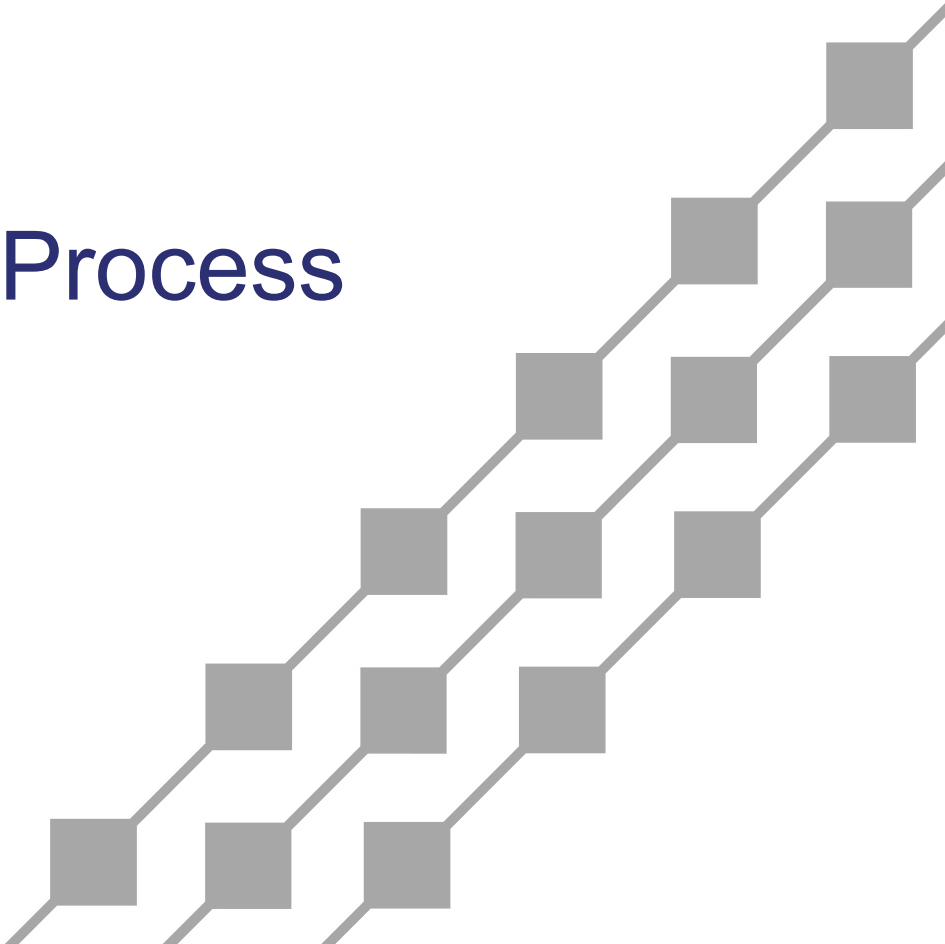
*Work in progress descriptions

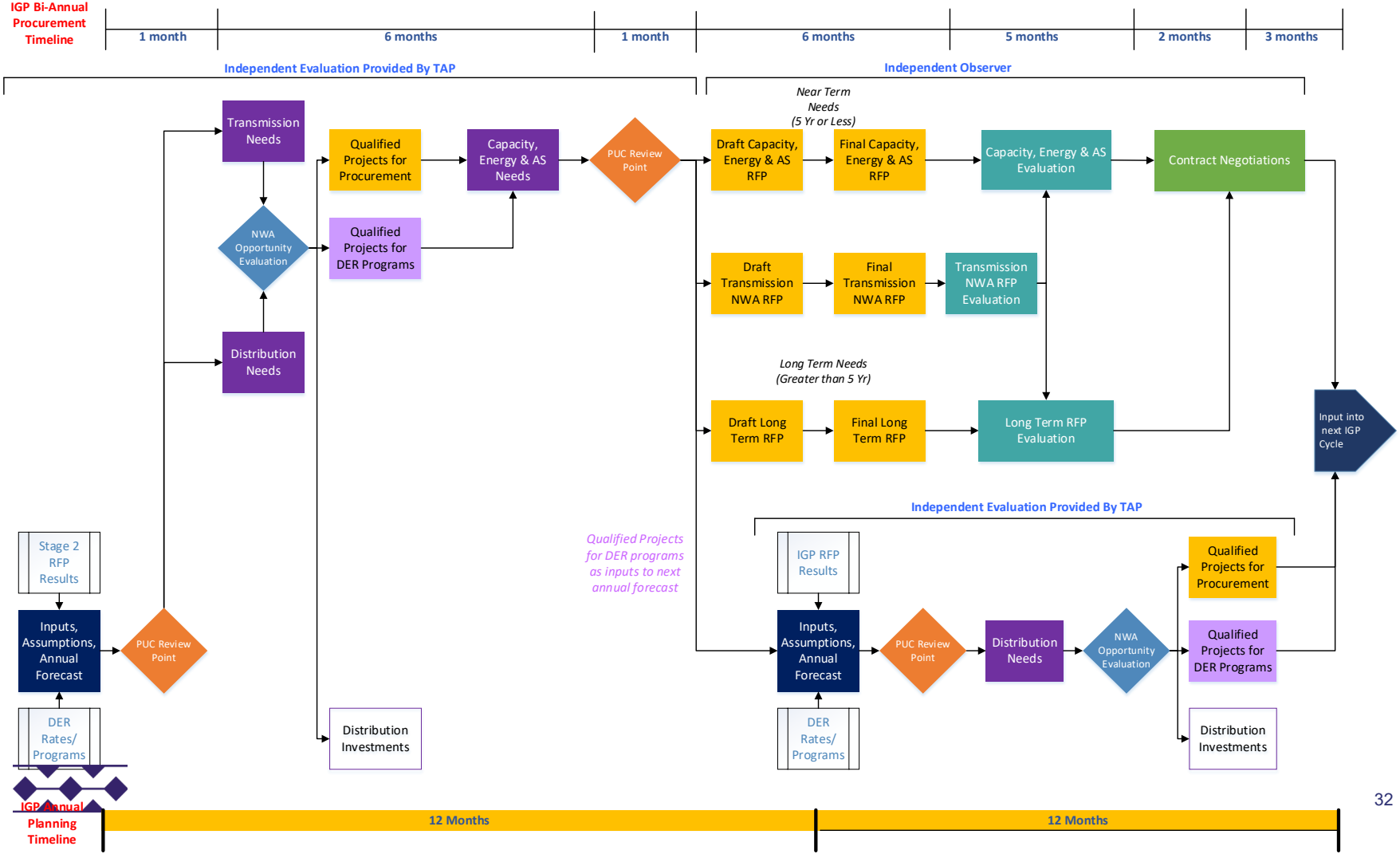
Grid Service Capability by Technology

Service by Resource	Inertia	Short circuit current	Volt. Supp.	Fast freq. resp.	Prim. freq. resp.	Trans. Capac.	Dist. Capac.	Energy	Energy Reser. Margin	Load Red.	Load Build	Reg. Reser.	RPS
		1							2				
GS PV		1							2				
		1							2				
GS BESS		1							3				
		1											
Sync. Cond.													

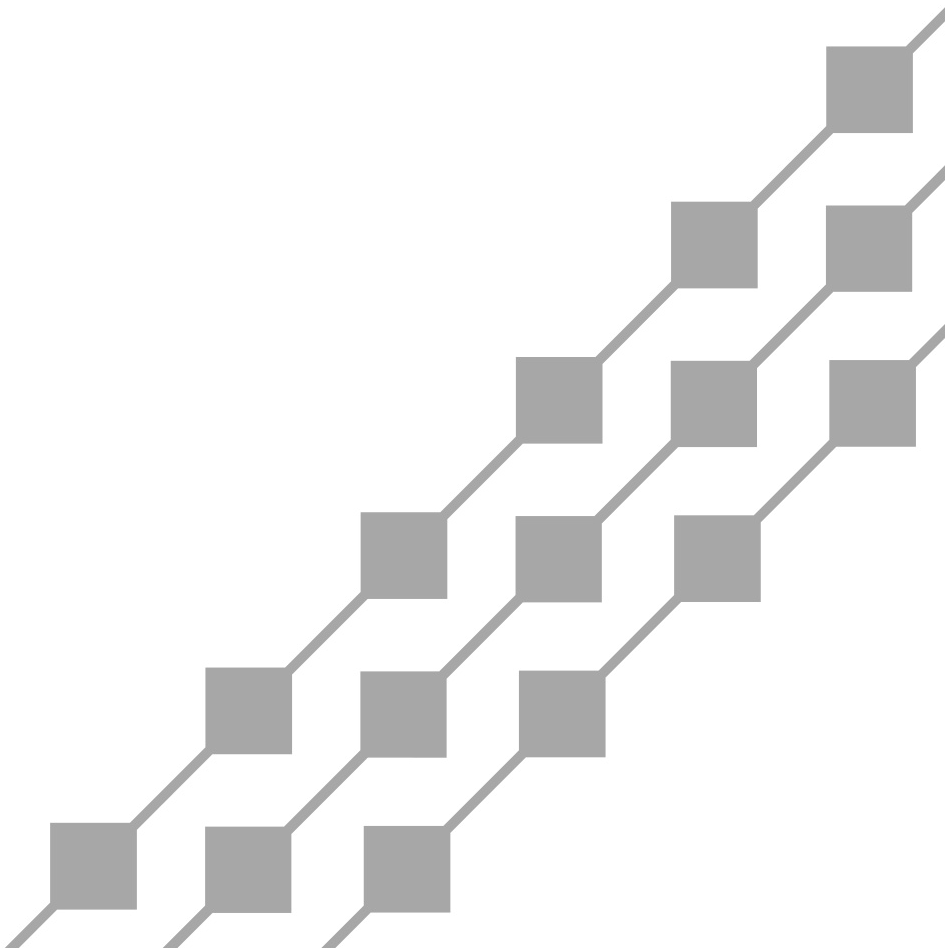
1. Requires grid forming inverter capability; 3-5 years away (Technology in transition)
2. Contribution to ERM limited by hourly dependable capacity
3. Contribution to ERM subject to change as resource portfolio changes
4. Requires controllability/communications for frequent dispatch signals

Solution Sourcing Process




IGP Bi-Annual Procurement Timeline
1 month
6 months
1 month
6 months
5 months
2 months
3 months
Independent Evaluation Provided By TAP
Independent Observer
Transmission Needs
Distribution Needs
NWA Opportunity Evaluation
Qualified Projects for Procurement
Qualified Projects for DER Programs
Capacity, Energy & AS Needs
PUC Review Point
Near Term Needs (5 Yr or Less)
Draft Capacity, Energy & AS RFP
Final Capacity, Energy & AS RFP
Capacity, Energy & AS Evaluation
Contract Negotiations
Draft Transmission NWA RFP
Final Transmission NWA RFP
Transmission NWA RFP Evaluation
Long Term Needs (Greater than 5 Yr)
Draft Long Term RFP
Final Long Term RFP
Long Term RFP Evaluation
Input into next IGP Cycle
Stage 2 RFP Results
Inputs, Assumptions, Annual Forecast
PUC Review Point
DER Rates/ Programs
Distribution Investments
Qualified Projects for DER programs as inputs to next annual forecast
Independent Evaluation Provided By TAP
IGP RFP Results
Inputs, Assumptions, Annual Forecast
PUC Review Point
Distribution Needs
NWA Opportunity Evaluation
DER Rates/ Programs
Qualified Projects for Procurement
Qualified Projects for DER Programs
Distribution Investments
IGP Annual Planning Timeline
12 Months
12 Months

Next Steps



Next Steps

- Release next draft of SEOWG Week of May 25
- Schedule June meeting to discuss transmission needs and stakeholder questions and comments
- Finalize SEOWG deliverable by end of June