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What is Capacity and Examples of How Capacity is Acquired

Oregon PUC Workshop on Capacity – UM 2011 Phase III

Carl Linvill, RAP

Jessica Shipley, RAP

Disclaimer

Opinions are our own, do not reflect the opinions of states where we work, the CAISO or the Western EIM GB. Examples presented to encourage discussion of Oregon solutions – inclusion of an example does not imply endorsement

Potential Sources of Capacity Value



What is Capacity Value?

A resource earns a capacity value when the resource ensures its availability with the requisite capability to meet a required need experienced at a given place at a given time. A capacity value may be experienced in the planning or operational time frame.

What is a “resource”?

A resource is any supply or demand side resource that provides real or reactive power or affects the need for real or reactive power.

How does a resource ensure its availability in the planning time frame?

A resource typically ensures its availability by being physically or contractually committed to the system operator. The capacity value in the planning time frame is based upon a capacity credit which may depend on the location, time and capability of the resource.

How does a resource ensure its availability in the operational time frame?

A resource ensures its availability by being physically or contractually committed to the system operator. The capacity value in the operational time frame is based upon a capacity payment which in turn is based upon the capability, location and time of service provision.

What are examples of resource locations (individual/aggregated)

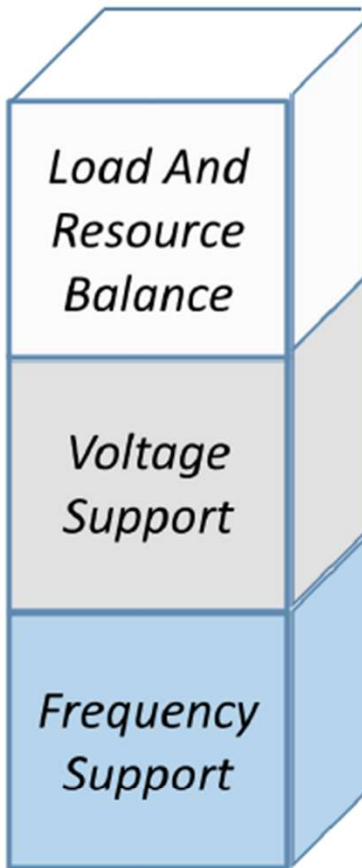
1. Interconnected to the transmission system
2. Interconnected to sub-transmission
3. Interconnected to distribution:
 1. Interconnected on the load side of a substation
 2. Interconnected on the load side of a feeder
 3. Interconnected in front of the meter on a circuit
 4. Interconnected behind the meter

What are examples of resource time frames

1. Planning time frames
 1. Annual
 2. Seasonal
2. Operational time frames
 1. Day ahead
 2. 4 hours ahead
 3. 1 hour ahead
 4. Real time (15 minutes ahead)

What are examples of resource capabilities that contribute to bulk system reliability?

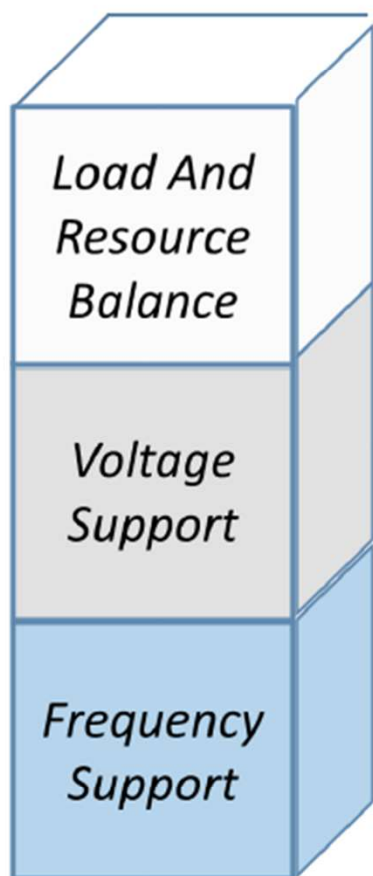
1. Resource Adequacy Capability
2. Flexible Ramping Capability
3. Essential Reliability Service Capability



- “Building blocks” of physical capabilities
- Stressed by resource changes
- Not all MWs are equal
- Some partly covered through ancillary services
- Accommodate local/regional needs



[Reliability Assessments URL](#)



[ERSTF Framework Report - URL](#)

Load & Resource Balance (Ramping & Balancing)

- Track and project the maximum one-hour and three-hour ramps for each balancing area

Voltage (V) Support

- Track and project the static and dynamic reactive power reserve capabilities to regulate V at points in the system
- Review the short circuit current at each transmission bus in the network, and calculate short circuit ratios

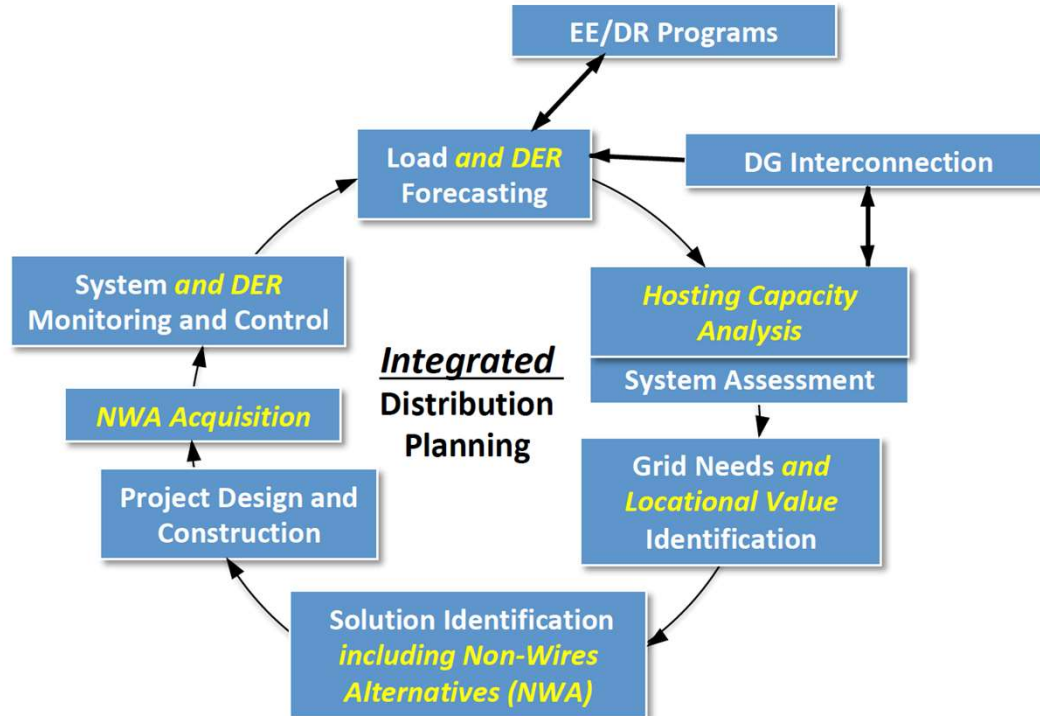
Frequency Support *(restoring after a major unit loss)*

- Track minimum frequency & its response post N-1 event
- Track & project level of conventional synchronous inertia
- Track & project the initial frequency deviation in the 1st $1/2$ second following the largest N-1 event

Examples of resource capabilities (Milligan, Grid Solutions)

1. Disturbance Ride-through
2. Reactive and Voltage Support
3. Slow and Arrest Frequency Decline (Arresting Period)
4. Stabilize Frequency (Rebound Period)
5. Restore Frequency (Recovery Period)
6. Frequency Regulation (AGC)
7. Dispatchability/Flexibility

What about resource capabilities that contribute to value on the distribution system?



“Integrated Distribution Planning: A Path Forward,” Kurt Volkmann for GridLAB

Transparently identifying need is essential

Capability	Description
1) Advanced Forecasting and System Modeling	Probabilistic planning and DER adoption scenario analyses; more granular load and power flow modeling; enhanced modeling of new smart inverter capabilities; and the ability to monitor, manage and optimize DER connected to the system.
2) Hosting Capacity Analysis	Determining how much additional DER each distribution circuit can accommodate without requiring upgrades.
3) Disclosure of Grid Needs and Locational Value	Identification and publication of opportunities for DER to provide grid services as non-wires alternatives (NWA); identification and publication of locations on each circuit where DER deployment can provide grid benefits.

“Integrated Distribution Planning: A Path Forward,” Kurt Volkmann for GridLAB

What are examples of resource capabilities that contribute to reliability on the distribution system?

1. Distribution capacity or peak load reduction
2. Voltage regulation
3. Reliability assurance/Resilience
4. Hosting capacity congestion relief

Compensating for meeting the need is just as important

Capability	Description
1) Advanced Forecasting and System Modeling	Probabilistic planning and DER adoption scenario analyses; more granular load and power flow modeling; enhanced modeling of new smart inverter capabilities; and the ability to monitor, manage and optimize DER connected to the system.
2) Hosting Capacity Analysis	Determining how much additional DER each distribution circuit can accommodate without requiring upgrades.
3) Disclosure of Grid Needs and Locational Value	Identification and publication of opportunities for DER to provide grid services as non-wires alternatives (NWA); identification and publication of locations on each circuit where DER deployment can provide grid benefits.
4) New Solution Acquisition	Acquiring or sourcing DER to provide grid services using pricing, programs or procurement.

“Integrated Distribution Planning: A Path Forward,” Kurt Volkmann for GridLAB

So Capacity is not one thing, it is an element of a 3 dimensional cube with location, time and capabilities dimensions

Let's consider some examples of how capacity is acquired



Contribution to RA - Colorado



Assessment of Need in Phase 1 of Public Service (CO) Energy Resource Plan

1. System reliability
2. Compliance with the Renewable Energy Standard
3. Flexible resources for integrating intermittent resources
4. EPA's Clean Power Plan (i.e. carbon reduction needs)

System Reliability Need

- Initial Plan identified a need in years 2022 and 2023 for additional generation capacity
- Compared peak demand forecast with existing and planned generation resources
- Proposes 16.3% planning reserve margin

Some Relevant Assumptions

- ELCC Capacity Credit for Wind
 - Existing Wind: 16%
 - Incremental Wind

Table 2.7-4: Average ELCC to Apply to Incremental Wind

(MW AC)	Northern	Limon	Lamar
250	10.0%	9.8%	18.8%
500	9.7%	9.2%	16.9%
1000	9.1%	8.4%	14.0%

Some Relevant Assumptions

- ELCC Capacity Credit for Solar
 - Existing Utility-Scale Solar: 55%
 - Existing Distribution-Interconnected Solar: 37%
 - Incremental Solar

Table 2.7-5: Average ELCC to Apply to Incremental Solar

(MW_AC)	Northern Front Range		San Luis Valley		Western Slope	
	Fixed	Tracking	Fixed	Tracking	Fixed	Tracking
50	37.0%					
100	37.0%	41.5%	13.5%	52.5%	41.5%	53.0%
250	35.8%	40.2%	42.2%	50.4%	41.0%	52.0%
500	33.9%	37.8%	39.1%	47.1%	39.0%	49.5%
1000	30.3%	33.2%				
1500	27.7%	29.1%				

Flexible Resource Need

- Supplemental reserve category designed to address large reductions of online wind generation due to losses in wind speed
- Calculated by analyzing historic 30 minute wind generation down ramps on the system
- Provided by electric generating resources that are available to generate electric energy within 30 minutes
- ERP concludes the company has sufficient flex reserve to accommodate additional 600MW wind

Ramping Capability – Green Mountain Power



Storage Availability has Capacity and Energy Value

Duration (Hours)	Power (kW) Available to GMP	Energy (kWh) Available to GMP	Total Monthly Credit	Total Monthly Credit (Constrained Area)
3	2-2.9	6-8.7	\$19.30	\$22.00
	3-3.9	9-11.7	\$28.95	\$33.00
	4-4.9	12-14.7	\$38.60	\$44.00
	5-5.9	15-17.7	\$48.25	\$55.00
	6-6.9	18-20.7	\$57.90	\$66.00
	7-7.9	21-23.7	\$67.55	\$77.00
	8-8.9	24-26.7	\$77.20	\$88.00
	9-9.9	27-29.7	\$86.85	\$99.00
	10	30	\$96.50	\$110.00

Efficient Use of the Transmission System



Hybrid Grid-scale Resources can bring Transmission Value

- Hybrid resources can enable efficient use of transmission interconnection capacity
- Hybrid resources can enable congestion reduction

Enabling Versatility: Allowing Hybrid Resources to Bring Their Full Value to Customers,” Goggin and Gramlich, Grid Strategies, and Burwen, ESA

Avoided Distribution Costs - Minnesota



Minnesota Value of Solar

Figure ES-1. VOS Calculation Table: economic value, load match, loss savings and distributed PV value.

25 Year Levelized Value	VOS Calculation Table						
	Gross Value (\$/kWh)	×	Load Match Factor (%)	×	(1 + Loss Savings Factor (%))	=	Distributed PV Value (\$/kWh)
Avoided Fuel Cost	GV1				LSF-Energy		V1
Avoided Plant O&M - Fixed	GV2				LSF-Energy		V2
Avoided Plant O&M - Variable	GV3				LSF-Energy		V3
Avoided Gen Capacity Cost	GV4		ELCC		LSF-ELCC		V4
Avoided Reserve Capacity Cost	GV5		ELCC		LSF-ELCC		V5
Avoided Trans. Capacity Cost	GV6		ELCC		LSF-ELCC		V6
Avoided Dist. Capacity Cost	GV7		PLR		LSF-PLR		V7
Avoided Environmental Cost	GV8				LSF-Energy		V8
Avoided Voltage Control Cost							
Solar Integration Cost							

Value of Solar

“Load Match Factor” (LMF)

- Used to reduce a given value component reflecting solar’s ability to meet those needs
- ELCC, calculated using MISO’s method, used as LMF for generation, reserve, and transmission capacity values
- LMF for distribution capacity values reflects distribution system peaks
 - Reflects time element of value

Implied Locational Value

- For distribution capacity value of solar, utilities may calculate on a system-wide or location-specific basis.
- In 2016, MN PUC ordered Xcel to calculate avoided distribution capacity cost on a locational basis
- In 2018, MN PUC suspended that order pending stakeholder review of Xcel calculations
- Revised Xcel proposal due by Dec 31, 2019
- August 2019, Xcel petitioned for changes to methodologies that imply a need for more granular, locational data on costs that can be avoided by solar

Non-wires Solutions Require Capacity - Oakland



Combining DERs in a Non-Wires Solution: Oakland Case Study

- The PG&E and East Bay Clean Energy project, the Oakland Clean Energy Initiative (OCEI)
- Replaces a retiring 165 MW Dynegy gas peaker, obviates need for 115 kV and 230 kV transmission
- Combination of resources includes:
 - 25-40 MW combination of EE, DR, PVDG (minimum 19 MW of load reducing response)
 - 10 MW/40 MWh storage
 - Substation upgrades and line re-ratings

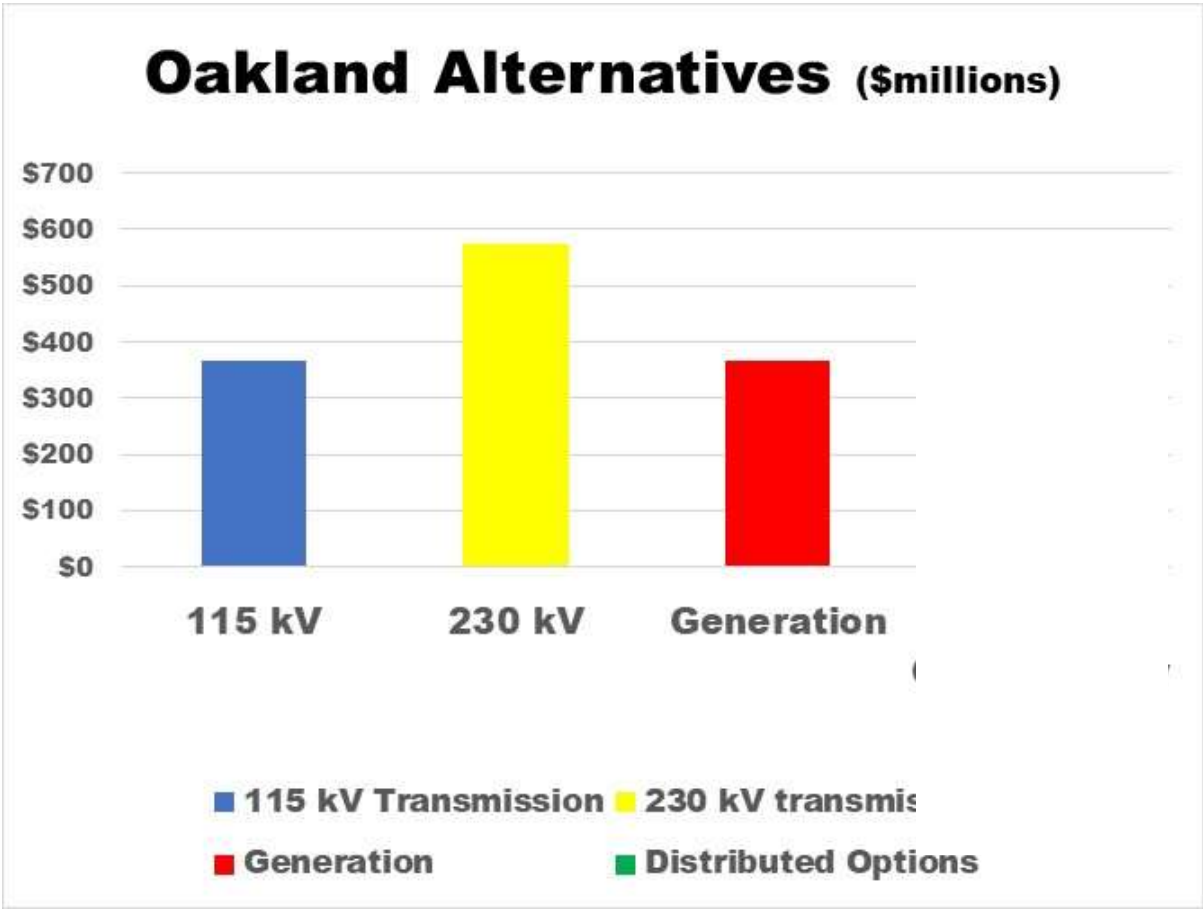
Estimated Cost of Alternatives

	Estimated Capital Cost (2022 \$M)	Total Cost (2022 \$M)
OCEI	\$56-\$73 ¹	\$102 ²
115 kV	\$193-\$217	\$367 ³
230 kV	\$316	\$574 ⁴
Generation	\$232	\$368 ⁵

CAISO approves clean energy, storage and system upgrades to replace peaker plant, *PV Magazine*, March 29, 2018 <https://pv-magazine-usa.com/2018/03/29/caiso-approves-clean-energy-storage-and-system-upgrades-to-replace-gas-plant/>

Request for Offers Launches for Oakland Clean Energy Initiative, *Business Wire*, April 13, 2018 <https://www.businesswire.com/news/home/20180413005630/en/Request-Offers-Launches-Oakland-Clean-Energy-Initiative>

Saves Ratepayers Money, Reduces Emissions



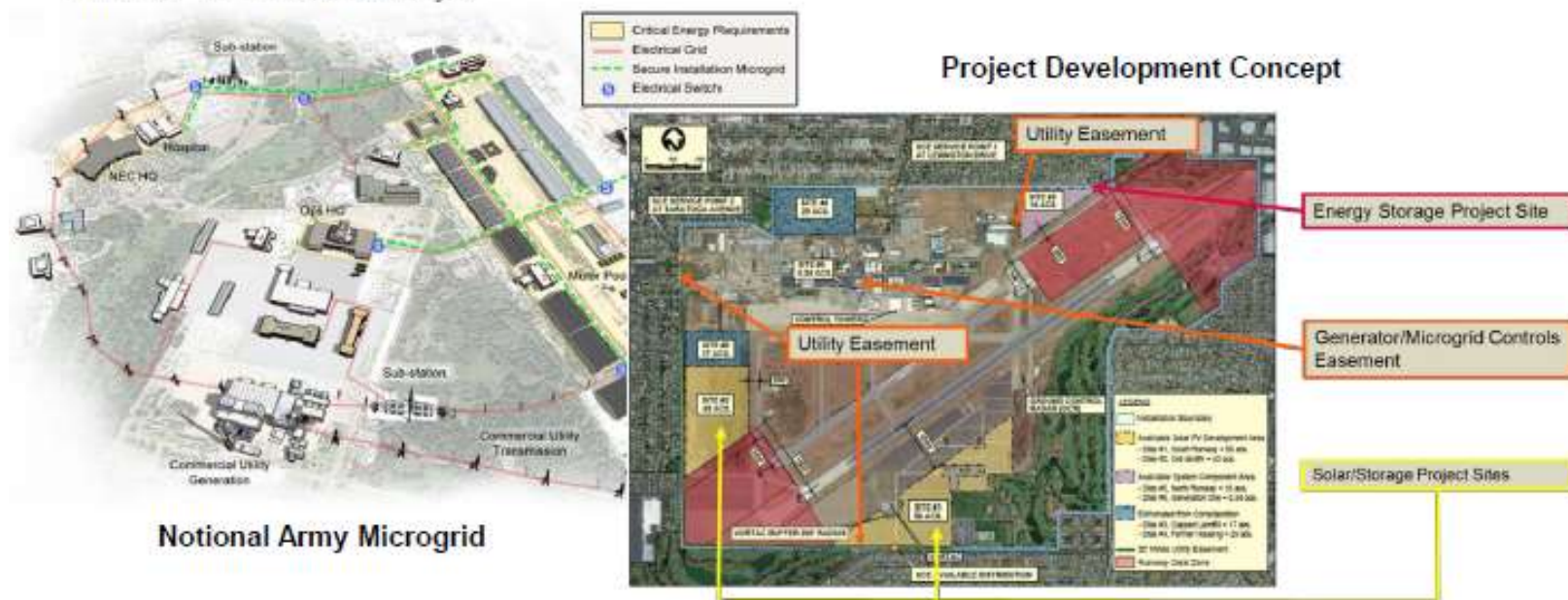
Microgrids for Resiliency have Grid Service Capabilities



Example of a US Army Project

Army proposed outgrant of 115 acres at JFTB Los Alamitos

- Developer would construct, own, operate and maintain 16 MWs of solar power, energy storage, and microgrid components
- During normal ops, the developer sells power to the grid
- During contingency ops, the developer would provide islandable power for critical loads for min 7 – max 30 days



Should Make-ready Be Compensated?



Resources Must to be Ready to Go When a High Value Need Arises

- What should be required of resources as part of being a “good grid citizen”?
- Should the capability to be called upon be compensated in advance of a specific need?
- What are the roles of utility build, third party aggregation, and competitive procurement?

Energy Hub – APS Example

- Energy Hub DERMS platform being tested by APS
- Combines solar, storage and electric water heater management
- Allows utility to aggregate resources to meet emerging high value needs, compensates hosts
- What is the capacity value of these resources?
- What would third party compensation of these same resources look like?

CAISO Market Participation Models – PDR and RDRR

- **Proxy Demand Resource (PDR) and Reliability Demand Response Resource (RDRR).** These models are for resources that can be dispatched to reduce demand, such as traditional DR load curtailment and storage resources. PDR and RDRR do not allow injection of energy into the grid (which excludes PV participation).

CAISO Market Participation Models – NGR

- **Non-Generator Resource (NGR).** This model is designed for storage or storage-like resources, but allows for aggregations of DERs including PV. NGRs can reduce demand or inject energy into the grid, providing a wide range of services to CAISO, including energy, reserves, and regulation services in all markets. A Pacific Gas & Electric demonstration program found that the most valuable NGR resource was frequency regulation.

Ease of Participation Matters - ERCOT Example

ERCOT and TDSP programs 2015		California DRAM 2016 (PG&E)	
Customer receives program offer	100%	Customer receives program offer	100%
Customer agrees to participate in program (no service account number required)	55%	Customer agrees to participate in program and provides service account number	9%
		Customer completes CISR-DRP form on third party site	5%
Customer is accepted into program	42%	Customer is accepted into program	3%

Table 1: Comparison statistics for customer enrollment funnels in California and Texas



Group exercise #1

- In 5 years time, what will be the most important capabilities of resources that are serving load in Oregon? What will be the biggest needs that system operators will face?
- Consider the three dimensions of value presented in today's workshop (location, time, and capability). In light of your answer to the above question, and your thoughts on these sources of value, in 5 years time what will be the most important types of capacity value?

Group exercise #2

- What is the value of having this kind of capacity?
- How is this value currently compensated?
- What other considerations should be incorporated as we think about valuing it in the future?