

Renewable Energy Storage: Implementing Projects, Overcoming Co-Location Challenges, and Mitigating Risks

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Discussion Outline

- Basics
 - Technologies
 - Locations
 - Asset Classes
- Storage Policies & Regulations
 - State & Federal
- Contracting for Energy Storage Projects
 - Procurement
 - Revenues
 - Operations & Maintenance

Technologies

- Pumped storage hydropower
 - projects consist of an upper reservoir and a lower reservoir (man-made or natural lake or river). When electricity demand is low, water is pumped to the upper reservoir and stored. When electricity demand increases, stored water is released from the upper reservoir and passes through the powerhouse, generating power as it is released into the lower reservoir.
- Hydrogen energy storage systems
 - use electrolysis to convert electricity into hydrogen, which is stored and later re-electrified.
- Battery energy storage systems
 - consist of one or more electrochemical cells that convert stored chemical energy into electrical energy.
- Thermal energy storage systems
 - temporarily reserve – in the form of molten salt or other materials – energy produced in the form of heat or cold.
- Mechanical energy storage systems
 - exploit kinetic or gravitational forces (e.g., spinning flywheel) to store inputted energy.

Locations

- Bulk Energy Storage
 - Transmission or distribution grid-connected and dispatchable
 - Based on grid requirements
 - Typically larger systems
- Distributed Energy Storage
 - Distribution grid-connected (front-of-the-meter/FTM) or not grid-connected (behind-the-meter/BTM)
 - Based on local and on-site requirements
- Integrated Energy Storage
 - Batteries at PV solar, wind or hydroelectric plants, molten salt storage at solar thermal plants
 - Co-Located v. Hybrid Facilities
 - Dispatch may be limited by host site

Asset Classes

- Generation: the process of producing electric power from sources of primary energy.
 - Energy
 - Firm/Peaking Capacity
 - Ancillary Services
 - *Note: energy storage is often both a generator and a load*
- Transmission & Distribution: the movement of electricity
 - Energy storage projects can inject and withdraw energy from the grid, allowing them to operate as a substitute for transmission facilities.
 - Energy storage projects can be used to defer new transmission construction and transmission system upgrades.

Applications & Services

Generation Applications

- **Bulk Energy Services**
 - Electric Time Shift
 - Electric Supply Capacity
 - Renewables Integration
 - Firming
 - Curtailment Avoidance
 - Spinning and Non-Spinning Reserve Capacity
- **Ancillary Services**
 - Frequency Response & Regulation
 - Ramping / Load Following
 - Voltage/VAR Support

Infrastructure Applications

- **Transmission Services**
 - Network Capacity
 - Congestion Relief
- **Distribution Services**
 - Network Capacity
 - Voltage/VAR Support
- **T&D Upgrade Deferral**
- **Increased Hosting Capacity**
- **Area Regulation**

Cross-cutting Applications

- **Peak Demand Reduction**
- **Energy Management Services**
 - Time-Varying Rate Management
 - Demand Charge Management
- **Reliability Services**
 - Back-up Power
 - Black Start
- **System Flexibility**
- **Power Quality**

Energy Storage Policies & Regulation

Federal Storage Policies

- The Federal Energy Regulatory Commission (FERC) which, under the Federal Power Act (FPA), has jurisdiction over the interstate transmission and wholesale sale of electric energy, has observed numerous times over the past decade or so that energy storage projects do not readily fit into only one of the traditional asset functions of generation, transmission or distribution.
- This presents interesting issues for FERC with respect to
 - Ability to participate in wholesale electricity markets
 - Rates
 - Eligibility for certain regulatory benefits
 - Federal/state jurisdiction

Energy Storage & PURPA

- Qualifying Facilities (QFs) under the Public Utility Regulatory Policies Act of 1978 (PURPA) receive certain benefits, including the requirement that electric utilities purchase the output of QFs (mandatory purchase obligation) at “avoided cost rates.”
- Certain types and sizes (MW) of QFs also are eligible for exemptions from regulation under some provisions of the FPA, the Public Utility Holding Company Act of 2005 (“PUHCA”) and state laws and regulations respecting the rates and financial and organizational regulation of electric utilities
- Under FERC’s regulations, small power production QFs must meet size (not more than 80 MW) and fuel use (renewable resources) requirements, and be certified as a QF.
 - In *Luz Development and Finance Corp.*, 51 FERC ¶61,078 (1990), FERC found that the primary energy source of a battery system is the electricity energy utilized to initiate the electrochemical reaction and held that energy storage facilities, including battery systems, are a renewable resource for purposes of QF certification, provided that the energy input into the facility is itself biomass, waste, a renewable resource, a geothermal resource, or any combination thereof.
 - *Note: this principle will limit the storage system’s ability to charge from the grid*

Energy Storage & PURPA

- *In Broadview Solar, LLC*, 174 FERC ¶ 61,199, at P 36 (2020), order on reh'g, 175 FERC ¶ 61,228 (2021), FERC ruled that a facility consisting of a 160 MW solar system and a 50MW/200 MWh battery energy storage system could self-certify as a QF as long as the facility's inverters prevented deliveries of more than 80 MW(AC) of electricity to the grid at any given time.
- *See also Gallatin Power Partners, LLC*, 177 FERC ¶ 61,116 (2021) (rejecting as a collateral attack on the *Broadview* rehearing orders Northwestern's protest of Gallatin's self-certification of a facility with a 160 MW solar system and an 80 MW battery energy storage system that was limited to 80 MW(AC) output by its inverters).
- *Broadview* is being briefed at the DC Circuit, with Respondent FERC's brief due in early February.
- FERC Rule: Solid Oxide Fuel Cell systems with integrated natural gas reformation equipment to be certified as cogeneration qualifying facilities

Wholesale Market Participation - FERC Order No. 841

- In 2018, FERC issued a Final Rule requiring that wholesale electricity capacity, energy and ancillary services markets operated by FERC-jurisdictional regional transmission organizations and independent system operators (RTOs/ISOs) be open to electric storage resources (ESRs). (162 FERC ¶61,137 (2018)).
- FERC required each RTO/ISO to establish a participation model consisting of market rules recognizing the physical and operational characteristics of ESRs and facilitating ESR participation in RTO/ISO markets.

This participation model must:

- ensure that an ESR is eligible to provide all capacity, energy and ancillary services that it is technically capable of providing in RTO/ISO markets;
- enable an ESR using the participation model to be dispatched.
- ensure that such a dispatchable ESR can set wholesale market clearing prices as both a wholesale seller and wholesale buyer consistent with existing market rules;
- account for the physical and operational characteristics of ESRs through bidding parameters or other means; and
- establish a minimum requirement for participation in RTO/ISO markets that does not exceed 100 kW

FERC Order 841 - Charging Energy Rates

- Sale of energy from the grid that is used to charge ESRs for later resale in to energy or ancillary services markets constitutes a sale for resale in interstate commerce and, as such, the just and reasonable rate for the wholesale sale is the RTO/ISO market wholesale locational marginal price (LMP).
 - This requirement applies regardless of whether the ESR is using the participation model for ESRs or another participation model to participate in RTO/ISO markets, as long as the resource meets the definition of an ESR.
- ESRs should be assessed transmission charges when they are charging for later resale into the wholesale market, but not when dispatched by the RTO/ISO to provide services such a frequency regulation or downward ramping service.

FERC Order No. 845 – Interconnection

- Revised the definition of “generating facility” to explicitly include electricity storage.
- Allows storage owners to avoid costly transmission system upgrades by asking for interconnection below the rated capacity of their units.
- Creation of “surplus” interconnection service — an expedited process to interconnect new facilities with existing generators that do not use their full capacity full time (*e.g.*, solar’s nighttime capacity).
- Delays in interconnection study processes in RTOs remain a significant issue.

FERC Order No. 2222

- Requires wholesale electricity capacity, energy and ancillary services markets operated by RTOs/ISOs be open to distributed energy resources (DERs).
- Threads a jurisdictional “needle”
 - Declared sales of electric energy by DER aggregators for purposes of participating in and RTO/ISO markets are wholesale sales subject to FERC jurisdiction.
 - An individual DER’s participation in a DER aggregation would *not* cause that individual resource to become subject to requirements applicable to FERC-jurisdictional public utilities.
 - If DER aggregator (1) aggregates only demand resources or (2) aggregates only customers in a net metering program that are not net seller, that DER aggregator would not become a public utility.

Co-Located and Hybrid Facilities

- *California Indep. Sys. Op. Corp.*, 177 FERC ¶ 61,153 (2021).
 - Addressed co-located and hybrid energy storage resources in the CAISO
 - Co-located resources are interconnected at the same generating facility, but with separate Resource IDs, bids, and market dispatch instructions.
 - A hybrid resource is modeled and dispatched as a single resource, possessing one bid curve for its constituent parts and settled under a single Resource ID.
 - FERC accepted CAISO's tariff change proposal (1) to enhance market participation for hybrid and co-located resources, and (2) to allow for the use of multiple aggregate capability constraints by co-located resources at a single generating facility.
 - Changes became effective in part in December 2021, and others are expected to take effect not later than June 1, 2022.

Tax Issues

- No Investment Tax Credit for Stand-Alone Energy Storage (yet)
- ITC-related Contract Issues – Co-Located PV + Storage
 - ITC can only be claimed on a generating asset; not transmission assets
 - 75% Cliff – grid charging risks; energy storage system will likely be required to charge 100% from solar until after end of recapture period (five years after the solar + storage system is placed in service)
 - Special government and tax-exempt entity considerations; establishing the PPA as a service contract and avoiding lease treatment
- Who wears risk of ITC loss/recapture?

States with Storage Incentives

- ***California:*** SGIP program for consumer-sited energy storage projects from 2017-2021
- ***Maryland:*** State income tax credit for energy storage systems of up to \$5,000 for residential customers and 30% for commercial customers
- ***Massachusetts:*** Department of Public Utilities issued an order which allows solar-plus-storage systems to participate in net metering as long as the storage system either cannot charge from the grid or cannot export to the grid
- ***Nevada:*** Legislature passed AB 145 for storage in the solar incentive program (SESIP)
- ***South Carolina:*** Legislature passed HB 3659 which allows projects with energy storage to net meter if the storage device only charges from an on-site renewable resource.

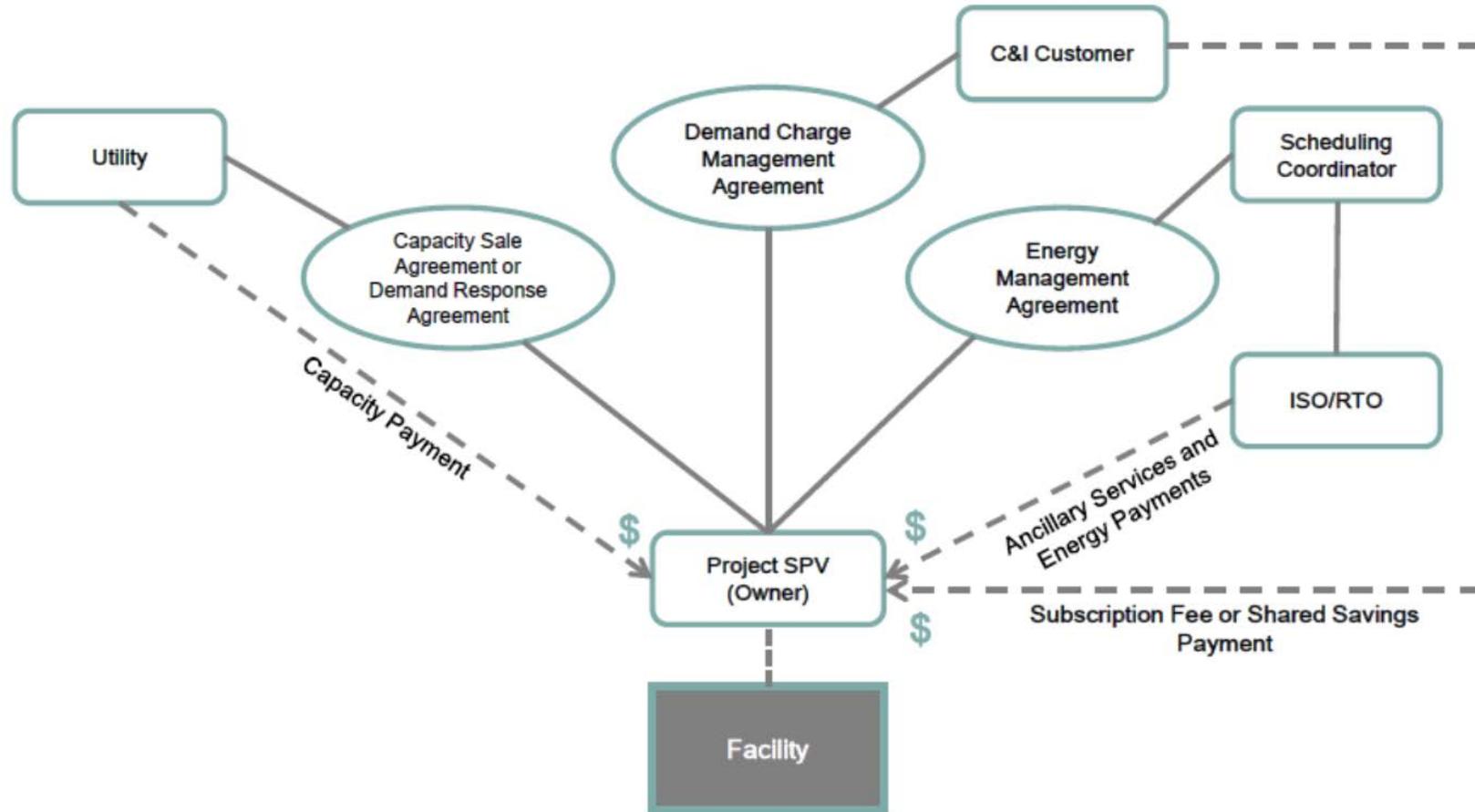
State Procurement Goals

- *California*: First-in-the-nation 1.325 GW procurement target for storage by 2020; later increased by 500 MWs
- *Oregon*: Applies to the state's two large investor-owned utilities: 5 MWh each by 2020 (minimum), up to 1 percent of 2014 peak load (maximum)
- *Massachusetts*: 1,000 MW by 2025
- *New York*: 1,500 MW by 2025 and 3,000 MW by 2030
- *New Jersey*: 2,000 MW by 2030

Resources

- The North Carolina Clean Energy Technology Center's DSIRE web site offers information about renewable energy and energy storage programs on a state-by-state basis. <https://www.dsireusa.org/>
- The Energy Storage Association (ESA) recently merged into American Clean Power. ACP's website includes periodic updates about energy storage issues. <https://cleanpower.org/?s=storage>

Contracting for Energy Storage



Energy Storage Contracts

- Procurement
 - Supply Agreement
 - Engineering, Procurement & Construction (EPC)
 - Build-Transfer Agreement (BTA)
- Offtake
 - Merchant Projects
 - Power Purchase Agreement (PPA)
 - Tolling Agreement
- Operation
 - Operation & Maintenance (O&M) Agreement
 - Energy Management System (EMS) Agreement

Note: Many other contract names and types exist – these are just common examples!

Contracting for Energy Storage: Procurement

Participating Parties

- Role of various entities
 - More parties = more complication
 - Special purpose entity
- Credit support & solutions



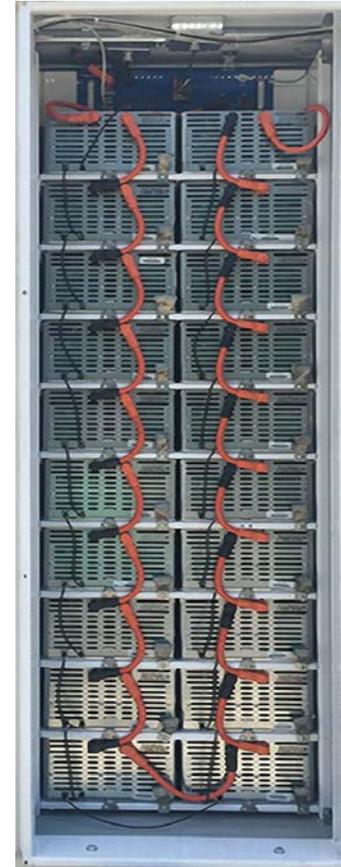
Completion Schedule

- Project milestones and schedule
 - Permitting
 - Interconnection
- Delays
 - Owner Caused Delay
 - Third Party Delay
- Liquidated damages



Changes

- Change in Law
- Regulatory
- Force Majeure
- Change Orders



Intellectual Property Issues

- Hardware vs. software
- Ownership of inventions
- License to project data
- Privacy issues



Warranties

- Manufacturer & Supplier Warranties
 - Depends on technology and use
 - Lithium-ion BESS = standard warranty is only 1-3 years; option to buy extended warranties
- Hardware
- Software
- ITC warranty



Indemnities



Ownership of Incentives

- Direct sale - Customer owns
- Energy Services – may be shared
- Covenant to cooperate
- Consequential damage waiver



Safety & Liability

- System Safety
 - For BESS, containment is generally as important as the batteries.
 - Include measures in Supply, EPC and O&M agreements to maintain temperature and humidity; include physical and electric protections between batteries, real-time monitoring, and remote shut-off capabilities
 - Emerging industry safety standards, certifications and auditors: (*e.g.*, Underwriters Laboratories (UL); National Electric manufactures Association)
 - Damage and injury insurance coverage; workers' compensation
 - Fire suppression systems; water access

Source & Supply Chain Issues

- Component Source Issues
 - Availability, Tariffs, Political Risk, Forced Labor
- Original Equipment Manufacturers vs. System Integrators
- Assuring investors and customers that the technology is “proven”

Build-Transfer Agreements: APA + EPC Agreement

- Developer transfers Project's development assets (real estate, permits, interconnection rights) to utility before commencing construction
- At closing of asset purchase agreement (APA), Developer and utility simultaneously enter into an EPC Agreement
- Developer builds the Project for the utility pursuant to the EPC Agreement and turns it over to utility at mechanical or substantial completion
- Developer receives mile stone payments pursuant to the EPC Agreement

Build Transfer Agreement: Construction and Transfer

- Pursuant to BTA, developer agrees to build the Project
- Developer's duties as EPC contractor (or to engage an EPC contractor) are set out in the purchase agreement
- Developer transfers the Project's assets to the utility when the Project achieves mechanical completion

Build Transfer Agreement: NTP

- Notice to proceed (NTP) may be conditioned on, among other things:
 - PUC approval (if the offtaker is a utility)
 - Title curative
 - Permits
 - Third party consents
 - Interconnection rights
 - Other conditions to buyer's duty to purchase (other than commercial operation)

Build Transfer Agreement: Closing

- Once post-NTP conditions to Closing have been satisfied, assets are transferred to utility
- IP should be licensed rather than transferred
- Seller completes punch list items, supplies spare parts

Build Transfer Agreement: Closing

- Seller provides performance guarantees (e.g., C_{max} , charge duration, D_{max} , discharge duration, round trip efficiency, duty cycle)
- Performance testing at Closing may yield a price adjustment
- Seller may provide and/or assign general and equipment warranties
- Seller may enter into an O&M Agreement

Contracting for Energy Storage: Revenues

Merchant Storage

- Financial Hedges
- Energy Arbitrage
- Capacity, Demand Response, Ancillary Service Revenues
- Increased Risk of Regulatory Changes
 - If an incentive seems too good to be true, it may have an increased risk for change (*e.g.*, Reg D in PJM).
 - Consider how long would it take to recover the investment and how nimble the regulatory regime is – can the applicable regulators change the rules of the game before revenue goals are met?
 - Does the applicable regime have any policies about grandfathering participants and contracts; or against making new policies apply retroactively?

Defining the Customer & Products

- In front of or behind the meter?
- Who is the customer? On-site C&I, offsite C&I, utility?
- What is the Customer's goal?
 - Shifting, Firming, Smoothing
 - Arbitrage, Incentives
 - Demand Side Management
 - Capacity
 - Frequency Regulation
 - Other Ancillary Services



Term & Termination

- Term
 - Accounting for unproven technology
 - Co-located Projects:
 - Battery Augmentation Schedule
 - Shorter BESS Term vs. overall (*e.g.*, solar + storage PPA may have one term for the solar component and a shorter term for the storage component)
 - Defining Commercial Operation
- Termination
 - Partial or complete?
 - Portable BESS
 - Decommissioning and disposal

Price

- Price
 - Fixed and/or Variable?
 - Different prices for different products from project?
 - Metrics: time-of-use, performance, value (price arbitrage)?
 - Impact on Traditional Tariff Formulation
 - Accounting for transmission facility value
 - Service Fees vs. Production Payment
 - Ability to stack revenue streams
 - Who has title to each Product the ESS is capable of producing?



Performance

- Performance / Availability Guarantees
 - Project as a whole or ESS separate?
 - Converter availability – *i.e.*, “mechanical availability”
 - Non-performance penalties or price reductions
 - Accounting for round-trip losses in output estimates
 - Accounting for degradation and/or battery replacement schedule
 - Performance standards need to be tied to storage system’s expected “use case”

State of Health

- Control & Health of System
 - Offtaker control rights vs. dispatch
 - Technical requirements paramount to ESS
 - Incorporate in PPA that the ESS will at all times be operated according to manufacturer recommendations and warranties; otherwise performance and term guarantees are void.
 - Indemnification and step-in rights to correct issues
 - Manage expectations
 - Set forth appendix of basic capabilities and requirements to PPA (*e.g.*, SOC, max capabilities, charge/discharge frequency limits)
 - Agree that technical requirements will be provided later, but include the source of the requirements.

System Charging

- Charging Energy
 - Where does it come from?
 - Grid? Co-located resource?
 - Who pays for the charging energy and who owns it? (*cf.* Capacity Services Agreement *with* Tolling Agreement)
 - Accounting for round-trip and other losses
 - Any relevant restrictions?
 - E.g., regulatory, tax

Change of Law or Market

- Utility may purchase storage to satisfy a particular regulatory requirement (e.g., Resource Adequacy in California)
 - PPA needs to address what happens if the regulatory requirement changes during the PPA
- Utility may purchase storage services expecting to use them to satisfy a particular use case
 - What if regulatory environment or market changes during the term, and that change creates different use case opportunities?
 - Consider including re-opener provision to address material change in market or regulatory regime

What is “Prudent” & Who is “Qualified” When it Comes to New Technology?

- Terms such as “Prudent Industry Practices” and “Qualified Transferees” or “Qualified Operators” require additional analysis
- In contrast to wind/solar contracts, it is not as easy to quantify sufficient experience in terms of years and capacity
 - A new *company* might not have relevant experience, but it may have employees with very relevant experience, or it may contract with an experienced entity to operate the project

Other Unique Storage PPA Considerations

- Confirm the technology and use case are *legal*
- Consider contracting with flexibility to accommodate the possibility of *new* products, services and revenues
- Expect rapid change as technology improves and prices drop

Energy Storage Tolling Agreements

- Derived from gas tolling agreements
- Seller develops, owns and maintains energy storage project
- Seller receives:
 - Capacity Payment
 - Fixed O&M/Variable O&M Payments
- Utility supplies charging energy
 - This means utility require storage system to purchase station service

Energy Storage Tolling Agreement

- Performance Standards
 - Availability Adjustment
 - Round Trip Efficiency (RTE) Adjustment
 - Capacity Test
- Considerations in Setting Performance Standards
 - Operating Parameters
 - Use case
 - Relationship to procurement contracts

Hybrid (Solar + Storage) PPA

- Solar + Storage Tolling Structure
 - Seller develops, owns and maintains project
 - Buyer purchases solar energy, some of which is used to charge the storage system
 - Includes tolling agreement features described earlier
 - Buyer may control charging and dispatch, or Seller may have authority charge and dispatch within stated parameters
 - Operating parameters and performance guarantees need to be reconciled with use case
 - Consider including mechanism for reconciling new use case with new operating parameters (change of law or market)

Capacity Services Agreement (CSA)

- Developer develops, owns and operates project
- Developer pays for and supplies charging energy to the storage system
- Developer receives a capacity payment, subject to adjustment for availability
- Utility receives Resource Adequacy benefits
- Capacity services may be required only during specified period—
developer can market other products from the storage system as long
as it can still satisfy its obligations under CSA

Demand Response Energy Services Agreement (DRESA)

- Used by California utilities
- Developer enters into participation agreements with owners of behind-the-meter (BTM) storage
- Developer enters into DRESA with utility
- At utility's instruction to developer, developer switches site hosts to stored energy rather than grid-supplied energy, thus reducing demand

Demand Charge Shared Services Agreement

- Energy storage installed at host's site behind-the-meter (BTM) pursuant to site host agreement
- Minimizes host's capital outlay
- Host uses energy storage to shave peaks and reduce peak demand charges
- Developer and host share savings

Contracting for Energy Storage: Maintenance & Management

Guarantees

- Part of O&M or Energy Services Agreement
- Guarantee claims typically require production of specific operation and performance data; requires O&M compliance and mechanisms to track and store relevant data
 - Look for “outs” and ensure PPA does not inadvertently invalidate guarantees or warranties
- Exclusions
- Insurance Products



Software & Intellectual Property

- Software is critical to ensuring and proving BESS system performance
- The acquisition of software typically includes a service / maintenance agreement for firmware updates
 - Updates to adapt to changing regulations, operating conditions, advances
- Third party operation of BESS; assigning rights to use IP
- Key Issue: Loss of software provider
 - Difficult/impossible to figure out someone else's software code; may require pulling and replacing the controller. Unlike commoditized solar/wind O&M, very proprietary service
 - Potentially expensive and timely endeavor to replace
 - Investors generally have independent engineers evaluate the contracts; scope of qualifications of the software provider
 - Code escrow agreements

Questions?

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