CHAPTER 20
ENERGY STORAGE PROCUREMENT

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Abstract

This chapter offers procurement information for projects that include an energy storage component. The material provides guidance for different ownership models including lease, Power Purchase Agreement (PPA), or Owner Build and Operated (OBO). It also includes contracting strategies for OBO projects including Design-Build (DB) and Engineer, Procure & Construct (EPC), and tools that can be used in procurement, such as Requests for Information (RFI) and Requests for Proposals (RFP). Pertinent information to develop procurement documents is provided here. More information is provided on the Sandia Energy Storage website.

Key Terms

Design-Build (DB), engineer, procure and construct (EPC), lease, owner build and operated (OBO), Power Purchase Agreement (PPA), Request for Information (RFI), Request for Proposal (RFP)

1. Introduction

This chapter supports procurement of energy storage systems (ESS) and services, primarily through the development of procurement documents such as Requests for Proposal (RFPs), Power Purchase Agreements (PPAs), and term sheets. It primarily addresses procurement of smaller-scale storage technologies such as batteries and flywheels. Larger-scale storage technologies, such as pumped hydro and compressed air energy storage (CAES), tend to be more site-specific and thus less replicable. In addition, due to their size and cost, they are generally undertaken by entities that have ample procurement experience. For more information on pumped hydropower storage, visit: https://www.energy.gov/eere/water/pumped-storage-hydropower. Sample RFIs, RFPs, contracts and term sheets for battery energy storage systems may be found in [1] and [2].

In addition to general guidance on procurement and the development of procurement documents, this chapter provides a matrix of elements to address in procurement documents.

Most importantly, when procuring energy storage systems or services, perform due diligence and seek the advice of an attorney. Nothing in this chapter should be construed as a replacement for sound legal advice. Additionally, appropriate government agencies should be consulted to make sure plans are in compliance with all regulations and policies.

2. State of Current Technology

Energy storage is a fast-changing field. The performance of storage technologies will continue advancing, while costs are likely to continue declining. New applications and business cases will be developed, and policy and regulations will evolve. However, to some extent, the elements of a sound procurement process will remain the same.

As with any procurement effort, basic questions must first be answered before proceeding with specific procurement strategies, ownership models, etc. Asking who, what, where, when, why, how, and how much will provide the building blocks used in constructing procurement project plans.

Table 1 provides details on how these basic questions apply to energy storage procurement processes. This table is designed to provide guidance on the minimum, basic elements that should be considered when developing procurement documents.

Note: Sample procurement documents are included in the Sandia *Energy Storage Procurement Guidance Documents for Municipalities*.

Table 1. Energy Storage Procurement Matrix

Section Topic	Section Sub-Topic	Information the Initiator should provide or ask for in RFP	Questions the Bidder should answer in proposal	Evaluation Criteria (Industry standards)
Who		**Provide**: Details about who is initiating project. Background of initiating organization and project. **Ask**: Who is bidder, including subcontractors/partners	Company and partners, contact information, details of experience of key participants, roles and responsibilities of all partners, resumes of principle project team.	Proven track record with solar+storage projects in municipal settings including references to completed projects. Include safety performance record at previous projects.
Why		**Provide**: Describe the overall goal of the project. Detail if the project fits within a larger state or municipal context; for example, state if the goal is emissions reduction, renewables integration, or resiliency. **Ask**: How will bidder's proposed project solve the problem or help to reach the goal(s) of the project? How will it fit within the larger context?	How does your project provide the best solution? What are the most compelling features of the system? How does the project solve the problem, meet the goal, or fit within the larger context?	For new solar & storage projects: check for monitoring systems that are able to obtain federal 30% Investment Tax Credit. For Behind the Meter projects: additional opportunities to monetize the project via delivery or supply rate changes or participation in specific utility or statewide incentive programs. For utility scale projects: scalability, replicability and LCOE/LCOS metrics
What	Project description	Provide: Project description. Describe the problem that needs to be solved; include power and energy minimums throughout project (if known). **Ask**: How will bidder solve the problem? What are the specifications of proposed system? How will proposed system meet the requirements of the project?	What is the solution to the problem? What are the specifications of the system? Operating conditions – cycle life. How will the system meet the specifications and requirements set forth by the owner?	Look at how available energy is specified in the response: Nameplate capacity (kWh or MWh).

Section Topic	Section Sub-Topic	Information the Initiator should provide or ask for in RFP	Questions the Bidder should answer in proposal	Evaluation Criteria (Industry standards)
	Scope of work	**Provide**: Detailed Statement/Scope of Work (SOW). Scope should delineate who will do what and when. Include timelines, milestones, roles, what applicant will be responsible for and what bidder will NOT be responsible for. **Ask**: How will bidder satisfy the SOW?	How does applicant propose to implement scope of work and meet project requirements?	Make sure response contains all assumptions from provider in their plan to complete Scope of Work, including items that may warrant a Change Order. Make sure that scope of work and exclusions from SOW are well aligned with project type (utility-scale or behind the meter). Behind the meter projects should not include medium voltage and SCADA/data integration, but should have more specifics about utility rates, integrations with on-site generation and revenue streams.
	Operational Specifications	**Provide**: Operational specifications – Load data, predetermined or required ramp rates, charge and discharge profiles and cycles, applications to be served and modes of operation. Control and monitoring requirements. **Ask**: How will bidder's proposed system meet these operational requirements? Who will own and operate the system?	How does applicant propose to meet all operational specifications? Are there any ways in which bidder's proposed system would not meet or would exceed operational specifications? Who does the bidder propose will own and operate the system?	Power purchase details and permitting requirements, where applicable. Look for how bidder describes operational metrics and relates them to financial and warranty metrics. Look for applications served and if system will be serving multiple applications how they will be handled and integrated.

Section Topic	Section Sub-Topic	Information the Initiator should provide or ask for in RFP	Questions the Bidder should answer in proposal	Evaluation Criteria (Industry standards)
	System Specifications	**Provide**: System requirements – System size in both power (KW) and energy (KWh), round trip efficiency, Type of energy storage technology, if it needs to be specified (not recommended), cycle life and project life required based on operational specifications, i.e. kW/kWh per year for how many years. Operating temperatures required, disposal requirements. **Ask**: How will bidder's system meet all required system specifications? If bidder's proposed system meets operational specifications but diverges from system specifications, what are the relative costs and benefits of bidder's proposed system? Request test data.	How does bidder propose to meet all required system specifications? Can bidder's system meet all operational specifications if diverging from system specifications? If so, what are the relative costs and benefits of bidder's system, compared with the prescribed system specifications? Provide detailed specification of all equipment. Include any system testing and performance data and how it was acquired. NOTE: It is recommended that system specifications not define a specific energy storage type of technology in an RFP or other solicitation unless absolutely necessary. Bidders should be free to propose any system that meets the operational and other project requirements, to provide for competition and allow innovative solutions to come to the fore. For example, don't indicate that you want a flow battery vs. an electrochemical battery vs. a flywheel or something else.	Look at how round-trip efficiency is defined if any kind of temperature control equipment is mentioned. For utility scale systems, be sure to double check that the proposed controls/SCADA architecture will fit well with the systems already in place. Make sure that testing data provided is applicable to the system/solution being proposed. Look for indication of energy storage degradation (number of expected cycles over ES lifetime).
	Design Requirements	**Provide**: Design requirements and system/equipment parameters not covered in operational and/or system specifications. If possible, provide design package including standards and specifications for procurement and installation as required. **Ask**: How does bidder propose to meet all design requirements?	How does bidder propose to meet all design requirements? Provide shop drawings and/or schematic drawings, as necessary.	If you require integration of new Solar PV and Storage, require that the type coupling (AC vs DC) be clearly indicated. Utility scale: make sure that a diagram detailing physical data and SCADA communication layers exist. Behind the Meter: one-line schematic drawing and a sequence of operations noted on a drawing or as a separate document is a plus.

Section Topic	Section Sub-Topic	Information the Initiator should provide or ask for in RFP	Questions the Bidder should answer in proposal	Evaluation Criteria (Industry standards)
Where		**Provide:** The location of the work and factors such as emissions or other regulations that may be imposed upon the bidder.	How to install project at the specified location, especially if there are any constraints?	Make sure that any work necessary to prepare the location is included in the SOW.
When		**Provide**: The project timeline and completion deadline. Include RFP process, RFP review, interview, bidder selection, project timeframe including any post-commissioning period of data collection and monitoring.	Provide detailed schedule starting at award date. Include design, permitting, procurement (long lead items), engineering, construction, commissioning (DV, OAT, startup, FAT, shakedown), closeout, warranty period.	For labor intensive projects that include multiple sites (especially those that include solar PV), make sure that construction and commissioning are planned in phases. The warranty periods for various parts of the proposed solution should be clearly spelled out (workmanship, components, equipment).
How		**Provide**: Define project deliverables and expectations. Address how the bidder be selected, i.e., selection criteria including grading system. Detail the contracting strategy and timeframe. Include expectations for project team's experience, testing and commissioning, training, operational support and warranty. Warranty should include needed maintenance service, spare parts for project lifetime.	How will you conduct project construction contracting strategy, procurement strategy, detailed schedule, org chart including partners with detailed roles and responsibilities. Provide maintenance, spare parts and warranty information. If appropriate, explain how the system will be operated long-term, i.e. Power Purchase Agreement (PPA); Engineer, Procure, Construct (EPC); etc.	Operations and Maintenance strategy should be put forward with assumptions called out. O&M should be clearly priced and scoped out – approximate schedules should be provided. Large capital expenditures, like battery replacement, should be called out.

Section Topic	Section Sub-Topic	Information the Initiator should provide or ask for in RFP	Questions the Bidder should answer in proposal	Evaluation Criteria (Industry standards)
How Much		**Provide**: Include details about any budget requirements, cost share. Include WBS breakdown worksheet for bid evaluation and comparison. Define methodology for computing LCOE. **Ask**: What are the total costs for the proposed system or services, including cost breakdown for components, subcontracting, etc? What matching/outside funds are included? Is any part of the project to be financed? If so, does the bidder have a commitment from a financier or bank?	Cost of total project using provided WBS; include any replacement needed to meet project life cycle. In addition, provide levelized cost of energy (LCOE) for life of project. List any and all exclusion, assumptions, and risk of cost overruns. List any matching funds, outside funds, or other resources included in the bid. If financing is included, show evidence that the project is financeable.	Budget breakdowns should help to gain insight into project costs as well as expected payment schedule. Items that are additional should be clearly labeled as such. Items that are estimated or not yet priced should also be clearly labeled. If there is a known risk with accomplishing a desired technical goal (for instance, providing backup power to loads larger than the battery capacity, or structural concerns with battery location), then an engineering phase should be clearly separated from the construction scope of work. There should be an option to exit the contract if engineering determines that the project falls outside the scope originally proposed during the bid. If applicable, the requirements for obtaining all matching or outside funds should be clearly indicated. LCOE calculations are not necessary for BTM projects.
Boiler Plate		**Provide**: All the terms and conditions that are required to be met. Certifications required. Bond requirements. Warranty requirements. ES systems installed and business bankability requirements, independent testing requirements for ES system. **Ask**: How will bidder meet these requirements?	Provide detail as to how company will meet boilerplate requirements.	

3. Current Implementation

Most energy storage project procurements will fall under one of three basic ownership models, one of which should be chosen prior to developing procurement documents:

- **Owner-operator** – purchasing an energy storage system outright
- **Power Purchase Agreement (PPA)** – purchasing energy storage services (usually measured in kilowatt-hours or charge-discharge cycles) from a third party that owns the system through a PPA
- **Lease** – purchasing the use of an energy storage system owned by a third party for a specific period of time. This model falls somewhere between the other two in terms of the user's control over, and responsibilities for, the storage system
- **Flip** – a hybrid structure in which ownership of the energy storage system changes hands ("flips") after a specified number of years of operation, usually to take advantage of tax incentives available to one party but not the other

3.1. Choosing an ownership model

The main difference between the ownership models is how control, benefits, risks, and responsibilities are allocated. The advantages and disadvantages of each type of ownership structure are discussed below and then summarized in Table 1.

In an owner-operator model, the owner-operator enjoys control over system operations, and is able to capture all the available project benefits. However, the owner-operator also bears more risk if the system malfunctions or does not provide all the benefits expected, and is responsible for many tasks and costs associated with ownership such as ensuring the safety, operation, and maintenance of the system, and decommissioning the system at its end of life. The owner-operator is also exposed to regulatory and market risk, due to changing regulations and market rules that can affect system benefits, including revenues and cost savings.

In a PPA model, the user ("customer") does not own or directly operate the storage system, but instead purchases energy and/or energy services from the owner. The terms under which services are purchased are defined by a contract (PPA) between the user and the owner and may not be negotiable if the user's needs change. In addition, the user is not able to capture system benefits that fall outside of the services contract. However, this model does enable the user to shift risk and responsibility to the system owner—who is responsible to deliver the agreed-upon services at the agreed-upon price—regardless of changes in markets and regulations, system performance, and maintenance required to sustain performance over the contract period.

In a lease model, the user ("customer") leases the storage system from the owner for a specified period at a specified cost, as defined in the lease. A lease model provides the user with more control than a services model – the system can be operated however the lessee wants, within the limits set by the lease agreement–but the user also bears less responsibility and takes less risk than in the owner-operator model, because lease agreements generally provide the lessee with some protection against failures due to manufacturing defects and the like, and will often include maintenance provisions.

The flip model (sometimes referred to as the Minnesota Flip) is a hybrid of two other models. In this model, project ownership changes hands during the operational period. This is usually done to allow tax incentives to be applied in cases where the user cannot directly take advantage of tax incentives.

For example, a municipal utility wishes to purchase a solar+storage system but is not subject to federal taxes and therefore cannot monetize the federal Investment Tax Credit (ITC) and accelerated depreciation.

> **Note:** The federal investment tax credit and accelerated depreciation can be applied to energy storage so long as it is paired with and charged from an eligible renewable generator. The amount of the ITC credited to the storage device is pro-rated depending on what percentage of the charging is from an eligible renewable generator. There is a 75% floor (below 75% charging from a renewable generator, no portion of the ITC is credited to the storage device). The ITC is typically exhausted in the first five years of operation, after which any source can be used to charge the storage device.

To capture the value of the tax incentives, the municipal utility contracts with a for-profit partner (investor) who purchases the system. Initially, the for-profit partner sells energy storage services to the municipal utility at a discounted price through a PPA, while monetizing the tax credits and depreciation. After the tax incentives have been exhausted (typically after the first five years of operation), ownership of the system flips to the municipal utility, which takes over all risk and responsibility from that point forward. The terms of the PPA and the ownership flip are typically negotiated ahead of time and formalized in a contract between the two partners, with pricing during the initial five-year period being set to share the tax benefits between the partners.

Table 2. Ownership Structures

Ownership	Description	Pros	Cons
Owner-Operator	Owner pays for developer to build system, or to provide a turnkey system. Owner will operate system.	Complete control of system installation and operation. Ability to adjust operating load profiles and applications as markets warrant.	Owner assumes risk. If system does not perform as specified, would only have contract requirements, warranty or O&M agreements to solve operational issues. Will need maintenance support for inspections/adjustments not covered by warranty or maintenance agreements.
Power Purchase Agreement	Project developer/operator builds and operates ESS. Customer pays for kWh and/or services delivered.	Performance risk and maintenance burden is borne by ESS owner/operator. Customer only pays for energy and/or services.	Lack of ownership. Customer may be locked into operating load profiles and/or applications that become inconsistent with markets or project needs.
Lease	Customer leases ESS from owner for specified time at monthly rates. Customer will operate system within parameters of lease.	Control of system within lease parameters. Some ability to adjust operations if needs/markets change. Maintenance burden usually borne by ESS owner.	Lack of ownership. Storage customer bears some operational risk, is responsible for maximizing benefits.
Flip	System is owned by investor or for-profit partner for the initial five years of operation, during which tax incentives are taken; during this period the user/customer receives services through a PPA. Ownership then flips to the user/customer once tax benefits are exhausted.	Energy storage project can benefit from tax incentives even if eventual owner/operator is a nonprofit, a municipal entity or has insufficient tax appetite.	Contract defining flip structure and terms adds complexity to the project. Addition of investor or for-profit partner is not as profitable as owning the project directly (because cost savings and revenues must be shared)

In most situations, the ownership model will be decided early in the pre-development process, before procurement documents are developed. However, it is possible to write an RFI or RFP that allows vendors to propose various ownership structures. This allows a broad comparison among different types of bids.

Note that there may be circumstances or regulatory constraints that can influence the choice of ownership models for a particular project. For example, some state grant programs require the grantee to own the system outright. In some states, distribution utilities are not allowed to own generation, which may include energy storage (depending on how the state defines storage). There may also be market opportunities that favor one ownership structure over another. For these reasons it is advisable to determine what the project applications will be ahead of time.

If the entity procuring energy storage is not sure which ownership model to use or does not have prior experience with these types of procurement, it may be helpful to contract with an *owner's agent* to help analyze the merits of various approaches and guide the procurement process.

3.2. Procurement Documents

Once basic questions have been answered and an ownership model selected, procurement typically moves forward through a series of documents. These will often include an RFI followed by an RFP. The use of an RFI prior to an RFP serves multiple purposes, including:

- Responses to the RFI provide a better sense of what types of proposals, pricing, etc., to expect, and help determine whether the issuing entity (the entity conducting procurement) is operating under unrealistic expectations.
- An RFI can be used to help determine which ownership structure is most cost effective.
- An RFI provides vendors with an opportunity to provide feedback to the issuing entity regarding eligibility, system requirements, and information they will need to respond to an RFP. Vendor feedback obtained through an RFI can be used to refine the RFP.
- An RFI can be used to build a list of qualified respondents, which then become the RFP requestor list.
- An RFI provides an opportunity for a non-binding exchange of information between the issuing entity and vendors, allowing them to assess each other's needs and capabilities.

Following the issuance of an RFI but prior to the issuance of an RFP, a vendor feedback call (or "bidder's conference") may be held, allowing vendors an opportunity to ask clarifying questions and refine their understanding of the project. Further, after the RFI responses are fully vetted, a more detailed RFP can be developed using the information gathered through the RFI process.

An RFP, which allows vendors to propose a system that meets performance specifications, provides for more variety in proposed solutions than an RFQ (Request for Quote), which is sometimes used in construction, and which requires vendors to provide quotes for an already-specified system. The opportunity to compare a variety of proposed systems can be useful in that it allows broader competition among vendors and does not pre-judge which system will most economically and efficiently meet the needs of the project.

4. Contracting

If a decision is made to go forward with an owner-operator project, another important decision must be made regarding contracting strategies. The main choice is between a design/build (DB) approach and a design/bid/build (DBB) (also known as an engineer/procure/contract [EPC)]) approach. There are additional options (not covered here), but these two are the most common strategies, although both have advantages and disadvantages.

Table 3. Contract strategies

Contracting strategy	Description	Comments
Design-Build (DB)	In this strategy a firm is hired by the owner to design and build the EES project. This is sometimes called a turnkey system.	This is a convenient strategy when the owner has limited engineering and/or construction management resources. The DB firm can be contracted to be all-inclusive and can also act as the owner representative.
Design-Bid-Build (DBB) or Engineer-Procure-Contract (EPC)	Using this strategy, the owner will place a contract with a design firm, and then once the design is complete, the design is put out to bid to an installer.	When the owner has adequate staff, this strategy allows the owner more control, as they can act as the gate between design and construction.

4.1. Design-Build

The benefit of a Design-Build (DB) contract is that once an award is made the owner will only be responsible to ensure that the work gets done per scope, schedule, and budget, along with any safety requirements outlined in the RFP. However, the owner should expect to do a significant amount of preparation before awarding the contract. For example, before the contract can be awarded, the owner will have to issue a scope of work, estimated schedule, and detailed specifications that relate what problem(s) need to be solved, what the system needs to do, any requirements in regards to siting, safety needs, contract performance and schedule, and other terms and conditions.

The performance section should:

- Include the load profile (kW vs. time) that the system will need to meet (referred to as an ES charge and discharge cycle)
- Indicate how often the system will need to cycle during a period and how many periods it will need to perform (expressed as cycles per year and for how many years)
- Detail the percentage of available capacity required at the end of the period of performance relative to the original system capacity

Once the owner has developed the DB contract, the RFP can then be issued, typically to energy storage vendors or developers. In most cases these vendors or developers will provide the system and all the required designs and services. With the information provided in the RFP, vendors or developers should be able to determine whether their system can provide the solution needed to meet the performance specifications.

The owner may wish to include in the RFP a scoring chart that specifies how much weight will be given to various aspects of proposals. This chart usually lists specific attributes desired and attaches a weighting factor to each one to indicate its importance. Examples of project attributes typically included in a scoring chart include the proposer's safety record, number of projects in operation, size (KW/KWh) of operational projects, proposed technologies and methods, how long the proposer has been in business, and the strength of the management team. Using a scoring chart not only helps the owner define what is important, it also informs proposers more specifically what the owners is looking for. When the owner vets the submissions, a scoring chart can help ensure a fair comparison of the proposals.

Once the proposals have been vetted and scoring completed, the owner can begin final negotiations with the top bidder(s) to make sure the scope is understood, pricing is firm, and terms and conditions will be met. In a DB scenario, the selected bidder is responsible for the design phase, the build phase and selecting the ES technology. This is an important benefit especially if the owner doesn't have the staff or experience to do so. However, it could be in the owner's interest to be able to review all the shop drawings and installation designs, and to be an integral part of the commissioning.

4.2. Design/Bid/Build (DBB) or Engineer/Procure/Construct (EPC)

In a DBB or EPC strategy the process is similar to the DB strategy in that the owner will still develop a scope of work with specifications. But in this case two RFPs will be issued – one by the owner and a second by the selected engineering firm.

The first RFP will be to secure the services of an engineer. This RFP will be focused on the engineering firm's background, their experience with energy storage projects, and their ability to perform to scope, schedule, and budget. As discussed previously, this first RFP should include a scoring chart to help in the selection process.

Once the engineering firm is selected, the next step is to complete the installation design. To accomplish this, the engineering firm will need to know what type of energy storage system will be used (battery, as opposed to capacitor for example). If the specific energy storage system (i.e., chemistry, brand or manufacturer) has not previously been decided upon, an RFI could be issued by the engineering firm. An RFI is used when the problem is defined but technology and/or system size has not been determined. This process will allow the engineer to gather information on what solutions are available to solve the problem and their estimated costs. With this information the engineer can issue an RFP on the owner's behalf and purchase the energy storage system, then complete the design with the information from the selected vendor.

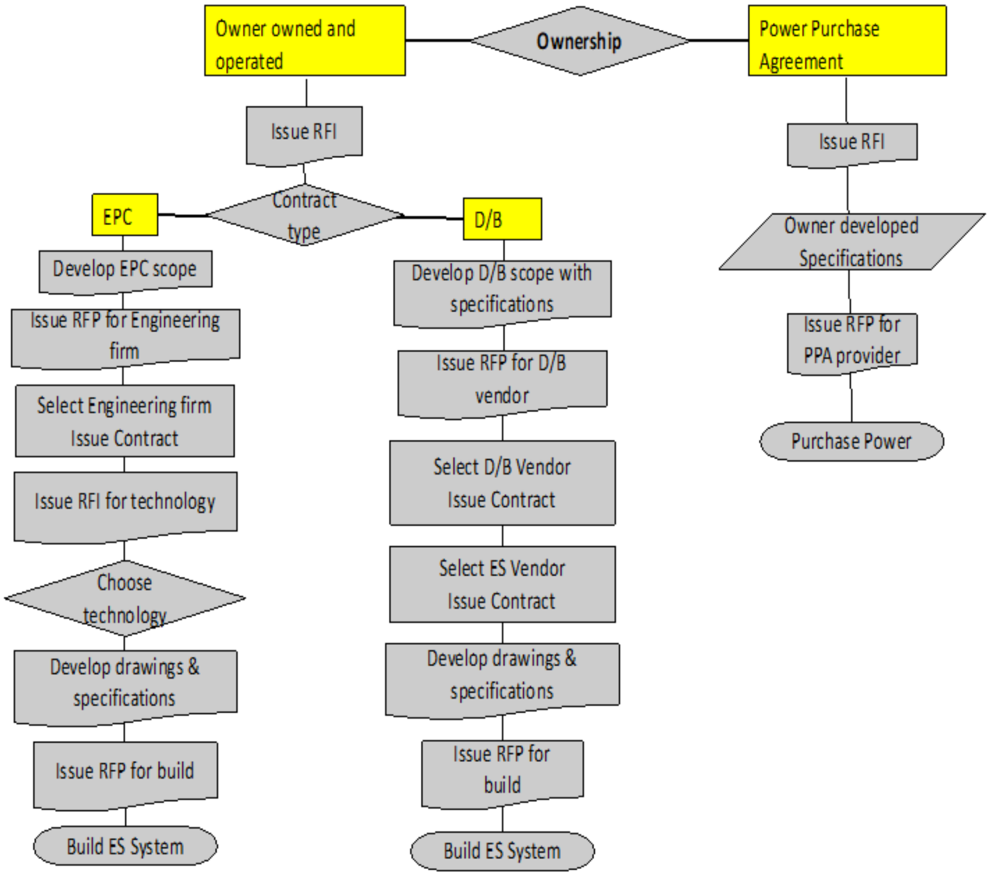

Figure 1. Ownership decision determines procurement path

4.3. Third-Party Ownership Contracts

As applications and markets for energy storage products expand, third-party ownership structures, such as leases and PPAs, are becoming more common. Procurement through a lease or PPA can provide significant benefits, but there are also risks associated with each. As with any other procurement, some risks can be minimized through contracts that define the relationship between the parties. If a PPA model is used, a term sheet (discussed in the following section) may also be needed.

Although related, leasing and PPA arrangements are different. In a lease, the storage user (lessee) is paying for the use of the storage system on a time basis – in other words, by the month or year. This is similar to leasing an automobile: the lessee pays for use of the asset for a certain period of time and can operate it as he or she wishes during that time within the parameters of the lease. At the end of the lease period, ownership of the energy storage system may revert to the lessor, or may flip to the lessee, depending on the terms of the contract.

Leases typically cover numerous topics. These include:

- Lease term
- Payment amounts and dates
- Owner or third-party access to the ESS for maintenance

- Owner or third-party internet access to the ESS for monitoring, data gathering and control
- Installation fees and procedures
- Warrantee obligations
- Limitations on usage, such as cycling and state-of-charge limits
- End of lease procedures

In a PPA arrangement, the storage user is purchasing energy or energy services from the storage owner on a per-unit basis for an agreed-upon price. The simplest PPAs take the form of the user purchasing power on a $/Watt basis, but because energy storage can provide multiple services, PPA contracts for storage systems can be significantly more complicated than a PPA for a generator would be. For example, a contract between a storage system owner and user could include terms under which the owner will purchase power from the user at certain times, and sell that power back to the user at other times.

There are many reasons a storage owner or user might prefer either a lease or a PPA arrangement. For example, federal tax credits and accelerated depreciation may not be available for solar and storage systems leased to tax-exempt entities such as municipalities and non-profits, but these tax benefits may be available if the same system services are sold to tax-exempt entities under the terms of a PPA.

4.4. Term Sheets

A term sheet defines what energy or energy services are to be bought and sold under what conditions, and is generally part of, or appended to, a PPA contract. Because energy storage PPAs are relatively new, there may not be appropriate boilerplate term sheets available. For this reason, a standard term sheet for a related product, such as solar energy, may need to be adapted. However, it is important to note that there are significant differences between energy storage and a generator such as solar, and therefore significant amendments would be needed to make a standard generation term sheet appropriate for an energy storage PPA.

Although storage is not a generator, it can act as a generator in some circumstances. However, storage can also act as a load or a grid asset and can often provide more than one monetizable service. A storage PPA term sheet should clearly define which services are being transacted, and who retains the rights to any other potential service the storage system might provide. In cases where the storage system is paired with a generator, the term sheet should specify whether energy and services are being transacted from the two assets combined, or whether each asset is providing separate services. The term sheet should also specify all other terms of the agreement, such as pricing, buy-out options, maximum and minimum available capacity, any performance guarantees, and system requirements.

5. Challenges an d Solutions

There are numerous challenges in energy storage procurement, especially for entities for whom energy is not their primary business. While electric utilities, for example, may bring in-house expertise to the storage procurement process, this may not be the case for municipalities, electric co-ops, universities, hospitals, airports, wastewater treatment plants, multifamily housing facilities, and many other potential storage users. These and other non-energy focused entities may find the prospect of energy storage procurement daunting.

The following is a list of some challenges in the energy storage procurement process, and suggested measures to address these challenges.

Challenges

- Vendors may **overpromise** in order to win project bids; systems may not perform as advertised.
- Vendors may have **limited track records**; energy storage technologies and chemistries may not be proven over a sustained period.
- **Modeling economic performance** can be challenging; system economics may be subject to many variables outside the operator's control, such as changing market rates, changing utility tariffs, and changing regulations.
- **Safety concerns** may add cost and risk to energy storage projects.
- Economic operations may depend on **accurate forecasting** of peak demand periods; operators may have to choose between competing demands on the energy storage system to maximize returns.
- The storage user/owner may not have **experience or knowledge** of how to operate and maintain a storage system.

Solutions

- Consider **procuring storage as a service** in order to shift risk and responsibilities to the third-party storage owner.
- Consider **hiring an owner's agent** to guide the procurement process.
- Consider **issuing a Request for Information (RFI)** before drafting an RFP. This can help provide a reality check on expectations and provide real market pricing input for use in drafting a subsequent RFP.
- **Learn from other, similar organizations** that have experience in energy storage procurement. For example, a municipal utility or rural electric co-op may be able to learn from other municipal utilities or rural electric co-ops that have undertaken energy storage procurement.
- Negotiate a **maintenance and/or performance contract** with the vendor. This type of contract requires the vendor to undertake whatever maintenance/replacement is necessary to ensure that the ESS continues to perform to specified standards over an agreed-upon period of years.
- Consider **hiring a third party to operate/dispatch** the ESS. This can be particularly important for storage use cases that rely heavily on timely dispatch to capture economic benefits during peak demand periods, or where operators must choose between several potential types of operations, such as demand charge management vs. frequency regulation.

6. Concluding Remarks

The evolution of energy storage in the United States is following a trajectory similar to the earlier evolution of solar PV. That is, as energy storage prices have fallen, applications have expanded and new markets have opened; the range of available ownership models and procurement structures is also increasing along with financing options, providing more flexibility and reducing a major barrier to storage deployment – the initial cost.

Another aspect of the evolution of energy storage as a commodity, is that it is increasingly paired with renewables like solar and wind generation. The pairing of energy storage with renewables paves the way for storage to gain quickly in markets where renewables are already successful. Solar developers, in particular, have begun to offer storage paired with solar for a variety of applications, from behind-the-meter resilience systems to grid-scale hybrid resources that can play in regional capacity and frequency regulation markets.

The down-side of this rapid expansion of energy storage markets is that advances in storage technology and its applications may outpace the development of related industries, including those that supply support products like standard contracts and warrantees, insurance, safety codes and standards, financing vehicles, and recycling and disposal services. At the same time, government policy and regulatory institutions are struggling to keep pace with the rapidly changing storage industry. This means that there may be some regulatory risk in developing energy storage projects, because market rules and regulatory requirements may change.

This does not mean that customers should not purchase energy storage systems or services. However, “caveat emptor” applies! Storage customers should perform due diligence and seek the advice of an attorney, as well as technical experts. Appropriate government agencies should be consulted to make sure plans are in compliance with all regulations and policies.

The challenge for storage procurement strategies, then, is to keep pace with, and even anticipate, fast-moving markets, technologies, regulations, and other variables. The pace of change is so rapid that these variables can shift significantly within the lifespan of a storage project, meaning that what is a cutting-edge project today might be out of step with changing markets, regulations or applications tomorrow. To some degree, this argues for considering a services procurement model, which shifts the burden of coping with such changing variables onto the storage owner rather than the procuring entity. However, there are still good reasons for preferring an owner-operated project in many cases. In either case, safeguards such as performance guarantees, maintenance contracts and outsourced operations can help minimize risk while ensuring that energy storage projects keep pace with shifting external variables.

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