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CPUC Energy Storage Proceeding R.10-12-007

Energy Storage Framework Staff Proposal

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1. Introduction

This proposal outlines the California Public Utilities Commission (CPUC) Staff approach to addressing energy storage policy considerations, including an analysis framework and a plan for developing policies and guidelines pertaining to energy storage. This proposal is based on the analysis of barriers to adoption of electric energy storage that have been identified thus far in the course of the electric energy storage proceeding (R.10-12-007). The purpose of the CPUC Staff proposal is not to resolve any of the barriers at this point in time, but rather to outline a roadmap for how they can be addressed. Additionally, the CPUC Staff proposal defines the steps to be taken in the next phase of this proceeding.

1.1. Background

On December 16, 2010, the CPUC opened Rulemaking (R.) 10-12-007 (Storage OIR) to implement the provisions of Assembly Bill (AB) 2514 (Stats. 2010, ch. 469). AB 2514 directs the CPUC to determine appropriate targets, if any, for each load-serving entity as defined by Pub. Util. Code § 380(j) to procure viable and cost-effective energy storage systems and sets dates for any targets deemed appropriate to be achieved. On May 31, 2011, the Assigned Commissioner and Administrative Law Judge (ALJ) issued a Ruling and Scoping Memo (Scoping Memo) which identified the issues to be considered in this proceeding and set a procedural schedule. Since the issuance of the Scoping Memo, the CPUC Staff facilitated two workshops to obtain additional information pertaining to energy storage. The first workshop, held on June 28, 2011, was a general discussion of energy storage systems and the second workshop, held on July 31, 2011, focused on barriers and impediments to widespread use of energy storage. Following the second workshop, the ALJ issued a ruling seeking additional comments from the parties. Based on the discussion during the workshops and the comments filed by parties, CPUC Staff has developed a proposal for an approach to address energy storage considerations.

On December 12, 2011, a draft CPUC Staff proposal was released to the service list in R.10-12-007 for comment by parties. Parties responded with opening comments on January 31, 2012 and reply comments on February 21, 2012.

1.2. Executive Summary

The parties in R.10-12-007 have identified a number of barriers to widespread use of electric energy storage technologies. Some of the identified barriers are under direct CPUC jurisdiction and may be addressed in existing or future proceedings. For those barriers that are under the jurisdiction of other state or federal agencies, the CPUC may be able to use its technical expertise as a stakeholder in those forums to address the barriers in a coordinated fashion. CPUC Staff has summarized these barriers and has identified best forums for these barriers to be addressed. In order to support the analysis of energy storage issues going forward, CPUC Staff proposes the adoption of an energy storage 'end use' framework. This framework will be utilized in a number of future activities, including defining the cost-effectiveness evaluation methods and defining Resource Adequacy value. CPUC Staff believes that this analysis framework, along with a plan for addressing identified barriers, will set a foundation for expanding the ability of energy storage to gain wider adoption. Specifically, CPUC Staff believes that the creation of a Resource Adequacy value and development of other rules allowing storage providers to participate more effectively in the utilities' proc urement programs will mitigate many of the identifi ed barriers. This effort will need to be coordinated w ith the California Independent System Operator (CAISO) to encourage policies and define products t o enable electric energy storage systems to participate in its markets similar to other generat ion facilities. In parallel, the CPUC will continu e to evaluate electric energy storage to make a determin ation whether or when an energy storage portfolio standard could be adequate.

1.3. Definition of Energy Storage System

Some parties identified confusion around the concep t of energy storage (given the wide range of technologies and uses being considered for implemen ting storage systems) and indicated a need to include a standard definition of energy storage systems[1] that are the subject of the Storage OIR.

CPUC Staff proposal references the statute creating the Storage OIR, Assembly Bill (AB) 2514 (Stats. 2010, ch. 469), which provides guidance on defining energy storage systems. The applicable language is quoted below (reformatted for clarity):

> (1) "Energy storage system" means commercially available technology that is capable of absorbing energy, storing it for a period of time, and thereafter dispatching the energy. An "energy storage system":
>
> may have any of the characteristics in paragraph (2),
> shall accomplish one of the purposes in paragraph (3), and
> shall meet at least one of the characteristics in paragraph (4)
>
> (2) An "energy storage system" may have any of the following characteristics:
> (A) Be either centralized or distributed.
> (B) Be either owned by
> a load-serving entity or local publicly owned electric utility,
> a customer of a load-serving entity or local publicly owned electric utility, or
> a third party,
> or
> is jointly owned by two or more of the above.
>
> (3) An "energy storage system" shall be cost effective and either
> reduce emissions of greenhouse gases,
> reduce demand for peak electrical generation,
> defer or substitute for an investment in generation, transmission, or distribution assets, or
> improve the reliable operation of the electrical transmission or distribution grid.
>
> (4) An "energy storage system" shall do one or more of the following:
> (A) Use mechanical, chemical, or thermal processes to store energy that was generated at one time for use at a later time.
> (B) Store thermal energy for direct use for heating or cooling at a later time in a manner that avoids the need to use electricity at that later time.

[1] Brookfield Renewable Energy Partners January 31, 2 012 comments at p.2.

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(C) Use mechanical, chemical, or thermal processes to store energy generated from renewable resources for use at a later time.
(D) Use mechanical, chemical, or thermal processes to store energy generated from mechanical processes that would otherwise be wasted for delivery at a later time.

2. Energy Storage Adoption Barriers

Following a series of CPUC Staff-facilitated workshops, the assigned ALJ issued a ruling on July 21, 2011, requesting comments from parties regarding barriers to electric energy storage deployment. Parties offered a wide range of distinct challenges for consideration, which CPUC Staff has grouped into nine broad categories. The purpose of this categorization is to provide an organized process to inform how challenges to electric energy storage deployment could be addressed, either within this proceeding, in conjunction with other CPUC proceedings, or in coordination with other state and federal agencies. The nine categories are:

1. Lack of definitive operational needs
2. Lack of cohesive regulatory framework
3. Evolving markets and market product definition
4. Resource Adequacy accounting
5. Lack of cost-effectiveness evaluation methods
6. Lack of cost recovery policy
7. Lack of cost transparency and price signals (wholesale and retail)
8. Lack of commercial operating experience
9. Lack of well-defined interconnection process

Each barrier category is discussed in the following subsections, including summary of parties' comments and proposed next steps.

2.2. Lack of definitive operational needs

2.2.1 Summary of Party Comments

The CPUC is currently assessing electric system operational needs in year 2020 within the CPUC's long-term procurement planning (LTPP) proceeding (R.10-05-006). As part of the LTPP proceeding, the CPUC and the CAISO are conducting a study to determine the likely capacity and operating characteristics needed to meet renewable integration requirements, with a focus on the newly established 33% renewable portfolio standard (RPS) [2]. Results so far indicate a wide range of potential needs, or lack thereof, under various scenarios.[3] The lack of a definitive conclusion to the study presents a challenge to

[2] The CPUC is currently implementing SB 2, which established the 33% Renewable Portfolio Standard, in R.11-05-005.
[3] See CAISO presentation at joint IOU/E3 presentation

determining to what extent energy storage technologies can indeed play a part in addressing grid system needs, including integration.[4]

2.2.1 Proposed Next Steps

CPUC Staff will continue to collaborate with other entities, including CAISO, to identify electric system needs and where electric energy storage could play a role to fill those needs. As system needs are identified in the LTPP proceeding, the CPUC should consider whether energy storage technologies could address these needs. The CPUC plans on issuing a decision regarding system needs in R.10-05-006 in 2012 and after that point we will solicit comments from the parties on how to best proceed.

2.3. Lack of cohesive regulatory framework

2.3.1 Summary of Party Comments

California's electricity markets are currently operated under the premise that energy cannot be stored in a practical cost-effective manner. This operational limitation can be traced to the history of energy market development and the way jurisdictional boundaries are drawn between regulatory agencies. Since energy storage has multiple uses across the electric system value chain, it is difficult to adopt a comprehensive policy within any one of the energy agencies such as the CPUC, the California Energy Commission (CEC), CAISO, and the Federal Energy Regulatory Commission (FERC). [5] Coordination is therefore especially needed both across policy proceedings at the CPUC, as well as between regulatory agencies.

2.3.1 Proposed Next Steps

CPUC Staff has completed the initial process of identifying proceedings which have implications for energy storage (see Figure 1: Storage Barriers Regulatory Matrix). Going forward, CPUC Staff will continue to identify proceedings both within the CPUC and other agencies that have implications for energy storage and encourage collaboration on energy storage issues. CPUC Staff will also use the 'end use' framework outlined in Section 3 of this proposal to facilitate discussion among the agencies of how address the multiple-use nature of energy storage.

In particular, the CPUC will monitor and participate in the CAISO "Pay for Performance" stakeholder initiatives, including CAISO's current proceeding, Renewable Integration: Market and Product Review (Phase 2), which addresses renewable integration policies such as Pay for Performance, load-following, and daily market settlements. A related effort includes FERC's two-part frequency regulation compensation for capacity held in reserve, and performance.

[4] Brookfield August 29, 2011 comments at 2; PG&E August 29, 2011 comment at 5; and Sierra Club August 29, 2011 comments at 7.

[5] Brookfield August 29, 2011 comments at 4; SDG&E August 29, 2011 comments at 5; SCE September 16, 2011 comments at 5.

Other proceedings which could impact energy storage in California include FERC's Orders 890 and 719, enabling non-generation technologies such as storage to compete with generation technologies to provide grid reliability and ancillary services. CPUC Staff will also monitor a current FERC Notice of Inquiry that addresses third party sales of ancillary services and accounting and financial reporting requirements for increased transparency of cost allocation for energy storage. This proceeding seeks to facilitate competitive markets for ancillary services and is considering classification of energy storage assets.

Furthermore, from a broad policy perspective, the CPUC will collaborate with the CEC to ensure that energy storage policy from this proceeding is in alignment with the Integrated Energy Policy Report.

2.4. Evolving markets and market product definition

2.4.1 Summary of Party Comments

There are many vehicles by which regulations affect the energy markets, but energy storage is often not consistently considered across the corresponding proceedings. For example, the CPUC set rules governing utility transactions for short-term to multi-year energy, capacity, fuel, and energy financial services in the LTPP proceeding. At the same time, the CPUC set rules on how utilities purchase renewable power, which are predominantly transactions of highly structured long-term energy products in the RPS proceedings. The Resource Adequacy (RA) program, in comparison, drives the one-year forward capacity market. In addition, the CAISO operates an integrated day ahead forward market for energy and ancillary services and a real-time imbalance market. The CAISO is currently reviewing how to define market products that are technology/resource neutral and more accurately reflect the needs of grid balancing when the penetration of intermittent resources increases.[6] Energy storage often does not clearly fall under market products as they are defined and evolving markets with updated product definitions provide an opportunity to better incorporate energy storage.

2.4.2 Proposed Next Steps

CPUC Staff has begun the process of identifying proceedings which have implications for energy storage (see Figure 1: Storage Barriers Regulatory Matrix). As wholesale markets and market definitions evolve, a policy framework for energy storage can guide how energy storage fits into each layer of the electric system value chain, irrespective of how specific market products are ultimately defined. CPUC Staff will continue to participate in CAISO's stakeholder processes to encourage policies and market design that is technology neutral.

2.5. Resource Adequacy accounting

2.5.1 Summary of Party Comments

[6] See CAISO webpage on the Renewables Integration Market Product Review.

A large number of parties have identified RA accounting rules as a barrier to broader energy storage deployment.[7] In the current RA methodology, no value has been assigned to storage-based services. Additionally, the current process of requiring load-serving entities to procure generic RA capacity does not account for grid operational characteristics necessary to operate the grid with an expected high penetration of intermittent renewable resources.

2.5.2 Proposed Next Steps

The first important outcome of this rulemaking should be to begin the process of having RA value assigned to energy storage as part of the new RA rulemaking (R.11-10-023), based on the current work in progress in that rulemaking to revise the RA methodology to include operational and performance requirements. The 'end use' framework outlined in Section 3 of this proposal identifies the broad uses for storage. The CPUC will need to determine whether and how RA can be attributed to each of the 'end uses' or their combinations. The RA treatment for energy storage is preliminarily in the scope of R.11-10-023.[8] CPUC Staff anticipates close coordination between R.10-12-007 and R.11-10-023 regarding the RA rules for energy storage.

2.6. Lack of cost-effectiveness evaluation methods

2.6.1 Summary of Party Comments

Many parties identified uncertainty around cost-effectiveness evaluation methods as a major barrier to adoption of storage.[9] In particular, they state that the unique operational aspects of energy storage pose a challenge in recognizing all relevant benefits and quantifying them. Parties express a concern that some of the benefits, particularly flexibility, optionality, and environmental, are not part of the current calculation methods and the total benefits of energy storage, therefore, end up being significantly underestimated.

2.6.2 Proposed Next Steps

Phase 2 of this proceeding will consider the appropriate methodology for evaluating costs and benefits of energy storage. The CPUC has utilized cost-benefit tests in previous energy efficiency [10], distributed generation[11], and demand response [12] proceedings. The CPUC will seek general consistency with these decisions, while recognizing that modifications to these methodologies will be required to reflect the unique attributes of energy storage.

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[7] Brookfield August 29, 2011 comments at 5; CESA September 16, 2011 comments at 4; DRA August 29, 2011 comments at 2; PG&E August 29, 2011 comments at 6; PG&E September 16, 2011 comments at 6; SCE August 29, 2011 comments at 3; Sierra Club August 28, 2011 comments at 4; Sierra Club September 16, 2011 comments at 1; SDG&E August 29, 2011 comments at 5.
[8] R.11-10-023 Appendix A at 2. See http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/146362.pdf
[9] CFC August 29, 2011 comments at 10;DRA August 29, 2011 comments at 6;PG&E August 29, 2011 comments at 4.
[10] The avoided cost methodology adopted in D.05-04-024, as modified by D.06-06-063.
[11] The avoided cost methodology adopted in D. 09-08-026.
[12] The avoided cost methodology adopted in D. 10-12-024.

2.7. Lack of cost recovery policy

2.7.1 Summary of Party Comments

Because energy storage could potentially provide transmission, distribution, and generation services, it is possible for it to recover cost under both cost-based and market-based rates.[13] Thus, without a clear way to fit energy storage into the existing regulatory and cost recovery structure, it will be difficult to both value and pay for energy storage.[14] Certain parties have proposed a long-term contracting mechanism similar to the RPS to help energy storage projects financing, as the CAISO market dynamic is insufficient to attract investments.[15] Other parties, however, believe that the CPUC should first clearly define cost responsibility and ownership structure, which could then make it easier to determine cost allocation.[16]

2.7.2 Proposed Next Steps

This proceeding should consider how storage applications across different grid functions can inform cost recovery policy that falls within the CPUC's ratemaking jurisdiction (distribution service and energy commodity procurement), and if appropriate, consider revising the regulatory and cost recovery guidelines to facilitate the use of storage assets for multiple applications where feasible to maximize the benefits of storage.

2.8. Lack of cost transparency and price signals (wholesale and retail)

2.8.1 Summary of Party Comments

Parties helped to identify three aspects of today's energy market and planning and procurement processes where more cost transparency and accurate price signals could help "level the playing field" such that energy storage could be a potential solution to grid operational problems. These areas where cost /price transparency could be improved are: (1) within the CAISO energy and ancillary market design to better reflect the cost of integrating intermittent resources (and the allocation of those costs) and locational value[17]; (2) within utility procurement planning and contract evaluation process; and (3) in retail rate design, where the need to balance various objectives within regulatory and legislative constraints[18] can be a challenge to reconcile with the desire to accurately reflect the locational and time of day cost of delivering electrical service.

2.8.2 Proposed Next Steps

[13] PG&E August 29, 2011 comments at 7.
[14] Sierra Club August 29, 2011 comments at 3.
[15] Brookfield August 29, 2011 comments at 5; CESA September 16, 2011 at 5; DRA August 29, 2011 comments at 2.
[16] CFC August 29, 2011 comments at 10; SCE September 16, 2011 comments at 12.
[17] PG&E January 31, 2012 comments at 4.
[18] PG&E January 31, 2012 comments at 4.

Of the three areas listed, the latter two fall within the CPUC jurisdiction and can be addressed in coordination with other proceedings (see Figure 1: Storage Barriers Regulatory Matrix).

2.9. Lack of utility operating experience

2.9.1 Summary of Party Comments

Energy storage, in many cases, represents a nascent set of technologies, which have yet to be utilized on a commercial scale. PG&E, SCE and SDG&E are currently evaluating the value propositions and useful life-time for advanced energy storage assets.

2.9.2 Proposed Next Steps

This particular challenge will be resolved over time, as utilities gain additional operating experience with energy storage. The CPUC can assist this process by pursuing a policy framework that promotes a technology-neutral competitive environment where energy storage can be a viable commercial option. Additionally, utilities should get more operating experience through tests and pilots that are part of the Smart Grid deployment and ARRA-funded stimulus programs.[19] As such, the CPUC will also ensure that the Smart Grid Deployment Plans[20] currently under review adequately incorporate energy storage.

2.10. Lack of well-defined interconnection process

2.10.1 Summary of Party Comments

Parties have identified the lack of well-defined interconnection processes as a barrier to energy storage deployment.[21] This challenge arises both as the result of overlapping tariffs (CPUC Rule 21 and FERC WDAT) and evolving technical standards.

2.10.2 Proposed Next Steps

The storage rulemaking should defer the consideration of distribution-level energy storage interconnection issues to R.11-09-011 (which includes the Rule 21 Working Group). For transmission level interconnection issues, the CPUC remains an active participant in the CAISO's Generation Interconnection Procedures initiative.

2.11. Energy Storage Adoption Barriers Summary

CPUC Staff summarized parties' comments into nine underlying barriers to energy storage adoption. Several of the identified barriers are the subject to either existing CPUC proceedings or soon-to-start CPUC proceedings, such as RA, LTPP and others. Additionally, others rely on work from entities other

[19] For example, SCE is testing a 4 MW/16MWH battery located at a substation to firm wind production from the Tehachapi. PG&E also received funding to begin testing the feasibility of a Compressed Air Energy Storage project at a location to be determined in the Central Valley .

[20] Applications by utilities pursuant to SB17: A.11-06-006; A.11-06-029; A.11-07-001

[21] Placeholder

than the CPUC, such as the CAISO, or are cross-jurisdictional in nature and will require ongoing collaboration across the agencies to address. As the first step to help advancement of energy storage, CPUC Staff has developed a matrix (see Figure 1: Storage Barriers Regulatory Matrix) to outline how the barriers are to be addressed in different proceedings and by different agencies. Going forward, this matrix will need to be refined and updated to reflect additional information and new developments.

While addressing barriers within the existing frameworks will be a significant step towards supporting energy storage, there are considerations that still need to be addressed within this proceeding. Mainly, there is a need for clarity around cost-effectiveness evaluation methods and for determination of next steps pertaining to an energy storage procurement target suggested in AB 2514. Subsequent sections will further outline the CPUC Staff proposal for Phase 2 of this proceeding.

BARRIERS TO ENERGY STORAGE DEPLOYMENT

BARRIER	CPUC RULEMAKING PROCESSES						INTERAGENCY COORDINATION		
	Energy Storage	LTPP	RPS	RA	SGIP, CSI	DSM	FERC	CAISO	CEC
	Sec. 2835, 9620	Sec. 454.5	Sec. 399.11-399.20	Sec. 380	Sec. 2851-2, 379.6	Sec. 379.6, 454.5(c), 743.1, etc			
	R.10-12-007	R.12-03-014		R.11-10-023					
[1] Lack of definitive system need	Considers setting a storage "need" or procurement target per AB 2514	Determine long-term grid operational need for flexible resources with CAISO analysis	RPS procurement targets could influence energy storage needs	RA requirements could influence energy storage needs	SGIP and CSI could influence energy storage needs	DSM program targets could influence energy storage needs		Use renewable integration study to help determine storage needs	IEPR considers long term needs
[2] Lack of cohesive regulatory framework	Identify regulatory barriers; encourage collaboration across proceedings						NOI,Orders 890 & 719 on regulation compensation for performance and reserve capacity	Collaboration on initiatives for RIMPR, "pay for performance"	Collaboration on integrated Energy Policy Report
[3] Evolving markets and market product definitions	Identify proceedings affecting storage market participation							Encourage technology-neutral policies and market design (RIMPR, pay for performance)	
[4] Resource Adequacy (RA) accounting	Determine uses where storage can be eligible for RA and collaborate with RA proceeding		RA value for storage sited at RPS generation should be determined by RA proceeding	Determine RA methods and establish rules for storage eligibility for RA value	Programs have impact on RA need and value	Programs have impact on RA need and value		May develop flexible attributes that impact RA methods	
[5] Lack of cost-effectiveness (C/E) evaluation method	Determin a cost-effectiveness framework for energy storage			RA value for storage may provide input to C/E framework	Existing program specific C/E methodologies may be releavent for some storage uses	SPM for evaluating demand-side programs may inform development of energy storage C/E framework		Establish methodology for calculating integration costs	
[6] Lack of cost recovery policy (cost- vs. market-based)	Consider how storage uses can inform CPUC cost recovery policies and consider revisions to allow multi-use storage	Consider cost-recovery policies for storage uses associated with utility power transactions	Consider incorporating avoided integration costs into offer valuation			Consider cost-recovery policies for storage uses associated with DSM	Clarify classification and cost-recovery rules for multi-use storage	Clarify renewables integration costs, cost causation allocation	
[7] Lack of cost transparency and price signals	Identify regulatory forums for improving cost & price signals, including within rate design	Improve cost-transparency within utility procurement planning and contract evaluation process	Allow incorporating avoided integration costs into offer valuation					Evaluate who should bear cost of intermittency through RIMPR	
[8] Lack of commercial operating experience	Considers targeted RD&D; coordinate with R.11-03-012 and R.11-10-003				Advance commercialization of emerging storage technologies	Utility program to encourage customer-owned PLS storage (A.11-03-001)			Storage 2020 study reviews status of storage technology development
[9] Lack of well-defined interconnection processes	Interconnection of distribution-level energy storage is currently being addressed in the OIR proceeding related to modifying to Rule 21 (R.11-09-011)						Set FERC-juridictional interconnection rules	Reform generation interconnection process	

Figure 1: Storage Barriers Regulatory Matrix

(Note: Grey cells indicate primary proceeding to address barrier. White cells indicate other proceedings that may influence resolution of barrier.
[1]RIMPR = Renewable Integration Market & Product Review. [2]OIR to Address Utility Cost and Revenue Issues Associated with GHG Emissions.
[3]OIR on CPUC motion to determine the impact on public benefits associated with the expiration of ratepayer charges pursuant to PU Code Section 399.8*)*

3. Energy Storage Analysis Framework

The purpose of the Energy Storage Analysis Framework is to set a foundation for how to approach energy storage. In its basic form, the framework is a decomposition of energy storage into manageable components that can be used in a variety of ways to assist with analysis. This section describes of how this framework was developed and how it will be used going forward.

3.1. Framework Introduction

Electric energy storage is a highly complex area and many analysts in the industry have come to the conclusion that a framework that decomposes storage into more manageable and discrete areas is needed to support analysis in this space. An example of such a framework was submitted by Southern California Edison (SCE) in comments on August 29, 2011. SCE proposes an application and operational usage approach, which decomposes energy storage by looking at physical location and operating profile across the value chain. The approach taken by SCE acknowledges that actual energy storage implementations may have several operational uses and, therefore, groups operational uses into 12 applications to facilitate a better understanding of benefits. [22] There are also several other similar frameworks, including one outlined by Electric Power Research Institute (EPRI) in the Electricity Energy Storage Technology Options whitepaper. [23] Leveraging work done by SCE and EPRI, among others, CPUC Staff has developed a similar framework that decomposes energy storage into 20 'end uses' across the energy value chain. This list (Figure 2: Energy Storage 'End Uses') is intended to be used as a foundation for further framework development and subsequent analysis of energy storage related issues.

[22] Southern California Edison, *Moving Energy Storage from Concept to Reality*

[23] Electric Power Research Institute, *Electricity Energy Storage Technology Options*, December 2010

Category	Storage 'End Use'
Describes at what point in the value chain storage is being used	Describes what storage is be ing used for i.e. its application.
ISO/Market	1 Ancillary services: frequency regulation
	2 Ancillary services: spin/ non-spin/ replacement r eserves
	3 Ancillary services: ramp
	4 Black start
	5 Real time energy balancing
	6 Energy price arbitrage
	7 Resource Adequacy
Generation	8 Intermittent resource integration: wind (ramp/volta ge support)
	9 Intermittent resource integration: photovoltaic (ti me shift, voltage sag, rapid demand support)
	10 Supply firming
Transmission/ Distribution	11 Peak shaving
	12 Transmission peak capacity support (upgrade defe rral)
	13 Transmission operation (short duration performance, inertia, system reliability)
	14 Transmission congestion relief
	15 Distribution peak capacity support (upgrade defe rral)
	16 Distribution operation (voltage / VAR support)
Customer	17 Outage mitigation: micro-grid
	18 Time-of-use (TOU) energy cost management
	19 Power quality
	20 Back-up power

Figure 2: Energy Storage 'End Uses'

The 'end uses' identified above are intended to be a comprehensive set of ways in which energy storage can be used and, therefore, provide value. As the u nderstanding of the ways that energy storage can be used evolves, the above list can be adjusted to reflect new developments.

3.2. Potential Framework Applications

There are many ways in which the energy storage 'end use' framework can be utilized. The decomposition of energy storage subject matter into more manageable areas can be useful across many areas of analysis. For example, the energy storage 'end use' framework can serve as the basis for:

- RA value: The recently opened RA proceeding should consider creating an RA value for storage. Parties in that proceeding should make use of the identified 'end uses' of storage and be able to calculate the RA value, where appropriate, of those identified 'end uses.' Parties and CPUC Staff should work with the RA proceeding to facilitate a discussion around the creation of an RA model and value for storage that can be used in a timely manner.
- Further barriers analysis: Barriers can be aligned to specific 'end uses'. This way, the more challenging applications of energy storage can be better understood. Additionally, barriers can be better prioritized and managed if considered in relationship to particular 'end uses' and consequently goals and benefits.
- Technology analysis: Aligning energy storage solutions to 'end uses' is a critical step in understanding both the functional requirements and maturity of technology required to enable 'end use' functionality.
- Value proposition: 'End uses' have corresponding benefit streams. In some cases, it will make sense to combine 'end uses' into applications in order to capture not just stand-alone benefits, but also synergies. 'End uses' and applications will have corresponding costs and through understanding both benefit and cost drivers value proposition for storage can begin to emerge.
- Roadmap development: The workshops and comments provided by the parties demonstrate that there are too many considerations, barriers, issues and uncertainties to be dealt with at the same time. Therefore, CPUC Staff proposes developing an energy storage roadmap that captures a vision for energy storage adoption based on policy goals, priorities and constraints. This roadmap can then serve as a tool to prioritize issues pertaining to energy storage and lay a foundation for developing a plan to address them.

It is also important to note that the proposed framework is not intended to eliminate analysis of energy storage from a unified perspective. Rather, by focusing on the specific 'end uses' it will become apparent which aspects of energy storage are unique to specific applications and which aspects of storage are common across all uses.

4. Continued Analysis and Next Steps

4.1. Analysis Process

The end goal of this proceeding is to determine what procurement targets, if any, should be established for energy storage. Also to be considered in this proceeding are the policies to encourage cost effective energy storage. Through the work conducted so far, CPUC Staff has identified several key themes:

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- The best practice for analyzing energy storage is to use a framework based on 'application' and/or 'operational use' of storage. Such frameworks have been developed by several entities in the market, including SCE and EPRI, for the analysis of the energy storage market.
- The variety of possible applications and operational uses of energy storage makes cost/benefit analysis particularly challenging.
- There are many different points of view regarding whether procurement targets, or including energy storage in the IOU loading order, would be beneficial.
- Different types of energy storage add another layer of complexity, as maturity varies drastically depending on the technology. Additionally, not only do different types of storage enable different applications and operational uses, but where energy storage is located on the grid also increases the complexity of defining benefits and uses.

Since energy storage is a very large and complex subject, the preferred approach for achieving progress is to incrementally manage the policy analysis. Therefore, it is proposed that the analysis approach going forward focuses on incremental steps and that the approach and framework be revised as issues become more precise. Also, CPUC Staff proposes that the energy storage issues are prioritized based on system needs and technology maturity to ensure that solutions with most potential are identified and supported.

The proposed analysis approach consists of four major categories: regulatory framework, cost effectiveness, procurement objectives and energy storage roadmap (Figure 3: Energy Storage Analysis Approach).

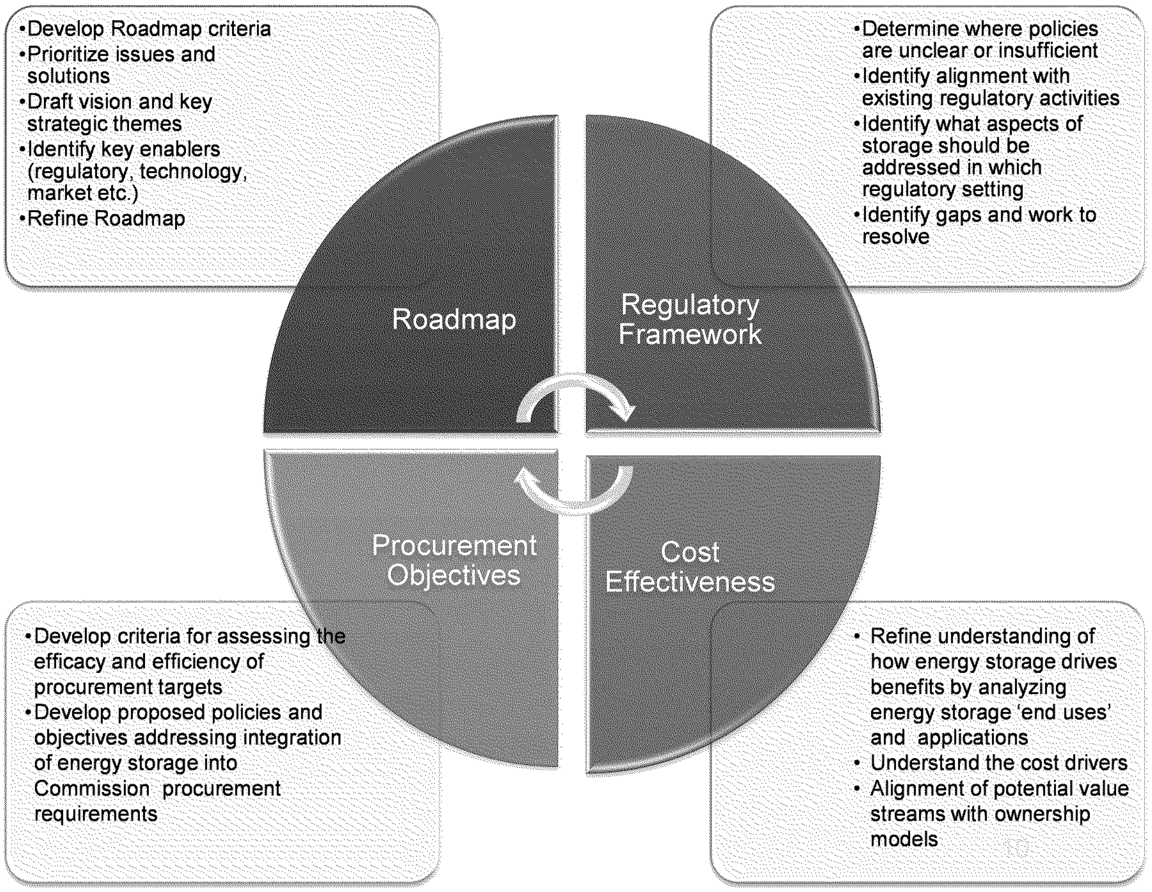

Figure 3: Energy Storage Analysis Approach

Notably, there are issues that fall outside of these four main categories. As our analysis progresses, these issues will either be addressed as part of these four focus areas or the framework will be adjusted to accommodate them. For example, assessing engineering and operations implications of introducing a significant amount of energy storage to the distribution network currently do not fall into any of the categories, as it remains to be seen to what extent this question needs to be addressed in this proceeding.

The analysis framework proposed would address the four analysis categories in an iterative manner. In other words, a draft roadmap and regulatory framework would be developed and then refined as value proposition and procurement objectives become better defined. The end result is that the four elements would come together synergistically to help frame energy storage policy direction.

4.2. Key Next Steps

Parties' comments have been utilized to finalize several work products, including an updated storage barriers regulatory matrix, cost-effectiveness methodology proposal and energy storage adoption roadmap. The outcomes of the analysis outlined above will be used to evaluate whether or not to adopt a procurement target or if other policy options are better suited to meet the objectives of AB 2514.

4.2.1 Prioritization of End Uses

As a next step, feedback from parties suggests that further analysis in the Storage OIR be pursued across the four categories discussed above by focusing on a few end uses considered high priority[24]. To achieve this, CPUC Staff recommends identifying priorities based on existing State and CPUC policy objectives, particularly increasing the penetration of renewable and distributed generation, GHG reduction, limiting peak growth and grid modernization. Rather than examining each end use individually, CPUC Staff proposes to prioritize four basic "scenarios" for deploying energy storage systems involving different combinations of multiple end uses (Figure 4: Energy Storage Deployment Scenarios).

The proposed scenarios will be a starting point for CPUC Staff in Phase 2 and will be further refined. In Phase 2, CPUC Staff recommends that there is an opportunity for the parties to recommend adjustments to the scenarios and priorities. The proposal below should be considered a point of departure and not a fixed direction.

[24] CESA January 31, 2012 comments at p.12.

Energy Storage "End Use"		Scenarios			
		A. Renewables Support/ Dispatchability	B. Distributed Storage	C. Demand-side Management	D. Ancillary Services
1	Ancillary services: frequency regulation				**X**
2	Ancillary services: spin/ non-spin/ replacement reserves			x	**X**
3	Ancillary services: ramp			x	**X**
4	Black start				
5	Real time energy balancing				x
6	Energy price arbitrage		x		
7	Resource Adequacy		x		
8	Intermittent resource integration (ramp/voltage support)	**X**			
9	Intermittent resource integration (time shift, voltage sag, rapid demand support)	**X**			
10	Supply firming	**X**			
11	Peak shaving		x		
12	Transmission peak capacity support				
13	Transmission operation				
14	Transmission congestion relief				
15	Distribution peak capacity support (upgrade deferral)		**X**		
16	Distribution operation (voltage / VAR support)		**X**		
17	Outage mitigation: micro-grid		x	x	
18	TOU energy cost management			**X**	
19	Power quality			**X**	
20	Back-up power			**X**	

Figure 4: Energy Storage Deployment Scenarios

Scenario A: Renewables Support/Dispatchability

The Renewables Support/Dispatchability scenario will look at how energy storage can be used to support renewable generation, including both transmission-level and distribution-level renewable generation. This scenario involves energy storage systems sited near intermittent/renewable energy resources to "improve" the dispatchability and value of the generator output (smoothing, firming, time-shifting), as well as avoid other system level integration costs.

Scenario B: Distributed Storage.

The Distributed Storage scenario will focus on distribution-level storage, particularly how it can be used to support grid operations. Analysis of this scenario will involve exploration of issues that have already been recognized as relatively unique to energy storage due to its multi-functional and flexible nature, such as to what extent multiple 'end uses' can co-exist together from an operational and performance perspective and how associated benefit streams can be monetized. This scenario will also involve considering storage as a distribution-level generation resource.

Scenario C: Demand-side Management

To the extent behind-the-meter storage systems are owned by customers, this scenario has already been evaluated in the demand response proceeding (A.11.03.001, 002, 003) for permanent load shifting. As part of Storage OIR, CPUC Staff can suggest further refinements of this case involving potential bundling of additional 'end uses' with load shifting and also look at cases involving the energy storage system on customer premise under utility ownership or managed by a third-party aggregator.

Scenario D: Ancillary Services

The Ancillary Services scenario will look into use of energy storage systems at the transmission level to provide generator-like services for ancillary markets. While this is largely a CAISO jurisdictional issue, CPUC Staff recommends including this scenario in evaluation as a basis for collaboration with CAISO and to also explore how distribution-level storage can participate in ancillary services through a utility tariff.

4.2.2 Roadmap

Parties offered several comments on potential goals or milestones for the progression of this proceeding and action on identified barriers to encourage adoption of energy storage resources and those comments have been incorporated into an energy storage roadmap summarized below. At this time, the CPUC Staff proposed roadmap is reflective of CPUC proceedings currently on-going or planned that are expected to address storage-related issues. CPUC Staff will work with parties to continue to monitor regulatory developments and adapt the roadmap as needed.

MILESTONE	VENUE / PROCEEDING	YEAR
Utility standard offer for customer-owned 'permanent' load shifting (PLS) storage	Pending approval in Demand Response applications (A.11.03.001, 002, 003)	2Q12
Requirements for flexible resources established	CAISO RI study phase 2	2012
Storage participates in regulation market	CAISO implements REM	
Dispatchability requirements added to RA methodology	RA OIR phase 1	
Storage cost-effectiveness methodology	Storage OIR phase 2	
RA value assigned to storage	RA OIR, phase 2	
Long term system needs	CAISO modeling of 33% RPS and LTPP	
Storage participates in ramping market	CAISO implements Flexiramp product	2013
Storage procurement objectives or other policies to encourage storage adoption	Storage OIR phase 2	
Storage as a transmission asset	Future FERC action	

Figure 5: Roadmap

5. Conclusion

Energy storage is an evolving area and there are many barriers to adoption, including gaps related to how energy storage should be addressed from a regulatory perspective. To move forward with the analysis, CPUC Staff proposes that an RA value be identified for energy storage systems and that LTPP develop a process for energy storage to participate in utility procurement practices. Additionally, CPUC Staff recommends utilizing an energy storage framework with four prioritized scenarios, which align with State and CPUC policy priorities. In Phase 2 of this proceeding the analysis will continue to focus on the four major categories: roadmap, regulatory framework, cost-effectiveness and procurement objectives. CPUC Staff is supportive of energy storage technologies and will continue to resolve barriers to adoption of viable and cost-effective energy storage.