Storage as "Peaker"

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1. Overview Section

2. Use Case Description

This Use Case describes a hypothetical 100 MW energy storage system (ESS) functioning effectively as a "peaker" plant, referred to here as a "storage peaker," that connects to and charges off the transmission grid to deliver capacity, ancillary services, and energy to wholesale markets.

It is assumed that the resource has successfully connected to the transmission grid under California ISO interconnection rules and processes and includes CAISO-approved telemetry that allows for remote monitoring of the resource and related factors (i.e., generation output, availability, meteorological data, and circuit-breaker status).

2.1 Objectives

A "storage peaker" plant participates in wholesale markets and offers "emissions-free"[1] dispatchable capacity and energy in peak hours and ancillary services for balancing and reliability,

In comparison to conventional, gas-fired peaker plants, a storage peaker may offer several advantages, including: better operational flexibility, emissions reduction, renewable integration (including over generation), procurement flexibility, and risk mitigation,

Additionally, use of storage as a peaker, instead of a conventional combustion turbine (CT), may potentially avoid curtailment because of oversupply situations.

2.2 Actors

In this Use Case, the storage facility may be owned by 1) the utility, 2) a merchant supplier similar to an IPP, or 3) a third party that operates the facility under a under a long-term power purchase agreement with the utility (similar to a "tolling" agreement).

2.3 Proceedings and Rules that Govern Procurement and Markets for This Use

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[1] The "fuel" source for the charge cycle of the storage plant may not be emissions-free.

	Description	*Applies to*
CPUC	Long-term Procurement Proceeding	Utility
CPUC	Resource Adequacy	Utility
CAISO	GIP	Project developer/owner

2.4 Location

The storage peaker plant is connected to the transmission grid and is an independent facility that is separate from other generators. It charges off the grid and discharges into the grid. The total capacity of the storage plant could be located at a single site or aggregated over multiple smaller sites.

2.5 Operational Requirements

The "capacity" of storage peaker plant typically ranges from 25 MW to 250 MW x 3-6 hours. The total capacity could be located at a single site or aggregated over multiple smaller sites.

A key feature of peaker plants is operational flexibility. A variety of requirements could be considered for operational flexibility that may need to be satisfied by a facility like the storage peaker. These include ramp rate, start/stop times, re-starts, minimum run times, dynamic range, emissions limits, hours of availability, etc.

The ISO may dispatch energy from its 5-minute market (aka, Balancing Energy Ex-Post Pricing, or BEEP-stack) which represents a real-time market for ancillary services.

Storage peakers can participate in this real-time market and supply incremental energy in the same manner as traditional generators.

2.6 Applicable Storage Technologies

The storage peaker is most likely to be based on some form of battery system of various chemistries, such as Redox Flow Batteries (RFB), and above ground Isothermal CAES, Sodium Sulfur (NAS) or Lithium Ion (Li-Ion). These could be a number of units stacked in a single location, or dispersed but aggregated to act as a single resource. Other technologies that may apply potentially include smaller scale compressed air storage (CAES) facility or pumped storage.

Storage Type	*Storage capacity*	*Discharge Characteristics*
Redox Flow Batteries (RFB)	10 to 250MW / 3 to 6 Hrs	Long 100% DOD cycle life

Redox Flow Batteries (RFB) are especially suited for large capacity energy storage.

The decoupled power and energy of RFB provides the maximum flexibility in sizing system power and energy appropriately for the target application from common building blocks. System power is tailored via integrating groups of electrochemical stacks with power electronics. Optimizing system energy is achieved by adjusting the volume of liquid electrolytes and tank sizes. As result, RFB cost per kWh decreases with increased duration.

An additional major benefit of the decoupled power and energy in RFB technology is a high degree of safety as only the electrolytes contained in the stacks can release energy. This characteristic limits the risk of unintended energy release to a small fraction of the system's total energy as there is no mechanism for electrolytes contained in the separate storage tanks to react. This provides increased location flexibility and accelerates the permitting process.

2.7 Non-Storage Options for Addressing this Objective

Alternatives available to address functions associated with a peaker are:

- CT
- Hydroelectricity
- Combined Cycle Combustion Turbine (CCGT) coupled with TES

3. Cost-Effectiveness Analysis

3.1 End Uses / Benefits

End Use	*Primary/ Secondary*	*Benefits/Comments*
1. Frequency regulation	P	Faster response
2. Spin	P	Smaller incremental capacity with faster response and will increase efficiency and reduce maintenance of existing peakers

3. Ramp	P	Same as above
4. Black start		
5. Real-time energy balancing	P	
6. Energy arbitrage	P	Storage-specific benefit not possible with traditional peakers
7. Resource Adequacy	P	Optimized sizing with smaller incremental capacity and high locational flexibility
8. VER[2] / wind ramp/volt support,	P	
9. VER/ PV shifting, Voltage sag, rapid demand support	P	
10. Supply firming	P	
11. Peak shaving: load shift	S	Storage-specific benefit enabled by locational and sizing flexibility. Not possible with traditional peakers
12. Transmission peak capacity support (deferral)	S	Optimized sizing with smaller incremental capacity and high locational flexibility
13. Transmission operation (short duration performance, inertia, system reliability)	S	Same as above
14. Transmission congestion relief	S	Same as above
15. Distribution peak capacity support (deferral)		
16. Distribution operation (volt/VAR support)		
17. Outage mitigation: micro-grid		

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[2] VER = Variable Energy Resource

18. TOU energy mgt		
19. Power quality		
20. Back-up power		

In summary, storage offers smaller incremental capacity with high locational and operational flexibility thus creating multiple value streams not provided by traditional peakers.

3.2 Other Beneficial Attributes

Attribute	*Benefits/Comments*
Modularity/Incremental build	Highly dependent on choice of technology
Faster build time	Choice of technology and chemistry influences permitting time
Locational flexibility	Highly dependent on storage technology and chemistry
Safety and Environmental Impact	Highly dependent on storage technology and chemistry
Mobility	Not practical/possible for peaker- size storage solutions
Multi-site aggregation	
Optionality	Not sure what this means
Procurement flexibility	
Other?	

3.3 Costs

Cost Type	*Description*
Installation	
O&M	

3.4 Cost-effectiveness Considerations

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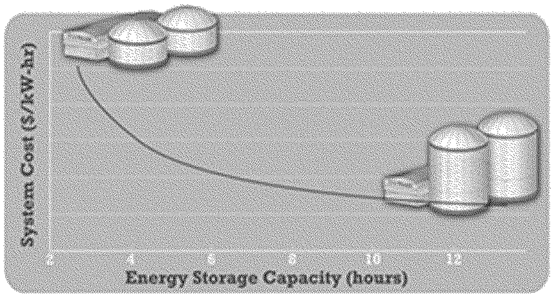

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4. Barriers Analysis & Policy Options

4.1 Barrier Resolution

Barriers Identified	*Y/N*	Policy Options / Comments
System Need	Y	Incorporate flexibility requirements into need authorization
Cohesive Regulatory Framework		
Evolving Markets	Y	
Resource Adequacy Value	Y	Higher valuation for flexible resources
Cost Effectiveness Analysis	Y	

Cost Recovery Policies		
Cost Transparency & Price Signals		
Commercial Operating Experience	?	
Interconnection Processes		
Issues with RFO design and offer evaluation process	Y	Develop a more comprehensive design & evaluation to consider more attributes
Operational flexibility requirements unclear	Y	
Value of operational flexibility unclear	Y	
Value of portfolio/procurement flexibility undefined	Y	
		Consider designating storage-based generators as "preferred"
		Consider portfolio approach to procurement

4.2 Other Considerations

5. Real World Example

5.1 Project Description

Primus Power/Modesto Irrigation District.

- 25 MW/75 MWh.
- Projected to be online by Summer 2013.

5.2 Outstanding Issues

Description	*Source*

5.3 Contact/Reference Materials

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6. Conclusion and Recommendations

Is ES commercially ready to meet this use?

Yes, See Section 5

Is ES operationally viable for this use?

Yes, See Section 5

What are the non-conventional benefits of storage in this use?

Refer to section 3.2

Can these benefits be monetized through existing mechanisms?

If not, how should they be valued?

No. A project-specific scoring system for non-monetized benefits should be considered and included in evaluating ES solutions.

Is ES cost-effective for this use?

Yes, but higher volumes are needed to improve cost-effectiveness.

What are the most important barriers preventing or slowing deployment of ES in this use?

What policy options should be pursued to address the identified barriers?

Refer to Section 4

Should procurement target or other policies to encourage ES deployment be considered for this use?

Yes. Targets with incentives are needed to accelerate adoption leading to higher volumes that will greatly improve cost-effectiveness