Appendix A

Workshop Materials August 20, 2012

The following application priorities and definitions are based on informal input/discussion between CPUC Staff, CESA, SCE, PGE, SDGE on April 12, 2012 and refined May 11, 2012. They are for discussion purposes only; the numbering is not in order of priority.

Basis for Prioritization

1. Magnitude of direct benefits to utilities, end users
2. Magnitude of societal benefits, including emissions reductions, market development, system flexibility etc.
3. Renewables integration (key California policy priority)
4. Fit with CPUC jurisdictional control
5. Availability of commercially ready energy storage technologies
6. Ability to be deployed quickly and achieve 'quick wins'

Key Definitions to Standardize in our Language:

1. <u>Benefit</u> = a single value or revenue stream captured by a resource. A stream of benefits comes from solving the identified problem and providing additional end-uses that result in providing value or capturing revenue. The cost-benefits for different solutions should be evaluated separately and the net benefits should be compared.
2. <u>End Use</u> = 'operational use (SCE)' = specific targeted operational use for a resource in the field, may result in capture of one or more

benefits.

3. Application = combination of end uses (and benefits) that an energy storage system may capture when sited at a specific place and managed in a particular way (consistent with SCE and CESA's definition)
4. Use-Cases = specific and detailed application w/ location, technology, operating regime, etc. A document that describes a problem being solved by a particular storage system in a particular location with a clear operating regime, funding structure, governance, etc.

New Terms that Need Definitions

1. Bulk Storage – large-scale energy storage that is interconnected to the grid at transmission-level voltage, and is used primarily for electric supply capacity. Can be generator co-located (storage onsite combustion turbines) or stand alone (CAES, pumped hydro) or aggregated (large-scale aggregated battery storage interconnected at transmission level).
2. Generation-Sited Storage – category of energy storage solutions that are co-located with large-scale generation (vs. distributed generation). Includes molten salt (co-located with concentrated solar thermal) and storage co-located with natural gas combustion turbines.
3. Operational Considerations – Description of how a storage project is used; i.e., on a defined basis, what application is it being employed for; what resource solution is it providing, who is deciding, etc..
4. Multi-Function Analysis – A storage project may at different times operate as a Generation, Transmission, Distribution or Load resource. This functionality determines the jurisdictional authority that governs its markets or terms of use; i.e., FERC/transmission, CPUC/distribution.

#	Application (use case)	Description/ Problem Solving	Potential Compensation or Ownership	Likely Siting & Scale (C x hr)	Storage Solution	*Conventional Solutions or Alternatives*	Energy Storage Case Study Example
1	Distribution	Defers	• Utility	• At or down-	• Upgrade	• Upgrade wires	• SDG&E

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	Storage	distribution upgrades. (For Example: overloaded wire, transformers , capacitor – not a load modifier!) Use energy storage in lieu of sub transmission capacity (for 1-4 years)	Ratebased • Third party • End User	stream from overloaded equipment • Substation • Circuit ➢ 1 MW x 4 hrs	Deferral* • Replacement Deferral* • Equipment life extension • Service reliability • T&D congestion • Transportability	or transformers.	primary distribution storage (batteries)

Operational considerations: Will operate on a scheduled basis (load modifier) **OR** maintains a prescribed level of charge and responds automatically to improve operational reliability (voltage support, etc).

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Application Priorities – Matrix

#	Application (use case)	Description/ Problem Solving	Potential Compensation or Ownership	Likely Siting	Primary End Uses	*Conventional Solutions or Alternatives*	Energy Storage Case Study Example
2	Community Energy Storage@	Improve local service reliability. Integration of distributed VREs Voltage control	• Utility Ratebased • Third Party under contract	• Adjacent to loads, on utility 'easement' >25 kW x 2 hr	• Service Reliability* • D Deferral* • T Congestion* • Electric Supply* • Ancillary Services* • Transportability	• Capacitor • Transformer	• AEP CES • Detroit Edison CES • SMUD Solar Smart RES/CES Project • SDG&E secondary storage projects

Operational considerations: Will operate on a scheduled basis (load shift) **OR** on an automated basis (power quality / operational reliability) depending on the nature of the problem to be solved [**OR** Bid into ISO markets; operate according to awards and ISO dispatch signal]

#	Application (use case)	Description/ Problem Solving	Likely Compensation or Ownership	Likely Siting	Primary End Uses	*Conventional Solutions or Alternatives*	Energy Storage Case Study Example
3	Distributed	Energy cycling	• Utility	• Subtransmission	• Electric Supply*	• *Conventional*	• Modesto

	Peaker@ (Load Modifier -- primarily in lieu of added electric supply capacity)	to address peaking needs (part year operated by utility, part year operated by CAISO)	Ratebased • Third Party ownership, PPA	Substation >25 MW x 4 hr	Ancillary Services* • T Congestion* • Service Reliability* • D Deferral* • Transportability	*Generation (CT, CC)* • *PPA* • *DR* • *Critical Peak Pricing (CPP)* • *EE* TES	Irrigation District • Raleigh, NC (TAS Energy)

Operational considerations: Bid into ISO markets; operate according to awards and ISO dispatch signal **OR** Operate on a scheduled basis (load shift) **OR** on an automated basis (power quality / operational reliability).

The unit is operated as a traditional generation resource bidding into the market; thus the unit is *not* operated to meet local reliability needs. The "potential additional" benefits are the cost savings resulting from proximity to load, thus avoided some congestion charges and line losses.

	Application (use case)	**Description/ Problem Solving**	**Potential Compensation or Ownership**	**Likely Siting**	**Primary End Uses**	***Conventional Solutions or Alternatives***	**Energy Storage Case Study Example**
4	VER-sited (renewables)	On-site firming or shaping of intermittent generation	• Expensed by LSE (if third party owns and sells higher value power to LSE) • Ratebased	• At or near RE Generation ✓ Subtransmission ✓ Substation ✓ Distribution 35 MW – 250 MW	• Variable RE Generation Integration ✓ energy time-shift ✓ capacity-firming ✓ ramping ✓ Volt/VAR	• *Additional Sub-T or D Infrastructure* • *Static VAR Compensator* • *Switched Capacitor Banks* • Generation	• Xtreme Power - various • Solar Thermal with molten salt or other • TAS Generation Storage™ • Laurel Mtn

			(If IOU owns and pairs with generation)		support	storage technologies	AES

Operational Considerations: Dispatch coordinated to smooth VER output to avoid future integration charges. **OR** Bid into ISO markets; operate according to awards and ISO dispatch signal.

This application is distinct from the [Bulk] Generation application only when the storage device is integrated in to the VER itself, such as solar thermal coupled with thermal storage. Otherwise, there is no need for the storage device to be co-located with the VER as opposed to at a transmission substation. There could *potentially* be additional value if the storage device was able to reduce or avoid an investment to increase the transmission capacity necessary to accommodate the VER, but this would be a FERC-jurisdictional benefit.

#	Application (use case)	Description/ Problem Solving	Potential Compensation or Ownership	Likely Siting	Primary End Uses	*Conventional Solutions*	Energy Storage Case Study Example
5	Bulk Generation/ Storage	Electric Supply Capacity/ provides resource adequacy, ancillary services, and energy	• Market • Utility Ratebasing • Third Party	• Transmission • Generator co-located >100 MW x 6 hr	• Resource adequacy • Ancillary services • Energy	• *Conventional Generation (CT, CC)* • *PPA* • *DR*	• Utility-owned Pumped Hydro-electric • Alabama CAES • TAS Energy Generation Storage™ Case

							Study

Operational considerations: While this application is conceived as large scale storage, the C/E template would be the same for a much smaller device so long as that device is interconnected at the transmission level and intended to earn revenues through markets exclusively.

#	Application (use case)	Description/ Problem Solving	Likely Compensation or Ownership	Likely Siting	Primary End Uses	*Conventional Solutions or Alternatives*	Energy Storage Case Study Example
6	Demand Side Manage-ment	End-use Customer Bill Management System load modification Service Reliability/ Quality	• Customer • Market (for ancillary services) • End-user • Third-party • *Utility Ownership?*	• Customer-side of Meter	• TOU Energy Cost Management • Demand Charge Management • Reliability (back-up power) • Power Quality • Ancillary Services *	• *Energy Efficiency* • *Combined Heat and Power (CHP)* • *Combined Cooling Heat and Power (CCHP)*	• Alameda County Santa Rita Jail • Various SGIP funded projects • TES • Tesla/Solar City?

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Application Priorities – Matrix

Operational considerations: Operated to minimize customer energy and demand charges, potentially responding to price signals sent by utility; potentially providing backup power in an outages if outage occurs when battery happens to be charged

Notes
#Heavily loaded transformers and underground cables with slow or no load growth.
*Responds to utility and/or ISO signals.
@Includes resource adequacy in the form of supply capacity and reserves.