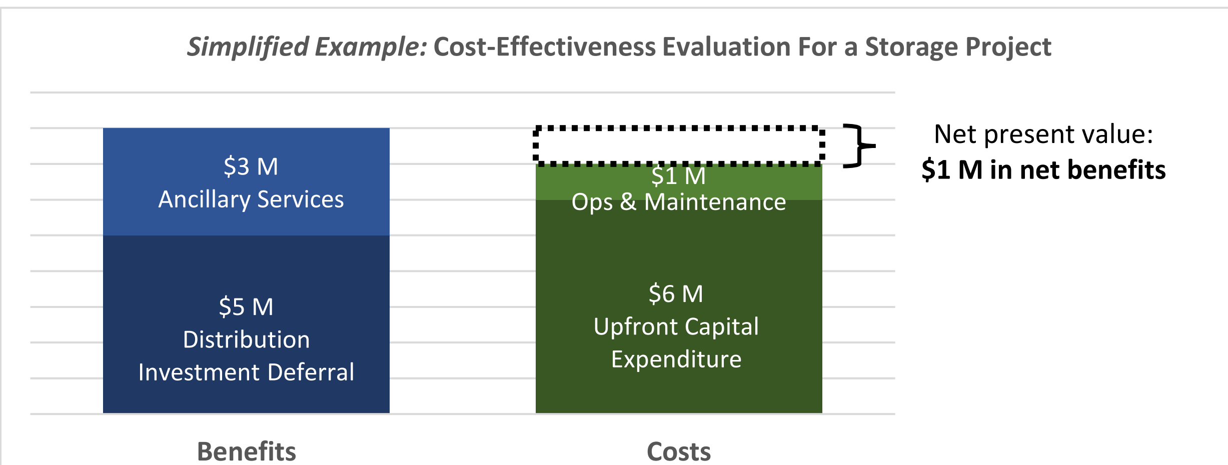
Energy Storage Cost-Effectiveness

Background for Distributed Generation & Storage Technical Advisory Committee

The cost-effectiveness of energy storage projects in utility valuation should be determined by the net present value (NPV) of both the benefits and costs expected over the lifetime of the projects. The factors – both benefits and costs – that are used to determine cost-effectiveness are the same as those considered for traditional grid resources and include the following benefits and costs when applicable.

Factors in Determining Cost-Effectiveness of Storage Projects for a Utility

Benefits	Costs
Generation capacity value	Capital expenditure or contract payments
Energy shifting value (aka. "arbitrage" value)	Operations & maintenance costs
Ancillary services value	Network upgrade costs
Distribution investment deferral/offset value	Debt equivalency costs
Distribution operation value (voltage / VAR support)	Market participation costs
Blackstart value	Property taxes
GHG and criteria pollutants emissions reduction	



Precedent for Storage Cost-Effectiveness Language in Legislation

Existing storage procurement target legislation addresses storage cost-effectiveness at a high-level:

- California's A.B.2514 says "all procurement of energy storage systems by a load-serving entity or local publicly owned electric utility shall be cost effective."[1]
- Massachusetts's H.4568 requires "cost-effective deployment of energy storage systems."[2]

Only utilities have the data to determine the value of various services on their grid. Therefore, utilities, in association with their regulators, are in the best position to determine the cost-effectiveness of specific energy storage projects.

[1] A.B.2514 (2010), Section 2836.6.
[2] H.4568 (2016), Section 15(a).

Understanding the Cost of Energy Storage Systems

The cost of energy storage systems is not easily compared with the cost of generation because storage is not generation. Storage does not produce electricity – it stores electricity when it is relatively less valuable to the grid and then discharges that electricity when it is more valuable to the grid. Thus, typical cost benchmarks for generation resources, such as Levelized Cost of Energy ("LCOE"), are not particularly useful for determining the cost-effectiveness of energy storage projects.

Various Ways to Measure the Cost of Energy Storage Systems With Example Pricing		
	1,000 kW / 2,000 kWh *(two hour system)*	**1,000 kW / 4,000 kWh** *(four hour system)*
System cost	$ 1,112,600	$ 2,012,600
System cost per kWh installed	$ 556 / kWh	$ 503 / kWh
System cost per kW installed	$ 1,113 / kW	$ 2,013 / kW
LCOE if cycling 100 times / year*	$ 0.56 / kWh	$ 0.50 / kWh
LCOE if cycling 720 times / year (twice daily)*	$ 0.08 / kWh	$ 0.07 / kWh

*Assumes 10 year system life. Note, cycling 100 times / year would likely result in underutilization.

$$\text{LCOE for energy storage} = \frac{\text{system cost}}{\text{energy throughput over life of project (i.e. kWh installed X number of cycles)}}$$

The LCOE for storage devices may appear high when compared with generation resources, however, given the valuable services that storage can provide (e.g. offsetting large capital investments needed to meet peak demand), storage projects that have high LCOE can still provide the most economical means to meet grid needs. NV Energy's proposed Smith Valley storage project, for example, probably had a high LCOE but was still the economical option because an $8 million energy storage system could offset the need for an $18 million distribution system upgrade.

Again, the cost-effectiveness of energy storage systems should be determined on a project-specific basis by calculating the net present value of both the benefits and costs of storage at specific locations on the grid.

Energy Storage Procurement Targets Policy Precedent

California's storage procurement targets

In September 2010, California Assembly Bill 2514 was signed into law, requiring the California Public Utilities Commission (CPUC) to open a proceeding to determine appropriate utility procurement targets for commercially available and cost-effective energy storage systems. In response, the CPUC opened Docket 10-12-007, holding a series of workshops, issuing various reports, and reviewing stakeholder input.

Ultimately, in 2013, the CPUC adopted Decision 13-10-040 setting storage procurement targets for the state's investor-owned utilities at 1,325 MW by 2020 (equivalent to around 2-3% of the utilities' peak load).[3] The targets are broken down into sub-targets by:

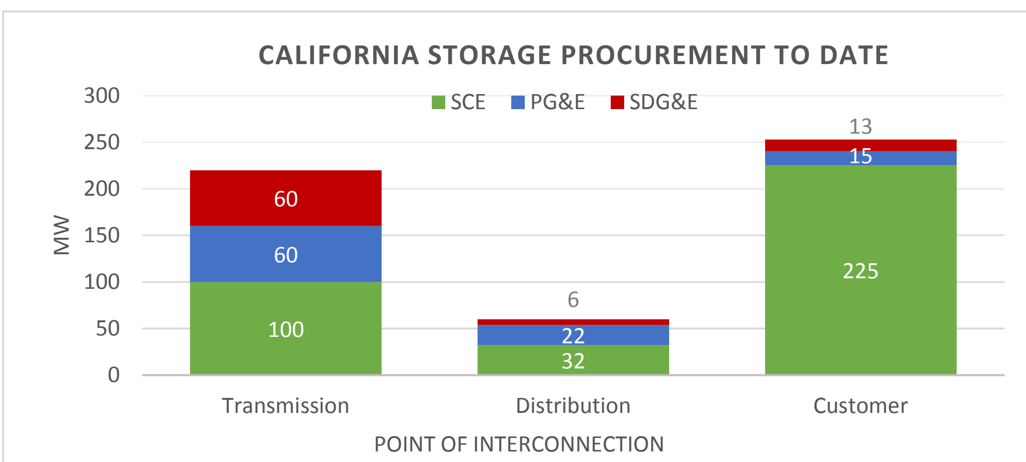
- *Year* – 2014, 2016, 2018, 2020;
- *Point of interconnection to the grid* – transmission, distribution, and customer; and
- *Utility* – SCE, PG&E, SDG&E.

California's Storage Procurement Targets (MW)

Storage Grid Domain Point of Interconnection	2014	2016	2018	2020	Total
Southern California Edison					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal SCE	**90**	**120**	**160**	**210**	**580**
Pacific Gas and Electric					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
Subtotal PG&E	**90**	**120**	**160**	**210**	**580**
San Diego Gas & Electric					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
Subtotal SDG&E	**20**	**30**	**45**	**70**	**165**
Total - all 3 utilities	**200**	**270**	**365**	**490**	**1,325**

COST-EFFECTIVENESS PROVISION

The CPUC decision allows the California utilities to defer 80% of their targets if projects are not economically viable -- "if the utilities can demonstrate that they have not received bids that are economically or operationally viable, or have not received sufficient bids to meet their procurement targets, they will be allowed to defer up to 80 percent of their procurement target to a later period." Despite this provision, the California utilities have bought over 500 MW of energy storage to date, well ahead of their targets, which require at least 200 MW of storage to be procured at this point in time.



[3] More info is available on the California Public Utility Commission website at http://www.cpuc.ca.gov/General.aspx?id=3462.

Other states' storage procurement targets policies

OREGON

Oregon's House Bill 2193, passed in 2015, requires each of Oregon's utilities to procure at least 5 MWh of energy storage by January 1, 2020.[4] The legislation also requires the Public Utility Commission to adopt guidelines for evaluating energy storage projects by January 1, 2017.

MASSACHESUTTS

On July 31, 2016, the Massachusetts legislature passed H. 4568 which, amongst other things, requires the department of energy resources to determine whether to set storage procurement targets that would be achieved by January 1, 2020. Any storage procurement targets shall be adopted by July 1, 2016 and reevaluated not less than every three years.

PROPOSED

Storage procurement bills have been introduced but not yet passed in Hawaii,[5] Maryland,[6] and New York.[7]

Lessons learned from Existing Storage procurement policies

HOW TO SET PROCUREMENT TARGETS?

Storage procurement targets are set as an amount of installed energy storage capacity that can be measured as a percentage of peak load, in megawatts (MW), or in megawatt-hours (MWh). Generally, however, some consideration of both the power (MW) and energy (MWh) is appropriate given that both attributes factor into the value of the energy storage systems to the grid.

Storage procurement targets should require deployment of some storage at every point of interconnection to the grid – transmission, distribution, and customer-located – to ensure sufficient learning with different applications of storage. The details surrounding what types of energy storage should be procured can be left relatively open-ended to allow (and require) the utilities to do the appropriate analysis to understand where energy storage can be most valuable to their unique grids.

WHY USE STORAGE PROCUREMENT TARGETS?

Setting storage procurement targets for utilities prompts learning-by-doing and jumpstarts the incorporation of energy storage into all of utility processes including planning, valuation, procurement, operations, and interconnection. Storage procurement targets result in lower costs to ratepayers if they include provisions ensuring cost-effective projects.

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[4] Oregon, HB 2193, 2015.

[5] Hawaii, HB 1, 2015; Hawaii, SB 2932, 2014.

[6] Maryland, HB 787, 2016; Maryland, HB 821, 2016.

[7] New York, S. 7533, 2016.