Evaluating Utility Owned Electric Energy Storage Systems: A Perspective for State Electric Utility Regulators

DOE Energy Storage Program

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Sandia National Laboratories

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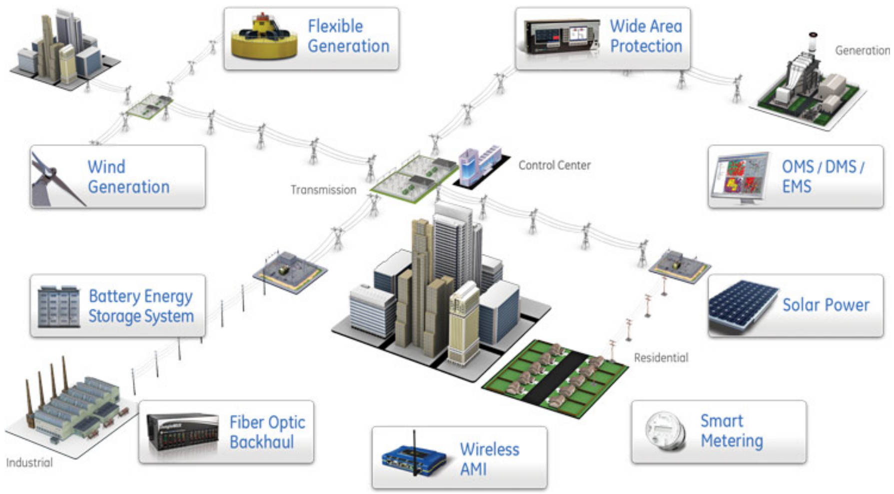
Motivation for this Work

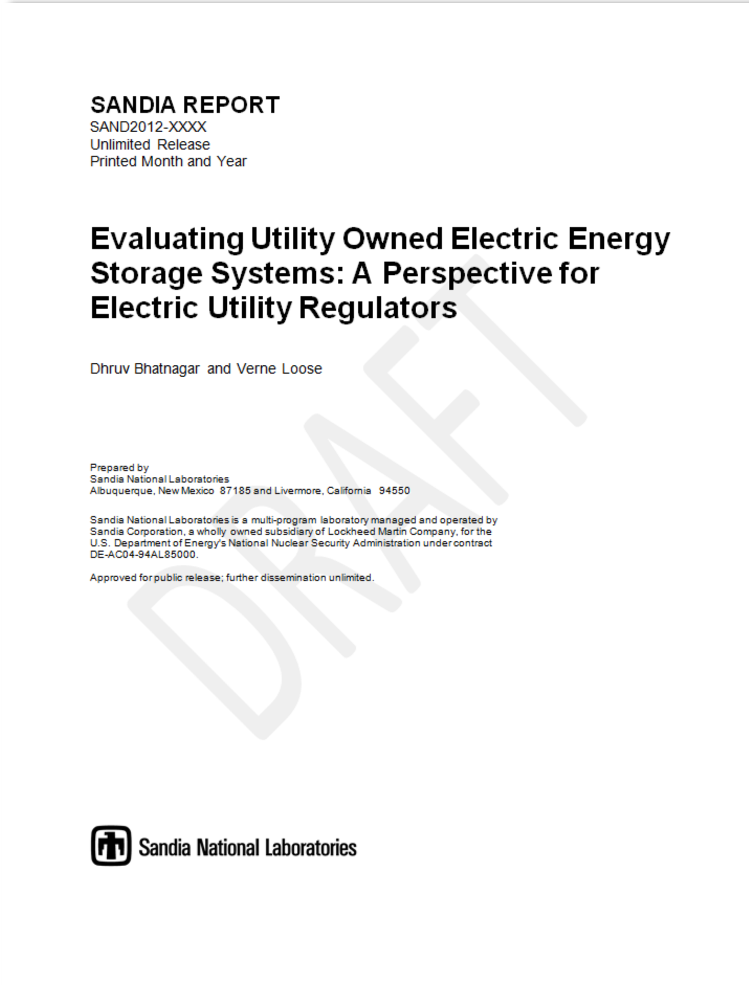
- Many state utility regulatory bodies are unfamiliar with electric energy storage systems
  - The technology
  - The functional uses
  - The value of these uses to the grid
- This leads to a handicap in their proper evaluation for rate base
- May prevent the best (economic) technologies from system integration



Source: GE

What we are doing

- Developing a guidebook:
  - Inform regulators about the system benefits of energy storage
  - Identify regulatory challenges to increased deployment
  - Suggest responses & solutions to challenges
  - Identify energy storage valuation principles
  - Provide sample economic evaluations for regulatory commission submissions



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Evaluating Utility Owned Electric Energy Storage Systems: A Perspective for Electric Utility Regulators

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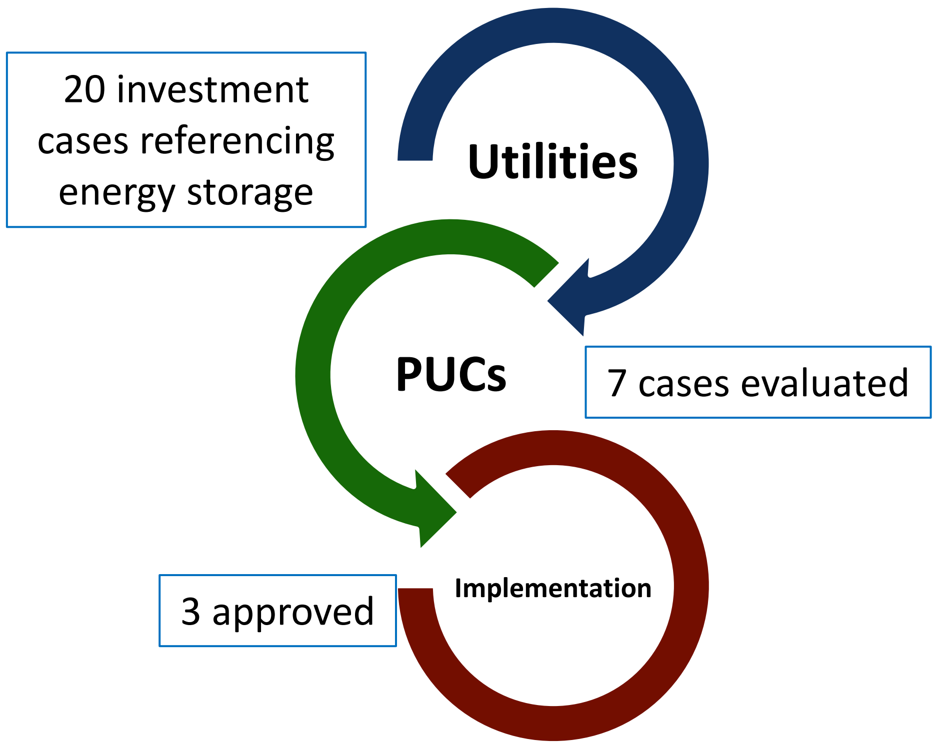
Ensuring informed and impartial analysis of competing technologies is the mechanism to develop a robust and efficient future U.S. electric system.

What we have completed

- Formed an advisory committee
- Extensive literature search
- Search of utility commission dockets throughout U.S.
  - All 48 contiguous states, Alaska and Hawaii



What we have completed

- Discussions with regulatory commissioners and their staff
  - Illinois, New Jersey, Arizona, California (CAPUC & CEC), New Mexico, Texas
- Discussions with utilities
  - SCE, PNM, FirstEnergy, Duke Energy
- Discussions with industry experts, consultants, academics, DOE, EPRI, NRRI
- Participated in NRRI and CESA webinars

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Draft guidebook

The Guidebook

1. Energy Storage Defined
   - Sources, technologies, functional uses, factors affecting demand & the future grid
2. Review of PUC Hearings
   - Challenges, regulatory responses to these challenges
3. A framework for evaluating the services of energy storage
4. Evaluation Case Studies
   - Renewable energy time-shifting and firming
   - Distributed generation smoothing and integration

Results of this work

- Limited operational experience leads to uncertainty regarding the ability of energy storage to provide reliable service
  - Deployments and performance standard development are often issues cited that would increase regulator (and utility) comfort

- Challenges to quantifying value leads to difficulty in proving cost-effectiveness
  - The value of an energy storage system is governed by the cost of the next best alternative means of providing the regulated service(s)
  - In market areas, energy storage can deliver services at market prices, but some products are not available

Results of this work

- Operational, definition and classification issues: energy storage defies classification as a generation, transmission, or distribution asset
  - These can be clarified by viewing energy storage systems from the view of the services they perform rather than their inherent engineering characteristics (Texas and ERCOT)

- The regulatory environment may make it difficult for utilities to propose energy storage systems
  - Regulatory commissions may need to work with utilities to facilitate deployment

- Mandates and incentives might encourage more deployment but interrupt the process of market valuation of the technologies.
  - Feed-in tariffs or other incentives might provide the necessary financial boost to induce utilities to invest in energy storage in the absence of carbon pricing.

The Analysis Process

For a specific deployment:

- Identify the problem
- Determine the technologies that can address the problem
- Conduct a generic technical evaluation of these technologies
- Perform B/C analysis to down select choices
- Perform Detailed Analysis

a. System specific modeling (internal modeling processes, Sandia Optimization tool, ESVT)
b. Production cost modeling
c. Power flow modeling
d. Long term planning models

Functional Uses & their Evaluation

		Functional Use	Value Metric	Possible Analysis Approaches
Energy	1	Electric Energy Time-Shift	The price differential between off-peak and on-peak prices minus any efficiency losses associated with the charging process.	Production cost modeling; Sandia optimization tool; ESVT
	2	Electric Supply Capacity	The avoided cost of new generation capacity (procurement or build capital cost) to meet requirements.	Long term planning models
T&D Service	3	Transmission Upgrade Deferral	The avoided cost of deferred infrastructure to address the issue.	Long term planning models
	4	Distribution Upgrade Deferral	The avoided cost of deferred infrastructure to address the issue.	Long term planning models
	5	Transmission Voltage Support	The avoided cost of procuring voltage support services through other means.	Power flow modeling
	6	Distribution Voltage Support	The avoided cost of procuring voltage support services through other means.	Power flow modeling
Reserve Service	7	Synchronous Reserve	Regulated Env: the avoided cost of procuring reserve service through other means. Market Env: the market price for synchronous reserve.	Production cost modeling
	8	Non-Synchronous Reserve	Regulated Env: the avoided cost of procuring reserve service through other means. Market Env: the market price for non-synchronous reserve.	Production cost modeling
	9	Frequency Regulation	Regulated env: the avoided cost of procuring service through other means. Market env: the market price for frequency regulation service.	Production cost modeling
Customer Service	10	Power Reliability	The avoided cost of new resources to meet reliability requirements.	Distribution modeling: power flow
	11	Power Quality	The avoided cost of new resources to meet power quality requirements, or avoided penalties if requirements not being met.	Distribution modeling: power flow
	12	Retail TOU Energy Time Shift	The price differential between low TOU and high TOU prices.	Simple internal models; Sandia optimization tool; ESVT
	13	Demand Charge Management	The avoided cost of demand charges.	Simple internal models; Sandia optimization tool; ESVT

Functional uses and value metrics jointly developed with EPRI & ESA

Future Tasks

- Publish final version of report
- Disseminate the report as widely as possible
  - Presentations to PUCs, utilities, NARUC

This will be a valuable tool that has great potential to help regulators understand, analyze and make the right decisions in evaluating energy storage technologies.

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