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Need for Energy Storage

Renewable Portfolio Standard, AB 32 Greenhouse Gas Reductions Smart Grid and Demand Response

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California Energy Commission
IEPR Committee Workshop
Energy Storage for Renewable Integration
Sacramento, CA

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Panel Questions

- *How can Energy Storage help California achieve the Renewable Portfolio Standard?*
- *How will Energy Storage help California achieve AB 32 Goal?*
- *How can distributed energy storage be used to help California achieve its future energy goals?*
- *What can be done to better define the role of energy storage in the California Grid of the future?*
- *What can be done to support the implementation of the Assembly Bill 2514 Energy Storage development, demonstration, and deployment plan activities?*

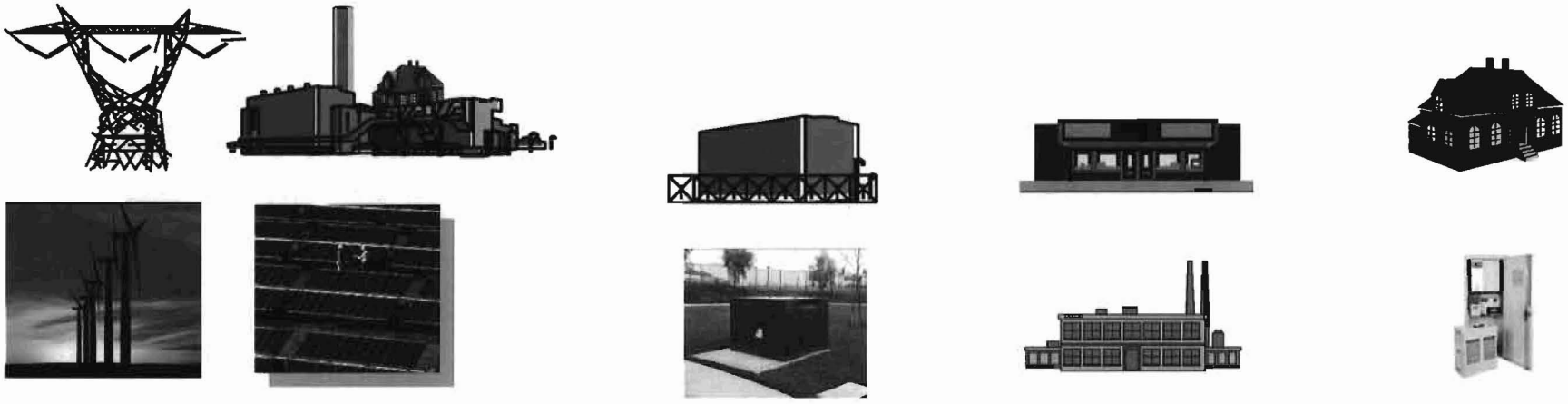
California Drivers for Electric Energy Storage Solutions




- Managing Increased Wind and PV Penetration on the Grid
- Ancillary Services – Support Renwables; Optimal use of Fossil Units
- Grid Asset Management
  - Managing Grid Peaks, T&D CapEx Optimization, Outage Mitigation
- Increasing the value of Distributed Photovoltaic systems
- Enhancing the value of a Smart Grid: Peak Management;

EPRI R&D Identified 10 Key Applications along the entire Electricity Grid… (not comprehensive)

Whole Sale Energy Services Renewable Integration	Stationary T&D Support Transportable T&D Support Distributed Storage (DESS)	C&I Energy Mgt C&I PQ and Rel. ESCO Aggregated	Home Energy Mgt Home Back-up



ISO/Bulk/Renewable Integ. Utility Grid Support Customer Energy Mgt

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Roles for Energy Storage in CA

See EPRI Research Reports: 1022261,1020676

Applications, Benefits and Costs of Energy Storage Systems

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An EPRI Executive Summary

Electric Energy Storage Technology Options

A Primer on Applications, Costs & Benefits

Program 94

Introduction

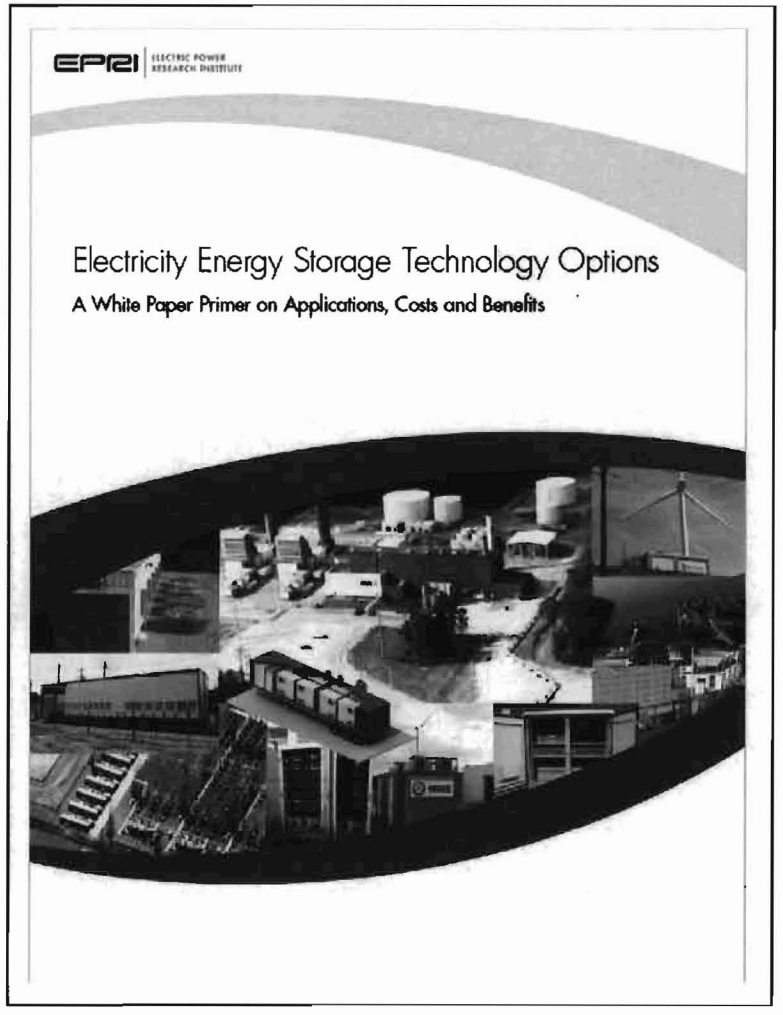
A confluence of industry drivers—including increased deployment of renewable generation, the high capital cost of managing grid peak demands, and large investments in grid infrastructure for reliability and smart grid initiatives—is creating new interest in electric energy storage systems. Just as transmission and distribution (T&D) systems move electricity over distances to end users, energy storage systems can move electricity through time, providing it when and where it is needed. Energy storage systems can help balance variable renewable generation and, properly deployed and integrated, can help increase electric grid reliability and asset utilization. With improvements in the cost and commercial availability of energy storage technologies, electricity storage systems should play a pivotal role in influencing the impact of these industry drivers.

This white paper was prepared to inform industry executives, policymakers, and other industry stakeholders of the various types of electric energy storage systems both available and emerging; their status, potential applications, and important trends in such systems for the electric enterprise. Cost and application value information is crucial to assessing the business case for energy storage system investments. However, traditional methods used to evaluate distributed energy resources (DER) do not adequately capture the range of benefits potentially offered by energy storage systems.

Storage applications differ from other DER options, such as distributed generation or energy efficiency, in key respects: they do not have a typical operating profile or load shape that can be applied prospectively; they are "limited energy" resources with a narrow band of dispatch and operation; and they can participate in multiple wholesale markets and provide several benefits simultaneously to the wholesale system, electric distribution companies, and end-use customers. These characteristics, plus the difficulty in monetizing multiple stakeholder benefits, often act as barriers to the widespread deployment of energy storage systems, whose multi-functional characteristics also complicate rules for ownership and operation among various stakeholders.

In producing this report, EPRI's Energy Storage research program drew on information from technology assessments, market research and analysis, application assessments, and input from storage system vendors and system integrators on performance and capital costs. The full paper provides an overview of energy storage applications and technology options, and the potential range of value of storage systems in the applications presented. Updated capital cost and performance information is also presented for storage systems available within the next one to three years. In addition, longer-term trends in emerging systems are highlighted. The full report also outlines a framework and methodology that electric utilities and industry stakeholders may use as one approach to estimating the value of energy storage systems in key near-term applications.

The conclusions of this work are the result of modeling efforts and calculations conducted at EPRI. Assumptions and estimates for many of these calculations have been developed by industry experts and vetted by stakeholders, but real-world needs, costs, and benefits can vary considerably. The objective of this study is to provide information and data that are timely and relevant, but with the consideration that readers carefully understand the assumptions and calculations made to reach the conclusions presented. A number of the high-value benefits identified in this report can vary widely across regions and will depend to a great extent on the operational guidelines, market rules and tariffs ultimately adopted for energy storage. Furthermore, as a broad survey of markets and technologies, this report does not take into account the substantial impact of local and site-specific condi-



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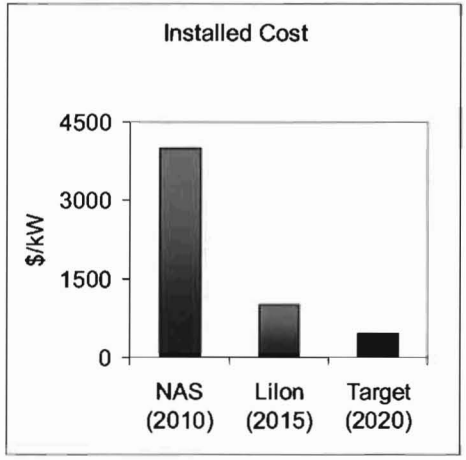
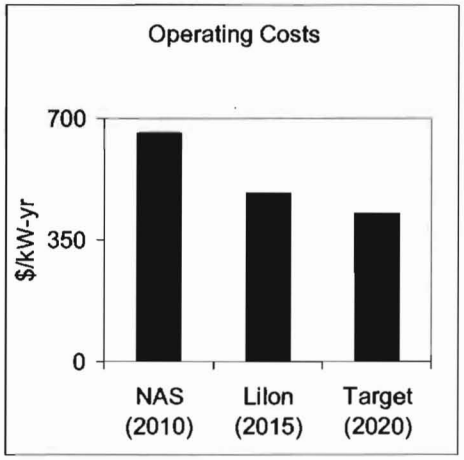
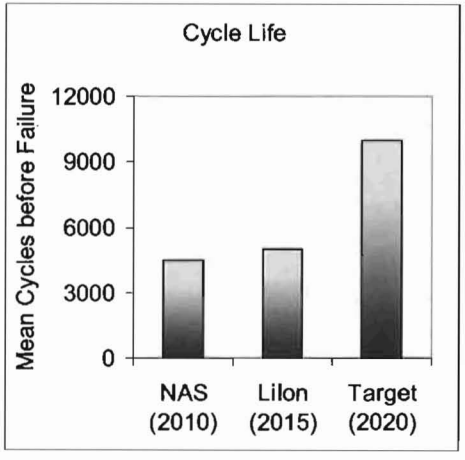
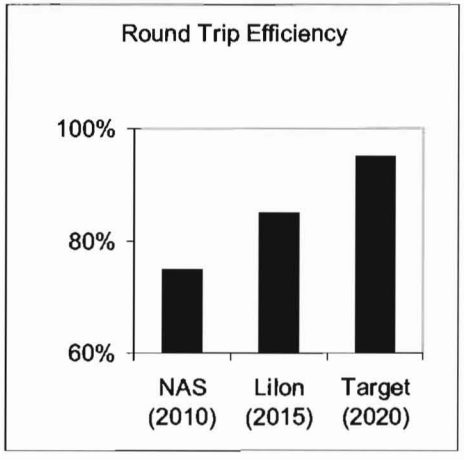
EPRI Energy Storage Program Research
Perspectives

- **Present options meet <u>few of the long-term technical targets</u>** we would like to see on the grid.
- **Near Term Goals**:
  Identify high value applications; Specify App Reqts; test and validate; quantify value; support grid integration.
- **Long Term Goals:** advance new technologies that can fully address needs for tomorrow's grid.









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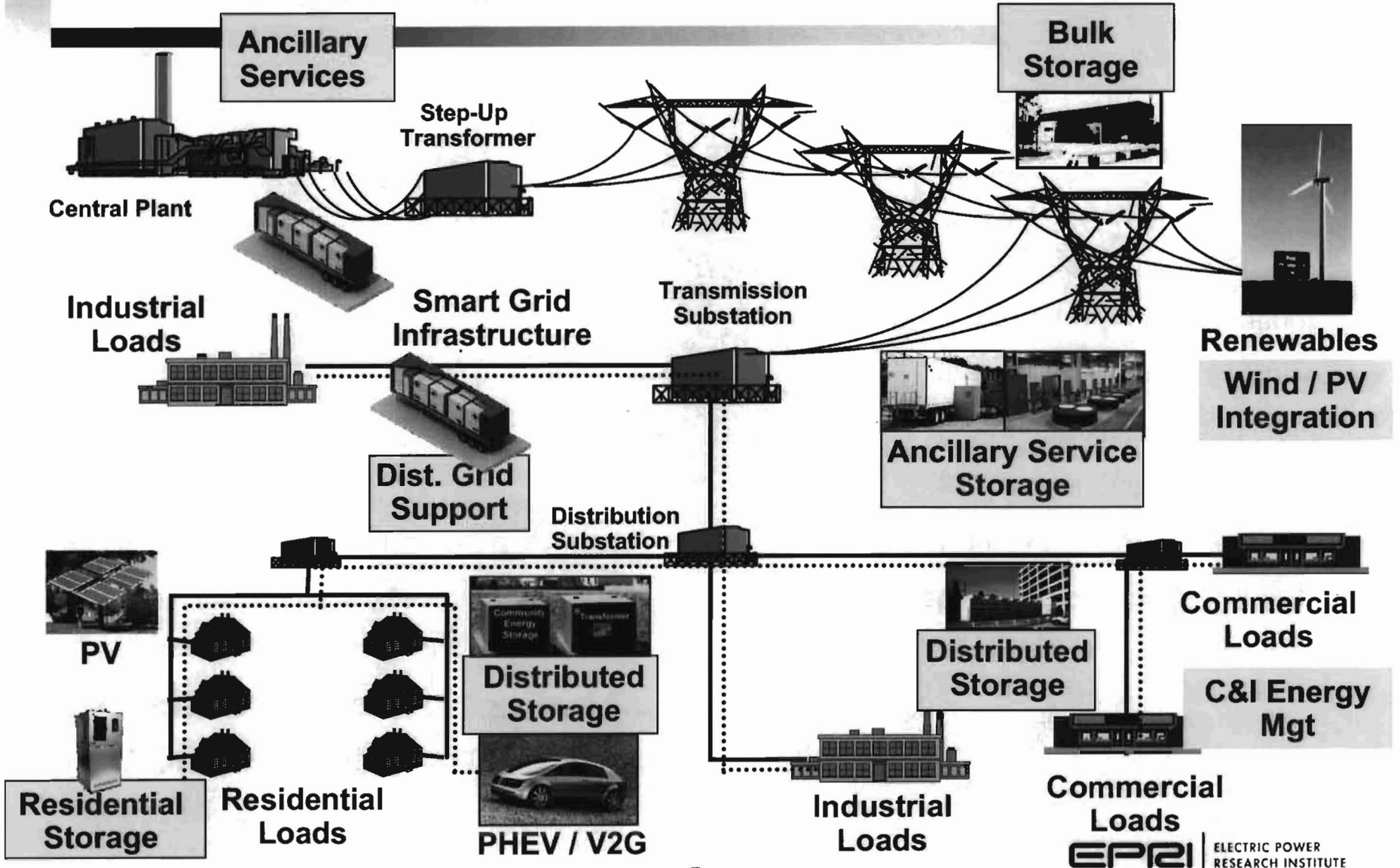
The Role of Energy Storage on the CA Grid

... each location requires different requirements / solution



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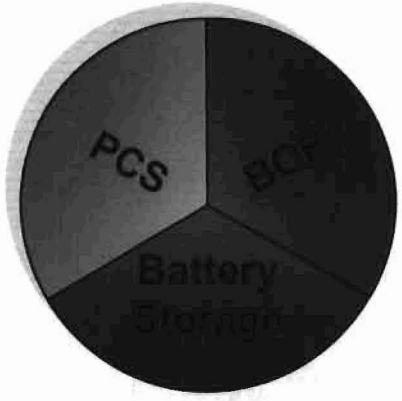
What can be done
Storage must be a complete product...

Power Conditioning System

- DC to AC conversion
- Charging control
- Reactive power management
- Integration point to the grid



Balance of Plant

- Data acquisition and controls
- Thermal management
- Communication and Control
- Physical structure
- Shipping and Installation
- Easy Interconnection

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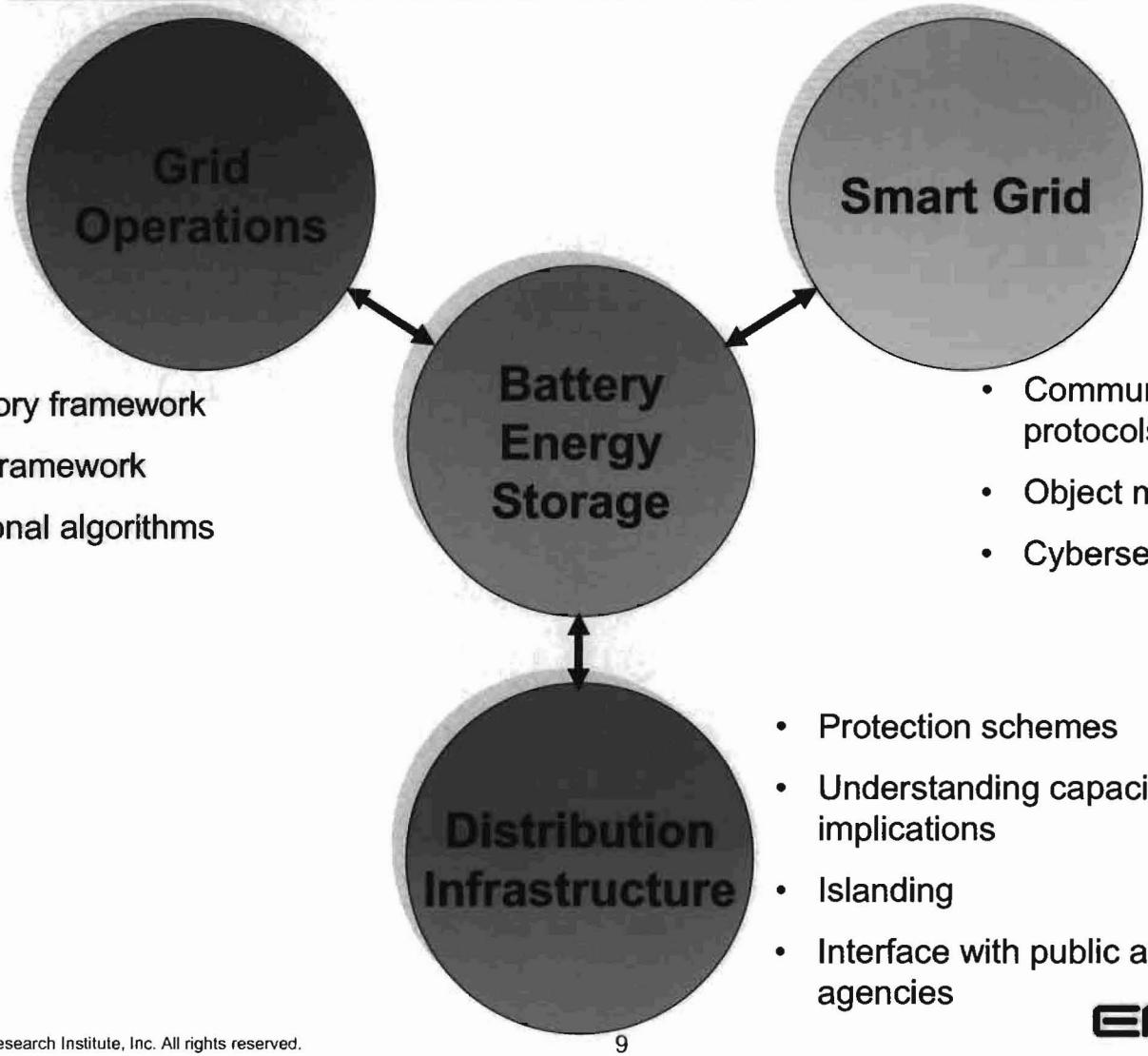
Storage must be integrated with the grid



- Regulatory framework
- Market framework
- Operational algorithms

- Communications and control protocols
- Object models
- Cybersecurity

- Protection schemes
- Understanding capacity implications
- Islanding
- Interface with public and local agencies

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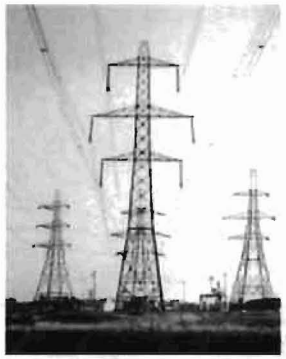
Recommendations for California

" Accelerate and enable a portfolio of energy storage options which are 'grid-ready', cost effective, safe and reliable by 2015."

Focus on Options that solve industry problems:

Renewable Integration	Utility T & D Grid Support	End-User Energy Mgt

Recommendations: Lead the Way for Storage Solutions in CA

- Establish Clear Targets for Safe, reliable, cost-effective, **grid-ready** energy storage solutions
  - Identify where storage brings the most value to CA Stakeholders
  - Specify clearly what the storage system has to do & problem(s) it is solving
  - Test, evaluate, and validate the storage product (s)
  - Determine the effects on the grid: impacts and operational value
  - Assess the true value of storage in real-life application

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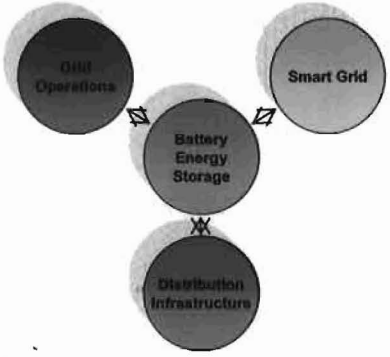
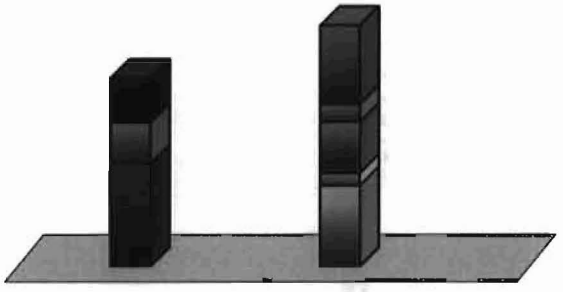
Recommendations for CA

- Productization
  - Functional Requirements
  - Product Integration
  - Validate via: Testing and Evaluation before wide spread deployment
- Grid Integration
  - Ensure Storage Systems are Grid Compliance
  - Demonstrated Use-Cases and Value
  - Tools and Analysis to Determine Grid Effects, optimal locations for storage and Planning
- Uses, Benefits, and Costs
  - Problems Storage is trying to solve
  - Business Cases
  - Applications and Roles
  - Policy to accommodate alternative business models





Recommendations for CA

Energy Storage to Support Wind Integration

- Conduct Integrated California Market and Grid Simulations (Supply, T&D, Demand) under RPS to better define the Role, Location, Optimal Mix of Storage Options which can contribute to CA Policy Goals;
- Use above Analytics to establish a Road Map and Application / Solution (s) for CA which are c ost effective and achieve desired impacts;
- Define Functional Requirements and Technically Specify Storage Solutions / Requirements

Energy Storage to support Load Serving Entities and Communities

- LSE's near and long-term planning to investigate use of storage as part of Smart Grid; Distribution infrastructure support; end-use peak mgt.
- Analysis to assess impacts and operational value
- Analysis of benefits and costs to support business case
- Policy to accommodate cost recovery and alternative business models

Recommendations for CA

- Consider: Storage Services to participants in CA 33% RPS
  - Bundled products – wind + storage
  - Shaping and Storage Services (firming off-peak wind, self-schedules)
  - Dynamic capacity to deal with variability in wind
- Assess Storage Options as alternative to transmission investments
- Asses Storage: Fast response, higher quality MWs
- Assess Storage as option to improve grid reliability
- Consider market based incentives for renewable energy performance
- Assess Storage role in demand side management programs (DR/DSM)
- Peak shaving (reduction of wholesale electricity prices)
- Congestion management (transportable storage assets)
- Deferral of investments in transmission & distribution

Together…Shaping the Future of Electricity