2020 Strategic Analysis of Energy Storage in California

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Presentation Overview

1. Project Overview (Team, Goals, Tasks)
2. Key Findings (Technology & Policy)
3. Contact Info

Project Team

- California Institute for Energy and Environment (CIEE)
- University of California, Berkeley School of Law
- University of California, Los Angeles
- University of California, San Diego

Goals

- Establish 2020 Energy Storage Vision for California
  - Develop scenarios for deploying energy storage
  - Discuss costs and benefits compared to non-energy storage scenario.
- Identify research needs on technologies and applications
- Assist CPUC and other regulatory agencies to create an energy storage roadmap

Project Overview

- <u>Part 1</u>: (A) Technology status review (B) Regulatory and policy review.
- <u>Part 2</u>: Strategic vision of energy storage scenarios over next ten years.
- <u>Highlights value of energy storage to meet future state energy goals</u>

Project Approach

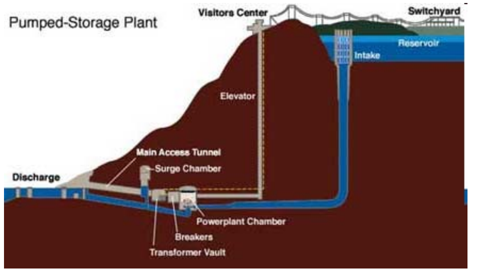
- Survey existing technical and cost data & energy policy documents
- Analyze state and federal policies affecting energy storage
- Identify critical policies by entity responsible
- Analyze feasibility of accelerated deployment by 2015 and 2020 for key applications

Key Findings: Technology

- <u>Electrochemical energy storage:</u>
  - Promising technologies include advanced lead-acid, Li-Ion, Flow batteries
  - Cost reductions needed
  - Safety issues need to be engineered into systems
  - Limited field demonstrations/deployment in utility scale applications

Key Findings: Technology (cont.)

- <u>Mechanical energy storage:</u>
  - Promising technologies include pumped hydro, compressed air, flywheels
  - Some technologies are mature
  - Siting concerns
  - Roundtrip efficiencies
  - High capital costs for pumped hydro and compressed air



Key Findings: Technology (cont.)

- Thermal energy storage:
  - Promising technologies include solar thermal and HVAC applications
  - Mature technologies
  - Application specific - may limit potential for deployment
- Hydrogen:
  - High capital cost
  - Very low roundtrip efficiency
  - Design improvements needed
  - Unproven field experience as energy storage system for grid support

Technology Needs

- Bulk and field energy storage demonstrations for variable renewable energy integration
- Evaluation/demonstration of aggregated storage, especially in Smart Grid scenario
- Cost/benefit quantification in grid applications
- Modeling impact of 33% renewable energy on California's electricity grid

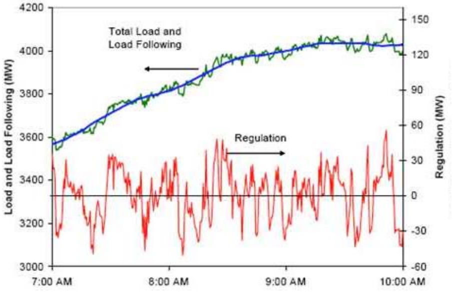
Key Findings: Policy Needs

- Studies indicate 3-4000 MW needed for 33% RPS
- Three exemplary applications
  - Frequency Regulation
  - Renewables Grid Integration
  - Community Energy Storage/ DESS

Promising Applications Analysis

<u>Application 1: Frequency Regulation</u>

- Benefits
  - Reduce (1) regulation capacity needs, (2) reliance on conventional resources and stress on generator equipment, and (3) GHG emissions
- Cost Factors
  - High value market but limited market size
  - Value likely to increase



Accelerated Frequency Regulation Scenario

- FERC, CAISO lowering wholesale market barriers
- CAISO reward speed and accuracy
- CPUC:
  - Long-term contract capability
  - Resource Adequacy (RA) value
  - AB 2514 Targets
  - Monetize environmental benefits

Application 2: Renewables Grid Integration

- Benefits
  - Reduce (1) Need for increased ramping, (2) curtailment, (3) integration costs, (4) T&D capacity expansion, (5) GHG emissions
- Cost Factors
  - Less $ value, but potentially large market size
  - Value streams defined but not all monetized

Accelerated Renewables Grid Integration Scenario

- CAISO PIRP value for forecast & delivery accuracy
- CPUC:
  - RA value or “adder”
  - Impose ramping limits on variable renewables
  - AB 2514 Targets

Application 3: Community Energy Storage (DESS)

- Benefits
  - Utility-side: Distribution deferral; lower variable DG integration costs; local reserve capacity
  - Customer-side: Improved power quality, reliability, and value; outage mitigation
- Cost Factors
  - Potentially high value, may be highly localized
  - Increased value close to high-penetration PV DG

Accelerated Community Energy Storage (DESS) Scenario

- Increasing variable distributed generation
- CPUC interconnection rules
- IOU smart grid plans
- Valuation of distribution deferral
- Avoided DG integration costs
- AB 2514 targets

Key Policy Areas

- Self-generating incentive program (AB 1150)
- Resource Adequacy (RA) program
- CPUC proceedings:
  - Smart Grid
  - Permanent load shifting
  - Demand response
  - Long-term procurement process
  - Alternative fueled vehicle
- Real-time pricing and strong price differentials
- California ISO and FERC opening markets
- AB 2514 Targets (“if any”)

Possible AB 2514 Targets

- Key Considerations
  - CAISO – grid needs under 33%
    - CEC-funded study of grid needs for DR and EES
  - Market design changes under FERC, CAISO
  - Purpose(s) must be well-defined
  - Application-specific and Tiered
- CPUC should begin valuation work early and identify cost-recovery methods simultaneously

Policy Research Needs

- Communication technologies
- Complement demand response technologies
- Impacts of tariff changes at NY-ISO, ISO-NE, PJM, and other grid operators
- Valuation methodology based on best applications

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Thank You