



Integrated Energy Policy Report Staff Workshop Smart Grid Technologies to Support California's Policy Goals

Energy Storage Activities

Prepared for Energy Commission

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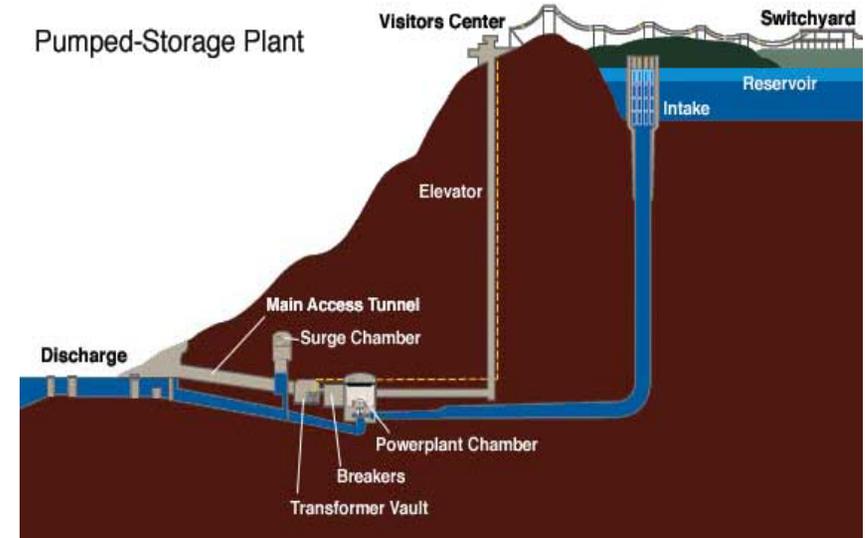
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Our objectives today – Storage activities and relation to California Renewable Energy Goals

- How does Storage fit into Smart Grid and California Renewable Energy Goals?
- Where is Storage going to be utilized – are there gaps?
- What are California Options?
- What steps are required to ensure storage is fully utilized to meet California Policy goals?

Energy Storage – What is the new in an “old” concept?

- Storage concepts have been around for a number of years and utilized in the state of California
 - Pumped hydro is the most common form of storage technology
 - Issue? Geographic limitations make it difficult to be placed where needed most
 - Seasonal unpredictability
- Recently, advancements with emerging storage technologies to provide the potential of making Storage a ubiquitous Smart Grid Tool
 - Where have advancements occurred?
 - Battery, Flywheel Storage Technologies, “Above Ground” Compressed Air Energy Storage
 - Why type of improvements?
 - fast response, multiple cycles, transportability
 - Are all the technologies the same?
 - No, they perform differently but can excel in specific applications

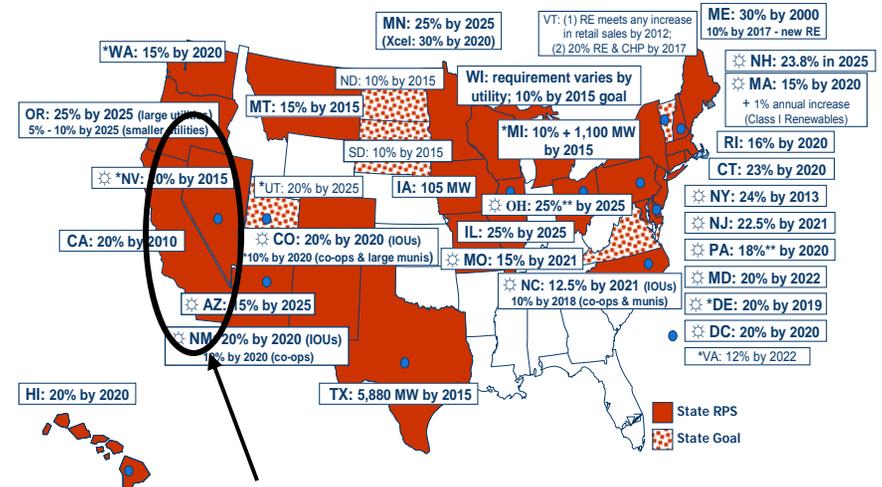
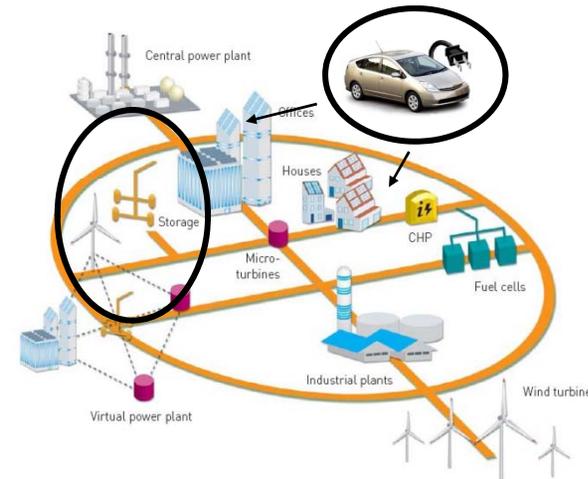


What issues are facing California with increased Renewable Implementation?

- Increased Regulation may be required
 - Variable generation patterns will make it difficult to maintain grid operations and reliability
 - As a solution to the variable nature of renewable generation, it is believed a need for additional regulation will be required on the grid
- Problems around Diurnal Cycles
 - Renewables in California seem to be out of sync with peak demands
 - Wind tend to peak at night, demand peaks during the day
 - Demand peaks are extending past solar availability (2nd evening peak)
 - When renewables are producing energy, they do not always steady generation profile
 - ramping issues from rapid drop-offs
- In each case, ability to capture renewable generation when needed and to “smooth” renewable generation are believed to be essential for increased renewable penetration

Why is Storage being made an integral issue for Smart Grids and Renewables?

- Storage is now considered a tool and component of Smart Grid
 - Chart shows where storage is being utilized in smart grids
- What type of applications is storage being applied to?
 - Integration of Renewables into Grid → can help maintain grid operations with large percentages of wind on the grid **(ramping – diurnal problems)**
 - Ancillary Services → Fast response capabilities allow devices to perform better than current devices **(Increased need for regulation)**
 - PHEVs – Convergence of Electric & Automotive Industries **(can aggregation solve problems)**



Focus for Today

Storage can provide the answer, but work still remains

- Storage is the answer for renewable integration...
...but questions do remain on whether it will be ready for the expected increases in renewable generation
- Why is Storage an answer?
 - Low emission technology that, with some technologies, can be sited quickly and in a “distributed” fashion
 - Alternative to traditional fossil generation plants thus preventing the renewable integration needs from increasing emissions
 - For regulation, this may be a significant issue
- Multiple MWs are going to be required to match the Renewable Policy Goals of California
 - Can the technologies be produced fast enough?
 - The answer to the question is the basis of PIER activity and focus efforts

What are the options available?

- Storage technologies are not equal in capacity capability or performance characteristics → Need to encourage the right technologies for specific applications
- Additional Regulation is believed to be required for 33% Renewable Goals
 - Only requires ability to provide 15-30 minutes of duration
 - Options are readily available in battery and flywheel technologies
 - Beacon Flywheel has been tested in California
 - Lithium-ion (A123 Systems) being tested by The AES Corporation
 - Price is a legitimate concern – but performance characteristics and emission benefits provide compelling motivations for applications



What are the options available?

- Diurnal issues requires technologies that need to be in the 100 MW range
 - Pumped hydro is still a valid option but not easily sited and linked to weather
- Compressed Air Energy Storage offers capability to reach the MW levels to provide solution to issue
 - At large scale (pictured), open to similar siting constraints as Pumped Hydro
 - Also subject to financing difficulties due to nature of underground construction
- Advanced CAES systems being developed by multiple groups
 - “Above ground” systems can eliminate current hurdles

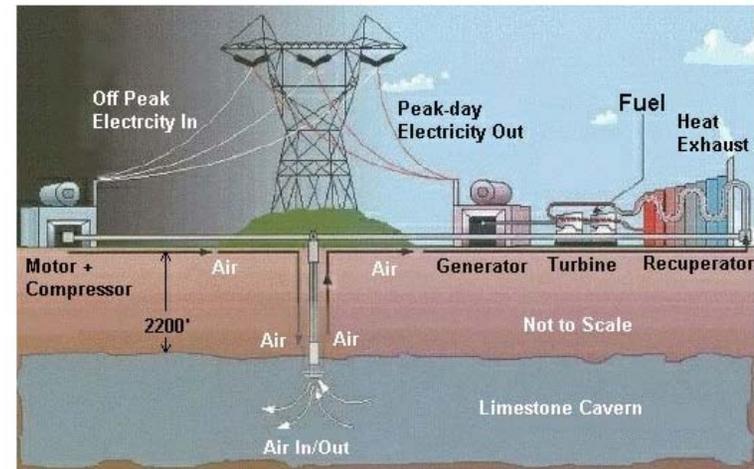


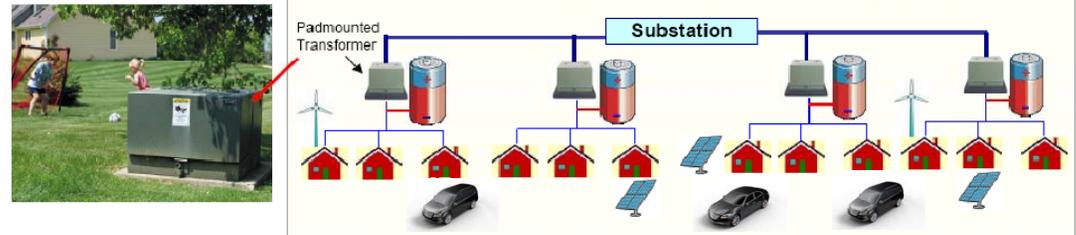
Photo Courtesy of CAES Development Company

What are the options available?

- Aggregated Distributed Applications can be “loads as resources” to help with renewable integration



- Role of EVs and Loads as a resource?
 - Batteries in vehicles are same technologies as utility scale devices
 - Smart Grid is key to the aggregation of devices



- Distributed or Community Storage provides capability to quickly ramp up MW capacity of storage
 - Distributed storage has ability to provide peak shaving capabilities, deferral, and improving reliability
 - Application being proposed for MW scale and kW devices (pictured)

Research Focus Areas for the Energy Commission

- **Vision:** *Storage throughout the electric infrastructure to support renewables penetration in terms of reliability, economics, operations, and deferred capital. Appropriate Storage technologies are integrated in light of applications*
- **Research & Development Focus Areas**
 - Modeling and analysis to determine how much storage is required/necessary to support California renewable goals
 - What role will storage play in helping the state achieve zero net energy residential and commercial new construction
 - What are appropriate regulatory, market, and incentive treatments to encourage storage in support of renewables
 - Identifying the control technologies and algorithms necessary to ensure storage can seamlessly work with Wind, Solar, and Grid requirements when integrating CA renewables to the electricity grid
 - Continued investigation of emission benefits of storage technologies – i.e. Commercial & Industrial uses
 - When Storage is used in a multi-purpose application (as at a substation), how to allocate costs and benefits for cost recovery

How to allow increased application & concepts to participate in California Markets

- Question: What can Stakeholders do to increase storage applications?
 - Seems each day, greater understanding of capabilities of storage
 - That is leading to more ideas on how to apply storage
- Manufacturers are rapidly entering this market place
 - California is currently testing with storage manufacturers on applications
 - Additional players from Defense, Satellite, and moving of “Asian Manufacturing” to the U.S. are all occurring simultaneously
- What is required to encourage this evolution
 - Let the manufacturers build the products that are necessary
 - Provide them the specifications – predicted requirements – to enable them to build what is required
 - Markets will work...if there is an opportunity, numerous suppliers will look to fill space → Currently happening in the U.S.

Additional Means to Remove Barriers to Storage Implementation

- Areas where additional focus will help pave the road for increased implementation of storage technologies
- These focus areas are:
 - Education
 - Standards
 - Testing
 - Grants
- Storage needs to focus on getting products into the field, demonstrated, and advanced. Requirements need to be made in order for additional players to participate in market opportunities

Creating Standards for Developers

- Manufacturers and developers are more than willing to get devices implemented into the field
 - For emerging technologies that have started small, experience is with “behind the meter” back-up applications
 - As applications increase to utility-scale, interconnecting at the transmission level requires a new set of standards for interconnection and safety
- For end-users, how do we classify the products?
 - Standards for labeling capacity? Duration? Energy?
 - Standards for performance testing so end-users know the unit they are receiving is meeting its performance standards?
- On the horizon, what to classify the device as also has implications
 - This issue will take time and effort to sort out in a manner that pleases all stakeholders

Increased Testing is Required

- Rapidly increasing interest in storage has the potential for devices to outpace testing
 - This may occur with life-cycle testing, safety, and performance
 - Additional issues may occur with technologies being applied to different applications
 - Applications may be able to perform in roles not envisioned by stakeholders or may be pushing “envelope” of their capabilities
 - Transparent testing of devices is required when an industry like storage is at an early stage
 - Data needs to be shared by all states
 - Hawaii? New York? Massachusetts all have projects in addition to California
- This issue is taking on more importance as storage devices – including many emerging technologies – are being considered as solutions to problems the grid will be facing as well as a necessary component to Smart Grids
- Efforts need to be initiated to create testing protocols for specific applications as well as increased efforts to test the technologies

Questions

Thank you for your time

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