

Storage: Is It Finally Coming of Age?

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Powering forward. Together.



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SMUD General Information

Energy Sales & Peak Demand

- \cong 11,000 GWh & 3,300 MW

Service Area

- County of Sacramento, plus a small part of Placer County (\cong 900 square miles)

Total Customers

- \cong 610,000 meters
- \cong 1.4 million residents
- 6th Largest Consumer-Owned Utility in U.S.

Generation

- Natural Gas-Fired
- Hydro – the Upper American River Project
- Wind & PV

Market Access

- Power Transmission Access to the Northwest
- Interconnection to CAISO Power Market
- Natural Gas Pipeline from Canada to the San Juan Basin

IRP Preferred Plan

Need for continued Flexibility and Adaptability

SMUD Board
Storage Policy
(SB2514)

New and Emerging Technologies - SMART GRID, DG, storage, EV, Grid, etc

New and Emerging State and Federal Policies - GHG, RPS, Competition, Electrification, Carbon Markets, Retail Rates, etc



Develop Portfolio of Renewable and local Capacity Resources - Pumped Hydro, Conventional, DR, advanced PV controls

Portfolio of capacity projects on line DR, pumped storage, recips

Longer Term capacity projects on line - Pumped storage, distributed storage, DG, EV, CAES, new or emerging, etc.

New transmission projects and/or Interconnections constructed

Declining fossil fuel usage/emissions in SMUD's natural gas fleet

New Energy Efficiency Technologies, renewables or carbon free resources meeting and maintaining GHG and RPS Policies



Hydro Storage Objectives

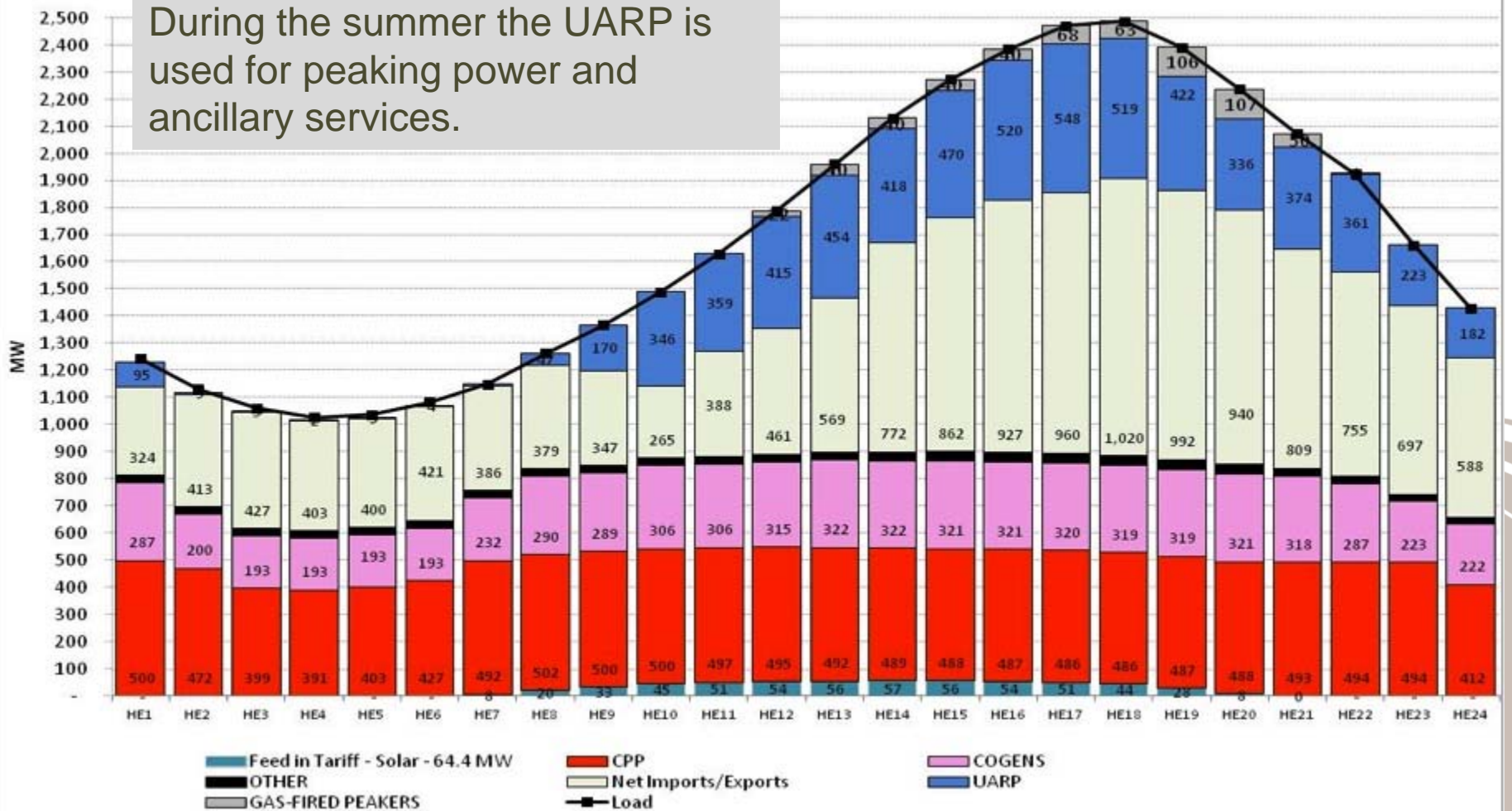
- ❖ Comply with FERC license requirements
- ❖ Support Reliable Electric System Operations
- ❖ Maximize Value for Customer-Owners



*Ice House Reservoir - 5,450 ft

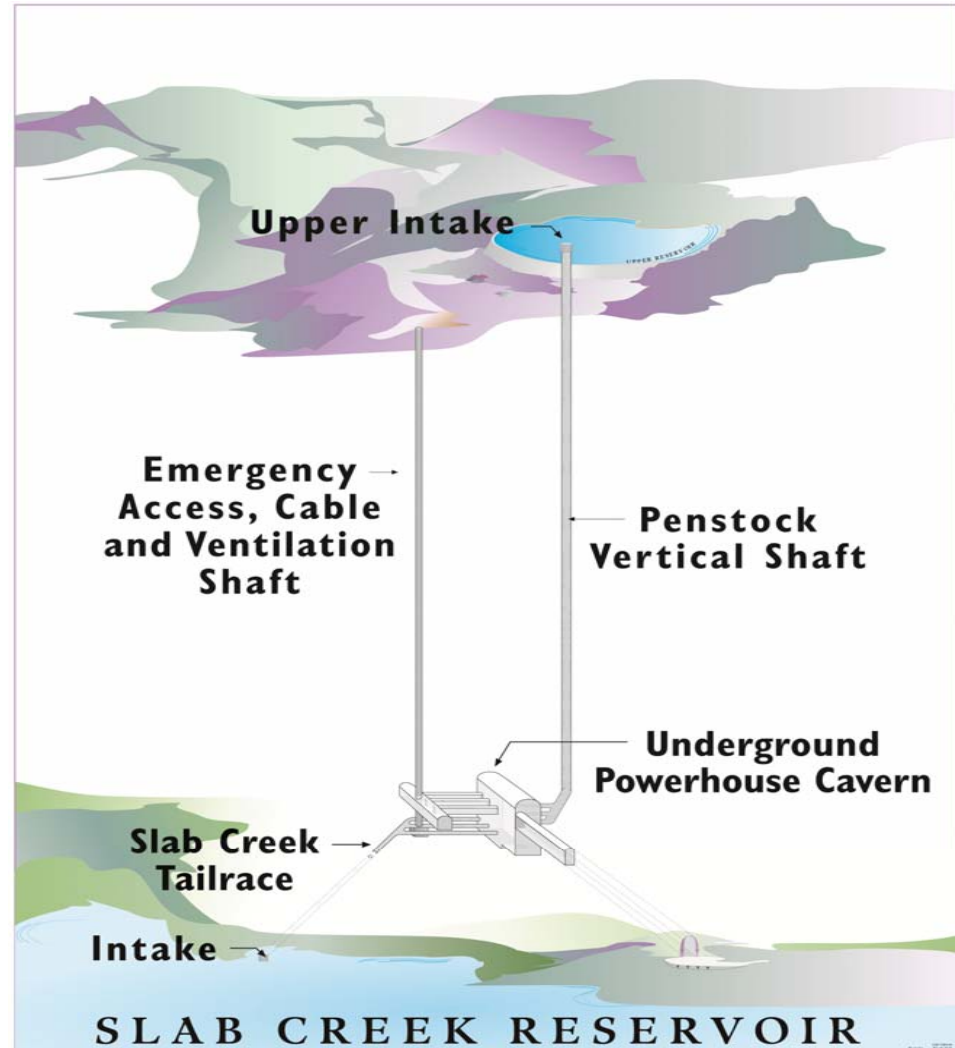
UARP - SMUD's Primary Source of Flexible Capacity

During the summer the UARP is used for peaking power and ancillary services.



Iowa Hill Pumped Storage Project

- Integrated into existing UARP facilities
 - Existing Slab Creek Reservoir will serve as lower reservoir
 - Gen-tie to existing UARP transmission line
- New upper reservoir atop mountain with 6,400 af storage
- 400 MW Capacity, with three adjustable-speed turbines
- All generating/pumping facilities will be underground



Iowa Hill Pumped Storage Project

DOE Wind and Water Power Program Grant

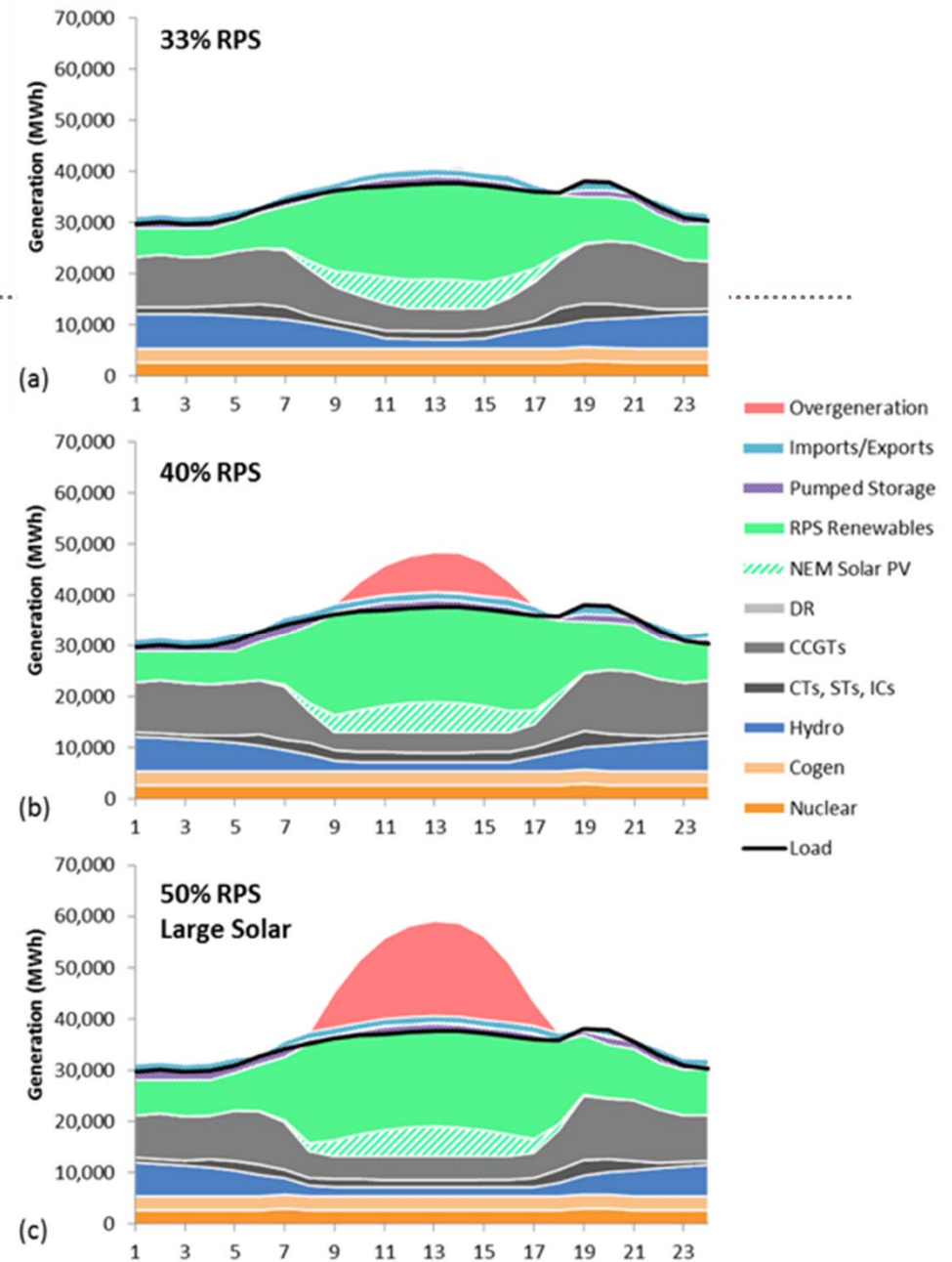
- \$5M Grant awarded in 2011
 - Exploratory geotechnical Investigation
 - Value Stream Modeling Analysis
- Modeling has quantitatively demonstrated significant value of Iowa Hill to ancillary services, resource adequacy, and other values
- Geotechnical Investigation, to date, has shown strong rock in mountain that will support underground construction and operation

Statewide Energy & Climate Policy Impacts

- Statewide carbon reduction goals of 80% carbon reduction below 1990 levels by 2050 a key overall resource driver
- Complementary policies including cap and trade, renewable portfolio standards, energy efficiency goals, rooftop solar, zero emissions vehicles, tailpipe standards, low carbon fuels and transportation planning, as well as others, were implemented to reduce statewide emissions to 1990 levels by 2020.
- Longer term targets require more aggressive decarbonization efforts. The CA legislature has been entertaining a bill to require 51% of the state's energy to come from renewable sources

Utility 50% RPS by 2030 Study

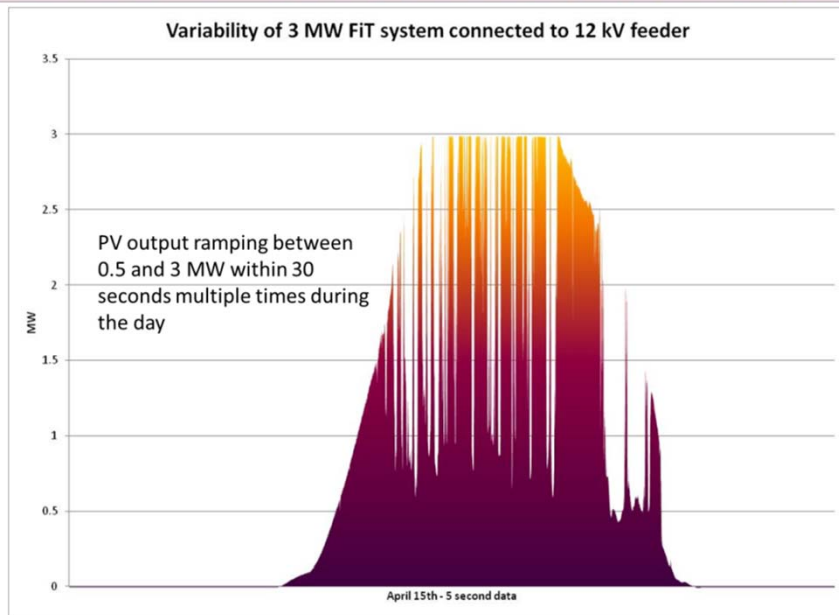
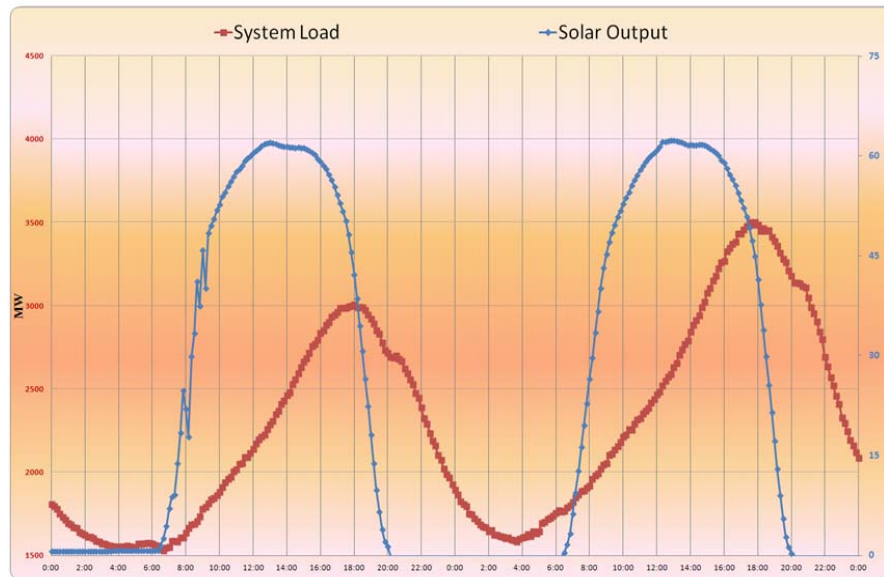
- Examine operational impacts of a 50% RPS in 2030
- Multiple renewable energy portfolio scenarios
- Renewable energy curtailment became lowest cost integration approach, with curtailment occurring in up to 23% of the hours in centralized solar case.



50% RPS Study Continued

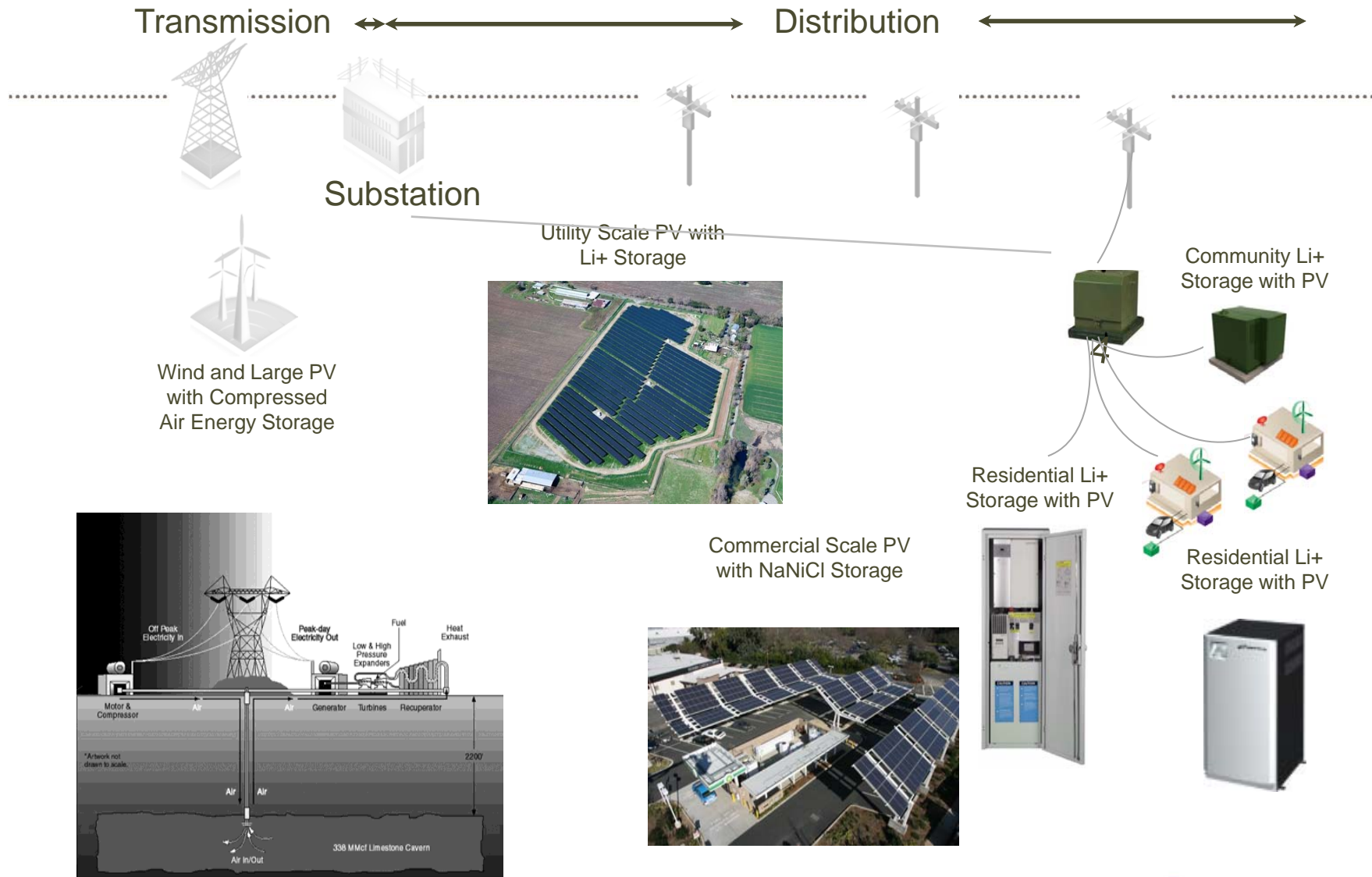
- Generation flexibility, and availability of energy storage and dispatchable loads were critical aspects of lower cost renewable integration scenarios
- The total amount of cumulative investment by the electric sector, *without substantial storage investment*, is between \$50 – 100 Billion out to 2030
- Storage, regional coordination, and DR scenarios were examined which indicated potential reductions in integration costs

Distributed Storage: Mitigation Strategy For High Penetrations Of PV and Wind



- SMUD will need bulk **and** distributed storage in long run
- SMUD R&D addressing: What kind? How much of it? When? Cost?
- Pursuing multi-pronged approach:
 - Understand storage technologies
 - Determine benefits to SMUD
 - Modeling and Analysis: assess value of storage technologies deployed at high value sites on the T&D system
 - Conduct distributed storage system demonstrations, monitoring performance and cost effectiveness
 - Prepare SMUD for energy storage utilization and AB2514 Procurement Plan

SMUD Storage R&D Portfolio



Implications for IRP

- Expectation that IRP will need to continue to push towards decarbonization
- Variety of strategies appear to be lowest cost, still significant uncertainty about future integration costs and market implications
- Opportunities for energy storage, though substantial barriers to deployment at scale including both capital and market

<https://www.smud.org/en/about-smud/company-information/innovation/>

