



CUSTOMERS FIRST

Energy Storage Project Development

NWHA - 2019 Annual Conference Confirmation

February 21, 2019



Agenda

Background

Importance of Energy Storage

Renewable Curtailment Challenges

Project Objective

Castaic Power Plant

Project Parameters and Considerations

Physical Constraints

Conceptual Proposal

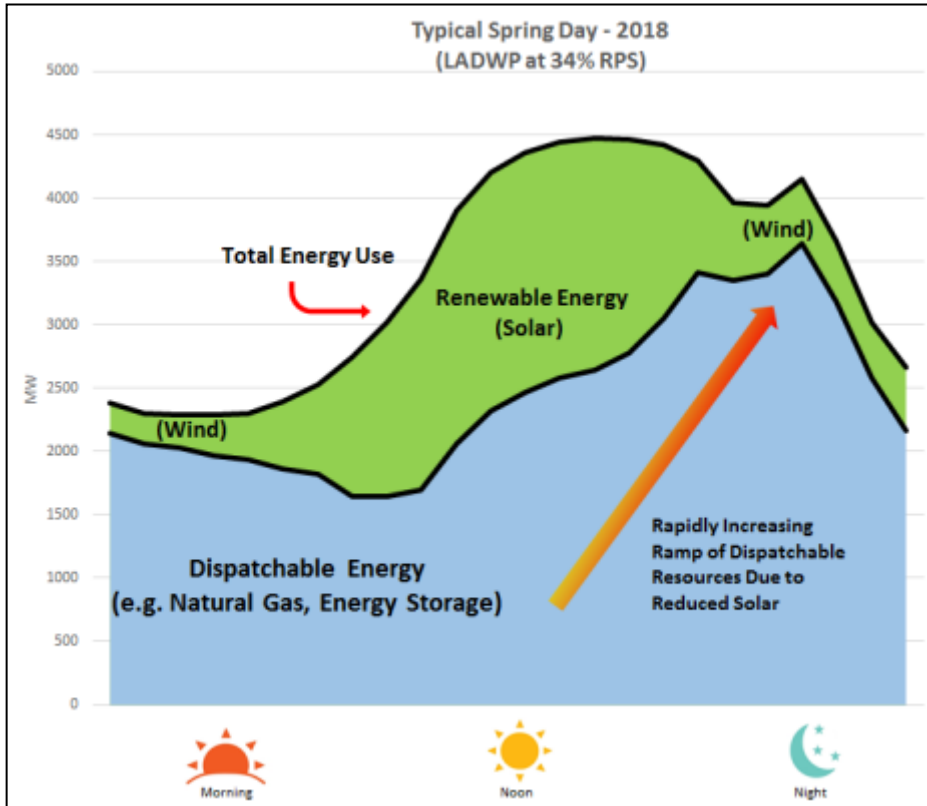
Diversity of Energy Storage

Background

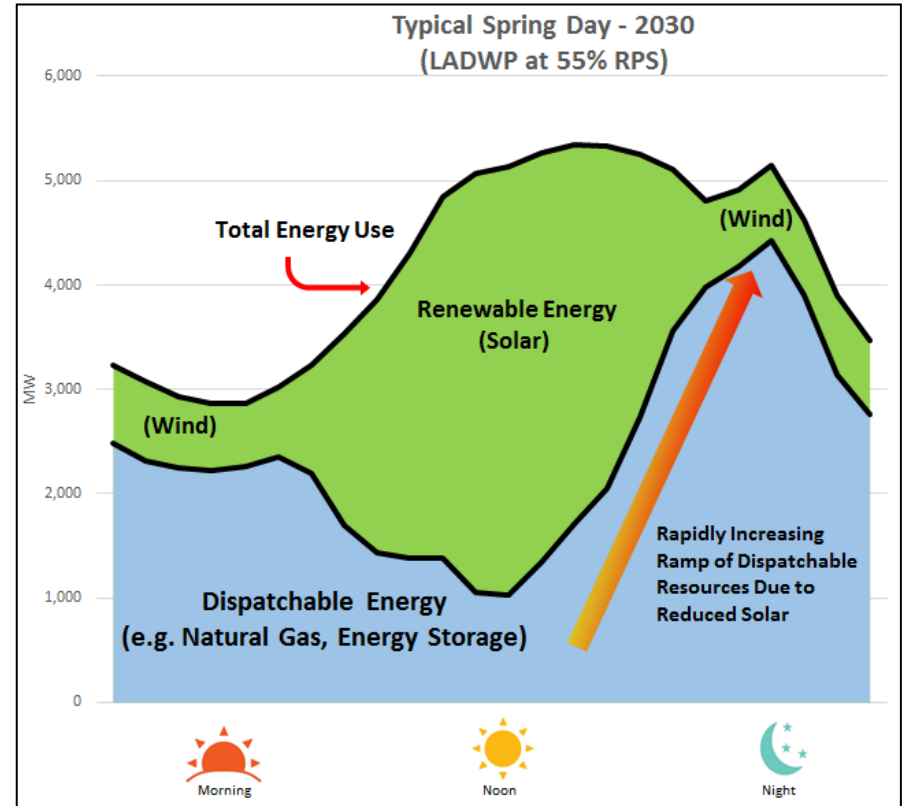
- California mandated RPS generation goals (33% by 2020, 50% by 2030, and 100% by 2045)
- These goals are creating significant amounts of excess solar and wind energy.
- While LADWP has deployed batteries as one of several energy storage options, hydro-based Pumped Storage is a proven technology that can be cost effective and potentially less environmentally impactful.
- To date, LADWP has installed two pilot battery projects. The larger of the two has a total cost of \$30M.

Importance of Energy Storage

Current



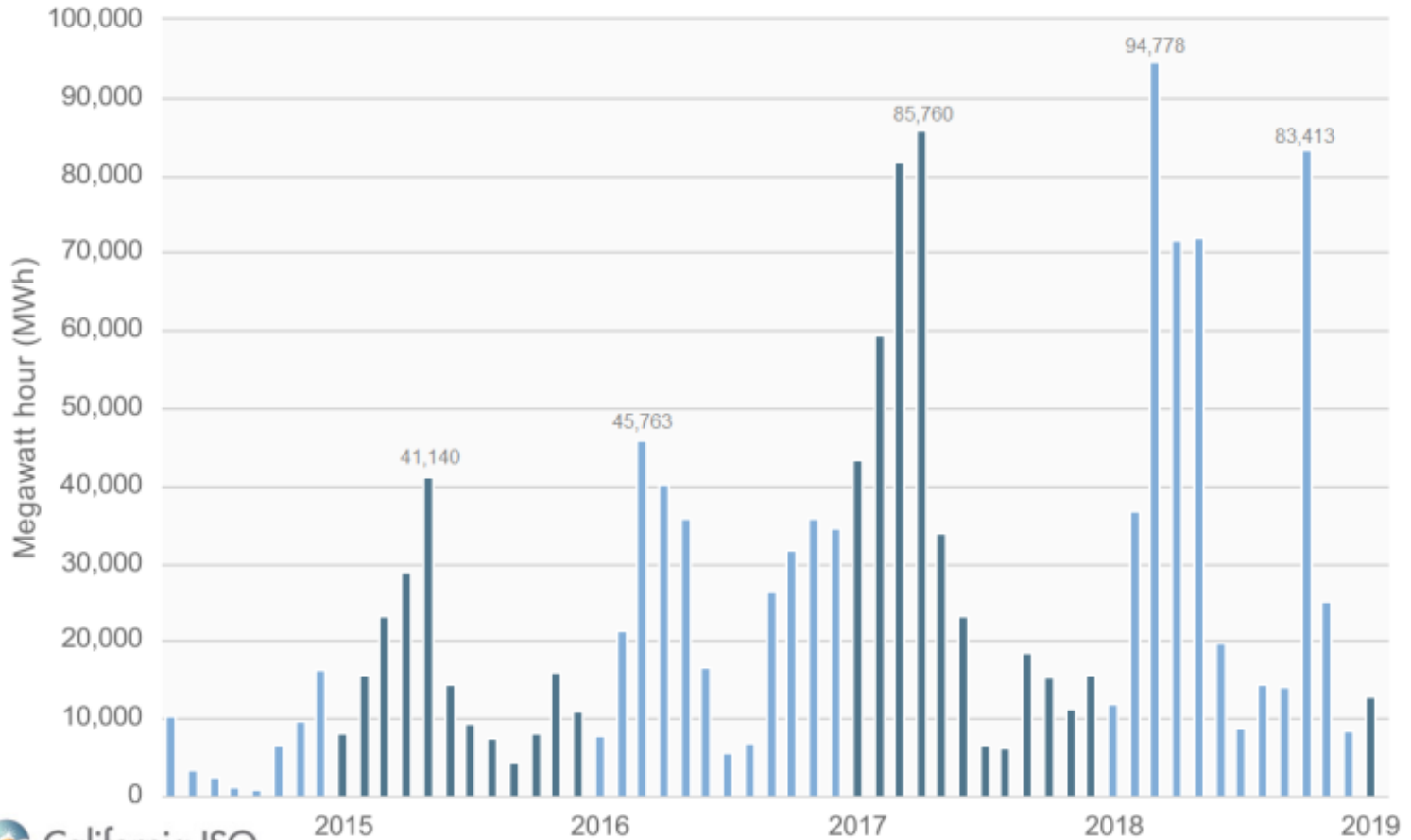
Future



California

Renewable Curtailment Challenges

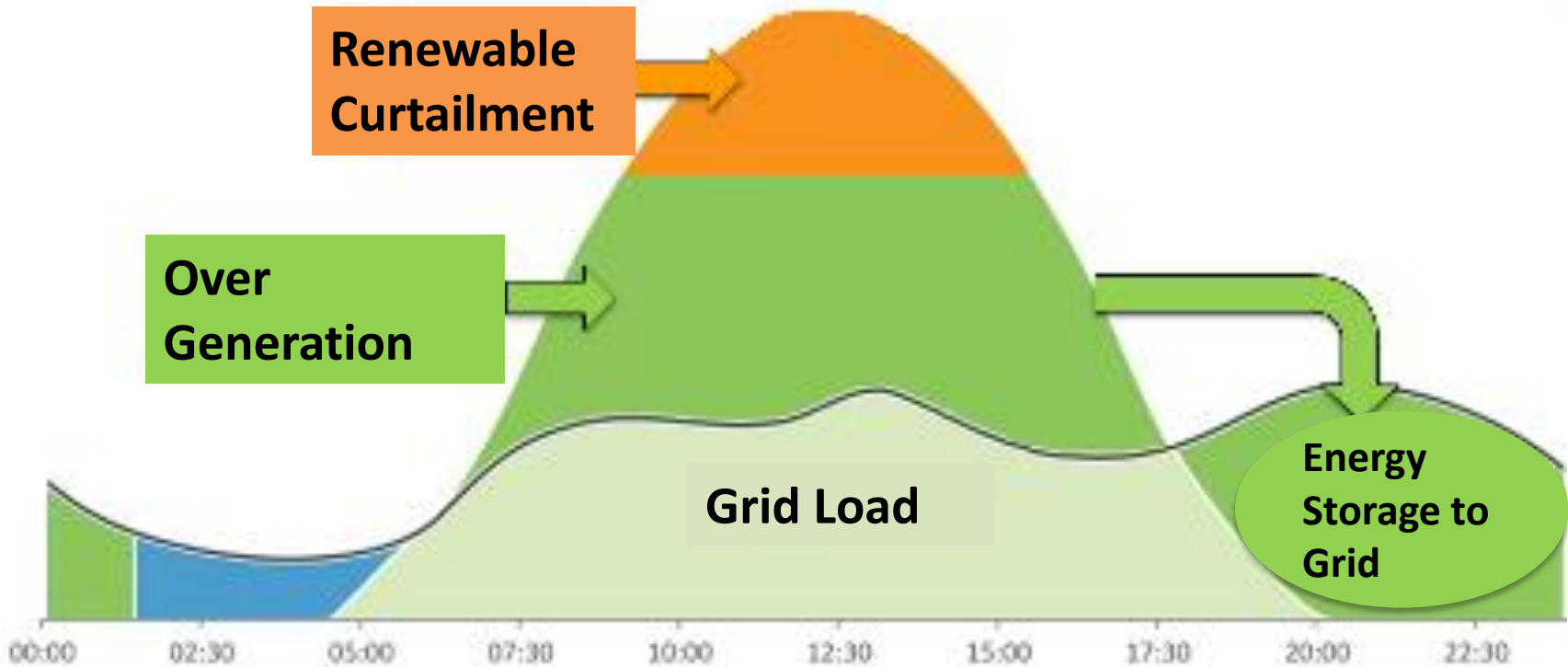
Wind and solar curtailment totals by month



California ISO

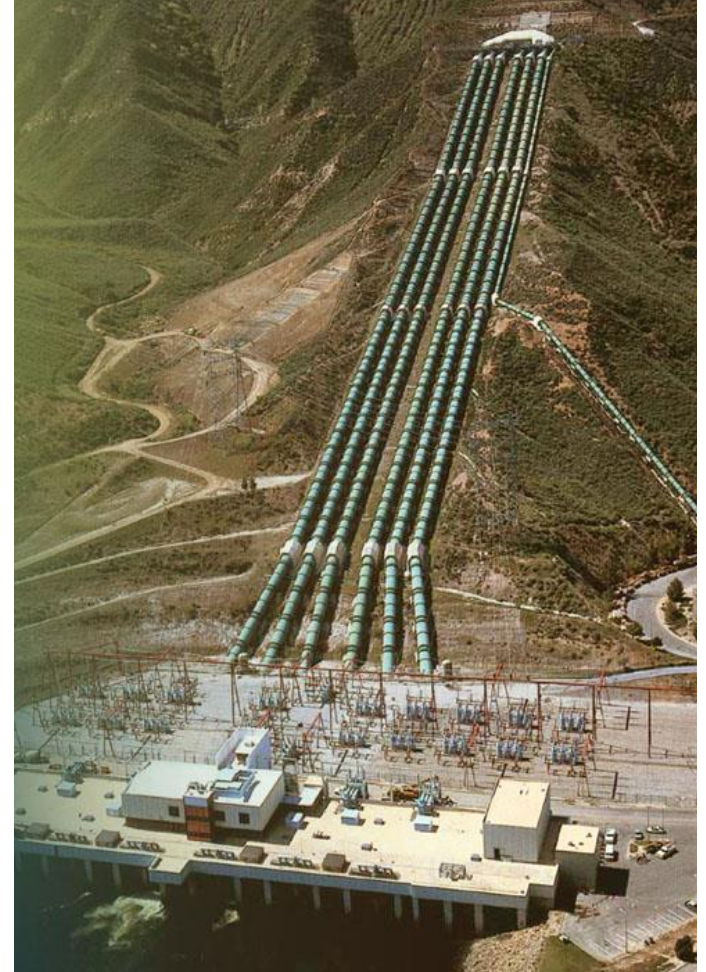
Project Objective

Cost effectively store energy, using over generation from solar and wind as well as “off-peak” energy.



Castaic Power Plant – 1250 MW

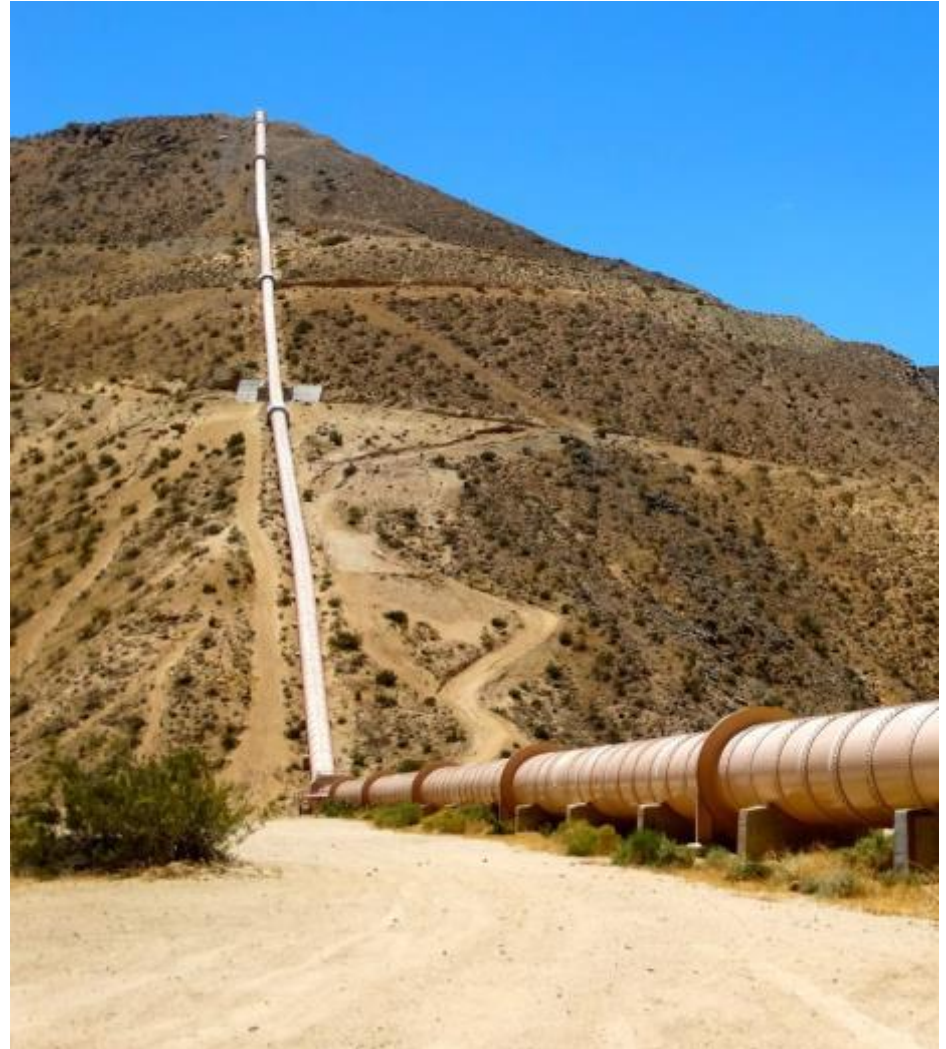
- Castaic is sited on west branch of California State Aqueduct
- The Project is a cooperative venture between LADWP and the California Department of Water Resources (DWR)
- Castaic was developed to help follow LADWP system load and provide for spinning reserve requirements



Project Parameters and Considerations

- Roundtrip Efficiency

- Tunnel losses
- Existing generation
- Unit Losses(New Equipment)
- Booster Pumps
- Recovery generation



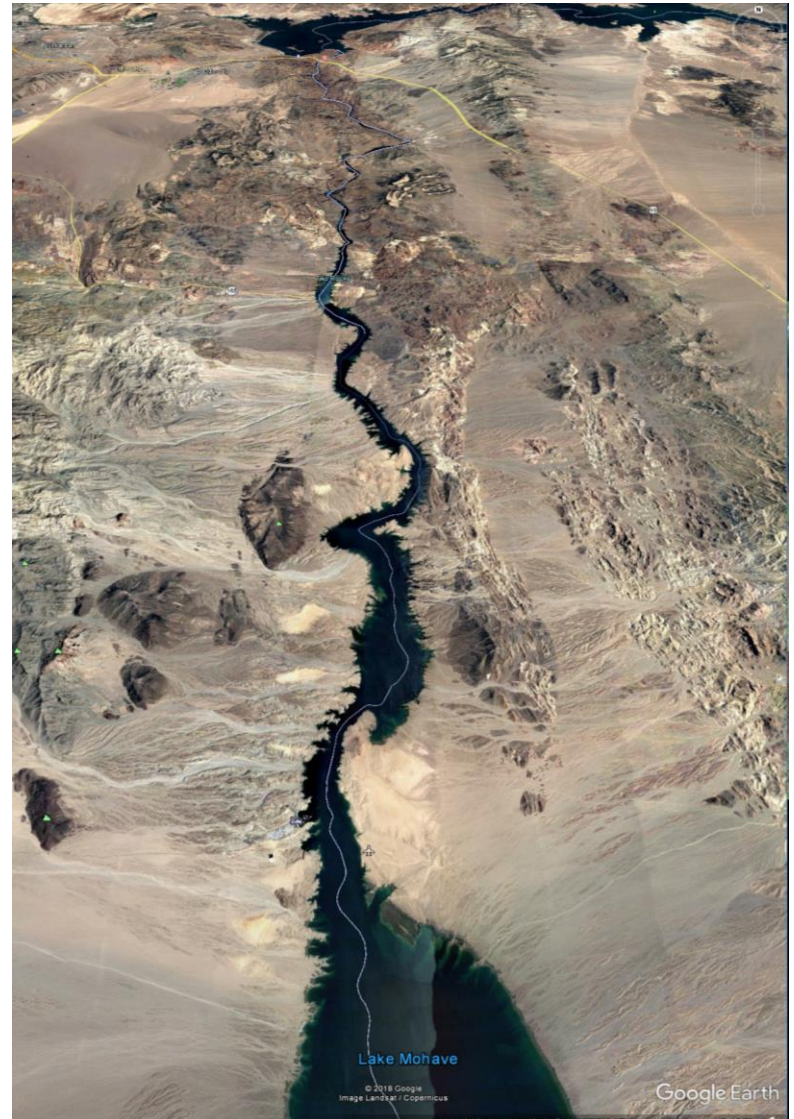
Project Parameters and Considerations

- **Cost Effective**
 - Pay Back Period (50 year asset)
 - Cost Drivers (Steel for the penstock)
- **Facility Sizing**
 - Capacity for pumping (MW)
 - Energy to be stored (MWh)
 - Transmission & Main Banks



Physical Constraints

- Topography
 - Site Accessibility
 - Visibility of construction
- Bathymetry
 - Water Depth
- Hydrology
 - Hydraulic Modeling
 - Lake level fluctuation
 - Water deliver schedule



Conceptual Proposal

*Existing Contract: Valid through Sept. 2067

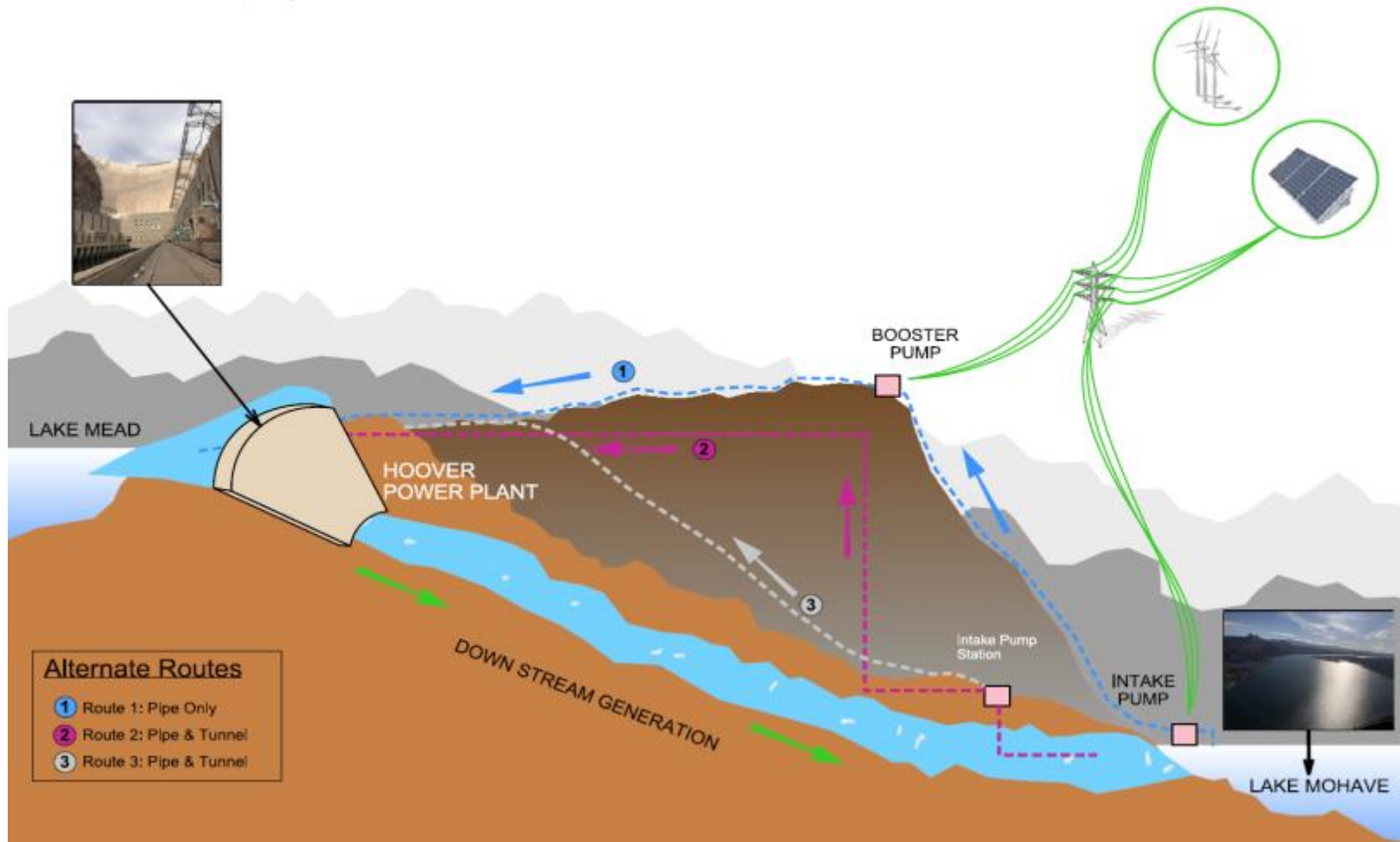
*Operating Agent: USBR / WAPA

*Hoover Dam Plant Capacity: 2074 MW, LA's share: 496 MW



Boulder Canyon Pumped Storage Project

Conceptual Design Alternatives



Diversity of Energy Storage

Current Energy Storage Project Evaluations

- Pumped Storage
- Battery Energy Storage Systems
- Compressed Air Energy Storage (CAES)

