

DOCKETED

Docket Number:	15-MISC-05
Project Title:	2015 Bulk Storage Workshop
TN #:	206691
Document Title:	Presentation - Pathway to Delivering New Pumped Storage to California
Description:	Swan Lake North Bulk Storage Presentation
Filer:	Collin Doughty
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	11/19/2015 10:15:32 AM
Docketed Date:	11/19/2015



PATHWAY TO DELIVERING NEW PUMPED STORAGE TO CALIFORNIA

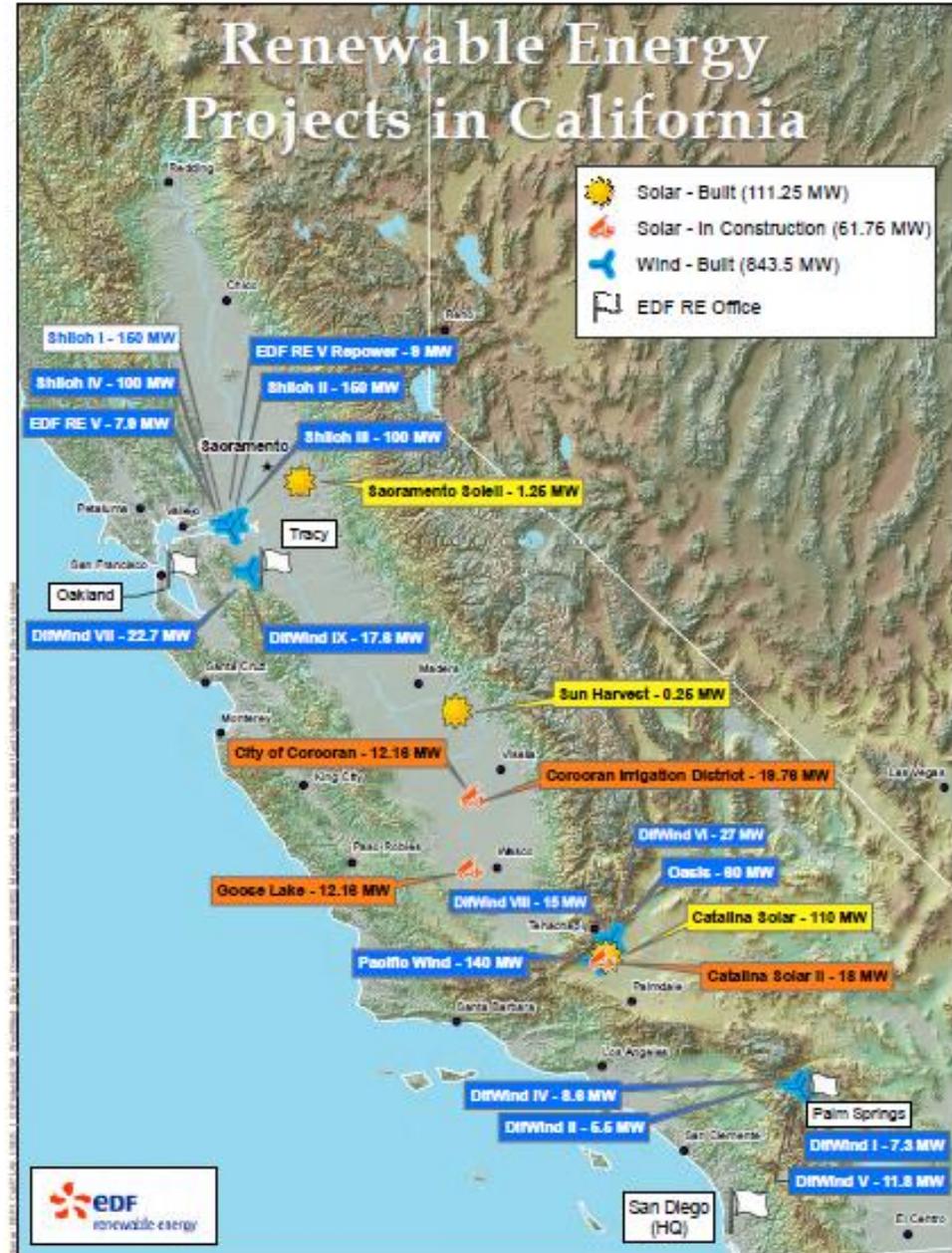
*CPUC/CEC Bulk Storage Hearing
November 20, 2015
Sacramento*

Swan Lake North



EDF in California

- Leading North American developer and operator of renewable projects
- Born in California and headquartered in San Diego, with offices in Palm Springs, Oakland, and Tracy
- 396 employees in California plus many vendors and contractors
- Over 1,000 MW of wind and solar developed in California
 - San Joaquin Delta wind
 - Central Valley solar
 - Tehachapi wind and solar
 - San Geronio solar



EDF Group Pumped Storage Hydropower Experience

- ✿ Developed 23,000MW of pumped storage hydro projects globally
- ✿ 1,000 employees at our Hydropower Center for Excellence
 - Over 600 engineers devoted to hydro development specialties and operations
 - Headquartered in Chambéry, France
- ✿ Developed and constructed 2 “sister” projects in the last 5 years (Morocco and Israel) with the same engineering characteristics as the proposed Swan Lake North project here in the WECC
- ✿ Experience with most up-to-date technology
 - Including variable-speed turbines
 - Optimal conveyance systems
 - Currently, retrofitting older fixed speed units in France with new variable-speed turbines
- ✿ Developing one of the most advanced pumped storage hydro projects in the USA as Swan Lake North



SWAN LAKE NORTH
pumped storage hydro 

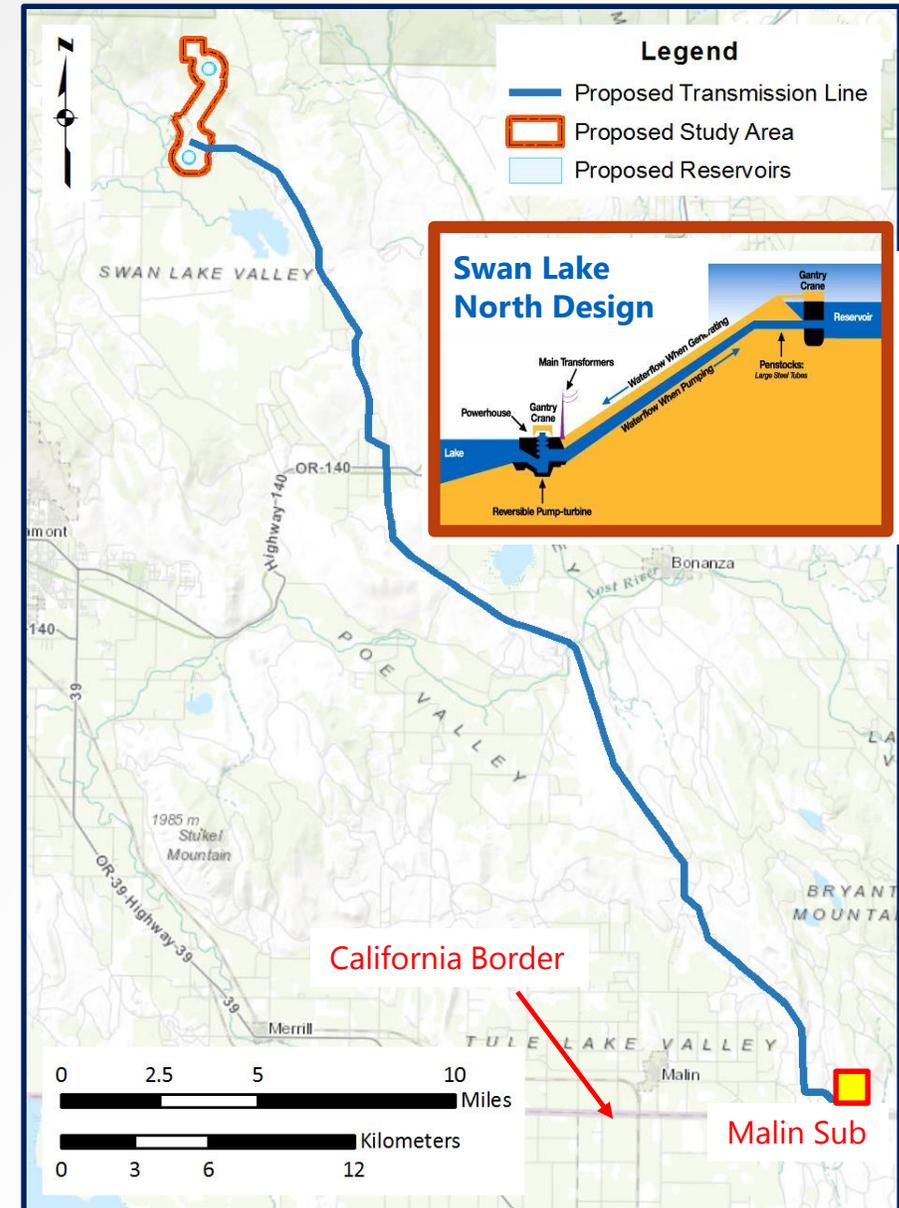


SWAN LAKE NORTH

pumped storage hydro

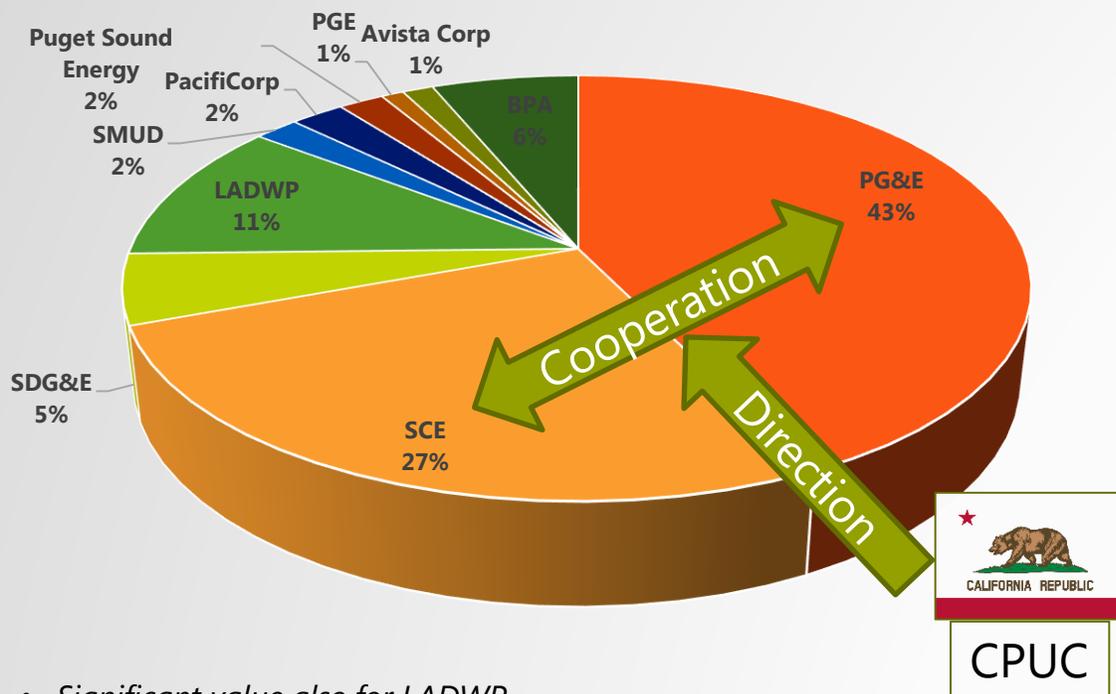
project characteristics

LOCATION	Approx 11 miles NE of Klamath Falls
CAPACITY	393.3 megawatts (MW) Generation Mode 415.8 MW Pumping Mode
PROJECT HEAD	1,680 feet
PROPERTY	Private & BLM
WATER AVAILABILITY	Leased groundwater rights, preliminary OWRD approval
TRANSMISSION ACCESS	At Malin Substation; near COB market; PacifiCorp or BPA with access to CAISO
CLOSED-LOOP SYSTEM	New upper and lower reservoirs No impact to existing water ways Initial fill and evaporation makeup from existing ground water wells
FACILITY DESIGN	Above ground powerhouse and penstock



Value for many, procurement by _____?

PG&E & SCE receive 70% of the modeled grid value



- Significant value also for LADWP
- Top 3 benefactors receive 81% of the value for Swan Lake North.
- This is a project for California.

Any LSE not involved
in procurement
is a potential Free Rider.

Key assumptions of economic modeling using PLEXOS

- Pie chart represents both LSE specific intrinsic and extrinsic benefits
- Production cost modeling software for year 2022 (first year of operations after COD)
- Same planning dispatch model used by CAISO and major LSEs
- Includes linear track to the 50% CA-RPS as per SB350 (~36.4% installed in 2022)
- Includes 1,325 MW of mandated CA storage

Installed cost of \$1,775/kW

PSH economics cannot support large Free Riders.
Joint cooperation and procurement is necessary
with direction by CPUC.

Procurement Pathways for Bulk Storage

- ❁ LTPP analysis of primary bulk storage technologies as part of low-carbon, high-reliability, low-rate portfolio (i.e., as a part of “the other 50%”)
 - Role for longer-duration storage?
 - Acknowledgement and quantification of multiple reliability and system attributes in making determination for authorization – i.e., do not wait for individual markets for each attribute to materialize given high complexity
 - Valuation of GHG value relative to other flexible resources
- ❁ If deemed prudent, then authorization from CPUC to IOUs to procure based on proportional benefits
 - Joint investment and joint operation
- ❁ Competitive procurement based on price, net of GHGs, and viability
 - Viability controls important for long lead-time projects
 - Viability in light of technology maturity, project-specific risk, and developer-related risk



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