

# Pumped Hydro Analysis

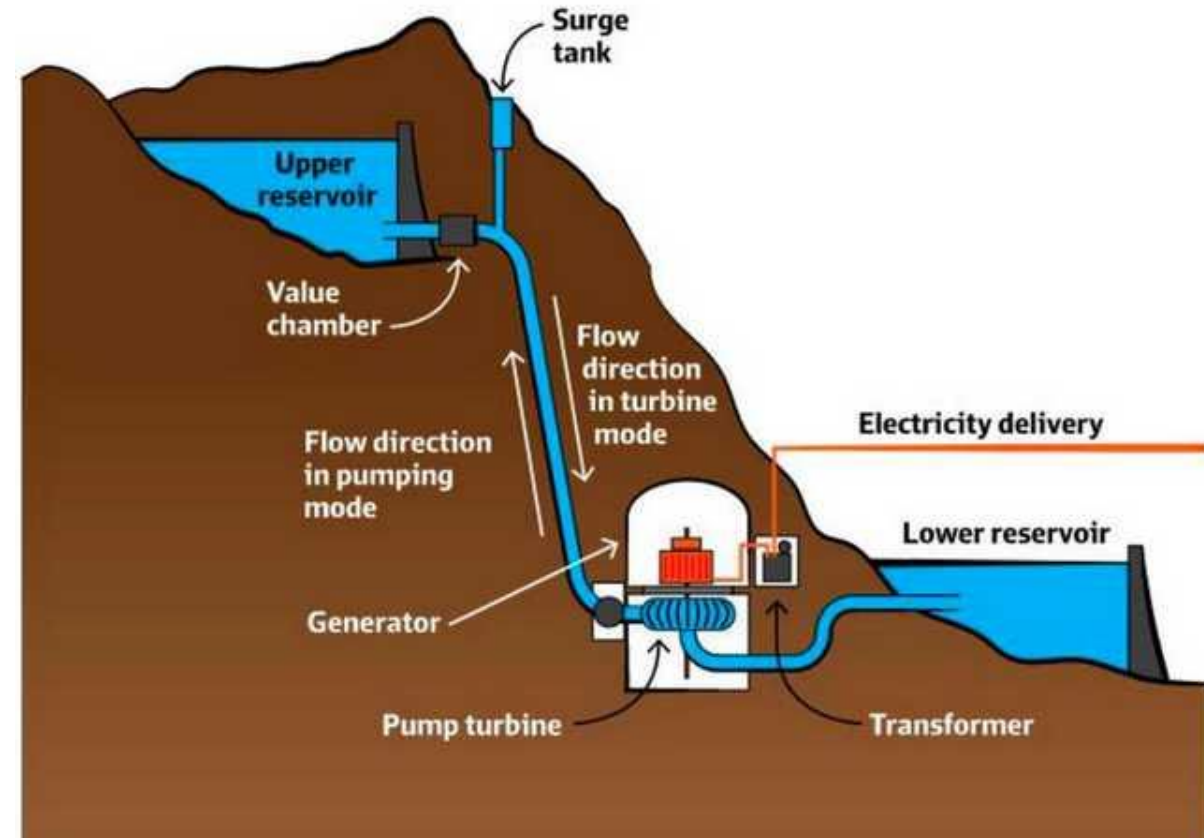
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# 2016 FER Strategic Policy

Explore feasibility (including access to present DOE/LANL lands) and estimate costs of pumped hydro storage somewhere within Los Alamos County

# Pumped Hydro

Energy is used to pump water to higher elevation  
Water is released through a hydroelectric turbine to generate electricity when needed



# Pros

Simple, mature technology

Minimal storage losses

70-80% round trip efficiency

Resiliency if locally sited (microgrid)

Fast Response

Long Lifespan

Storage of renewable energy

# Cons

Low energy density

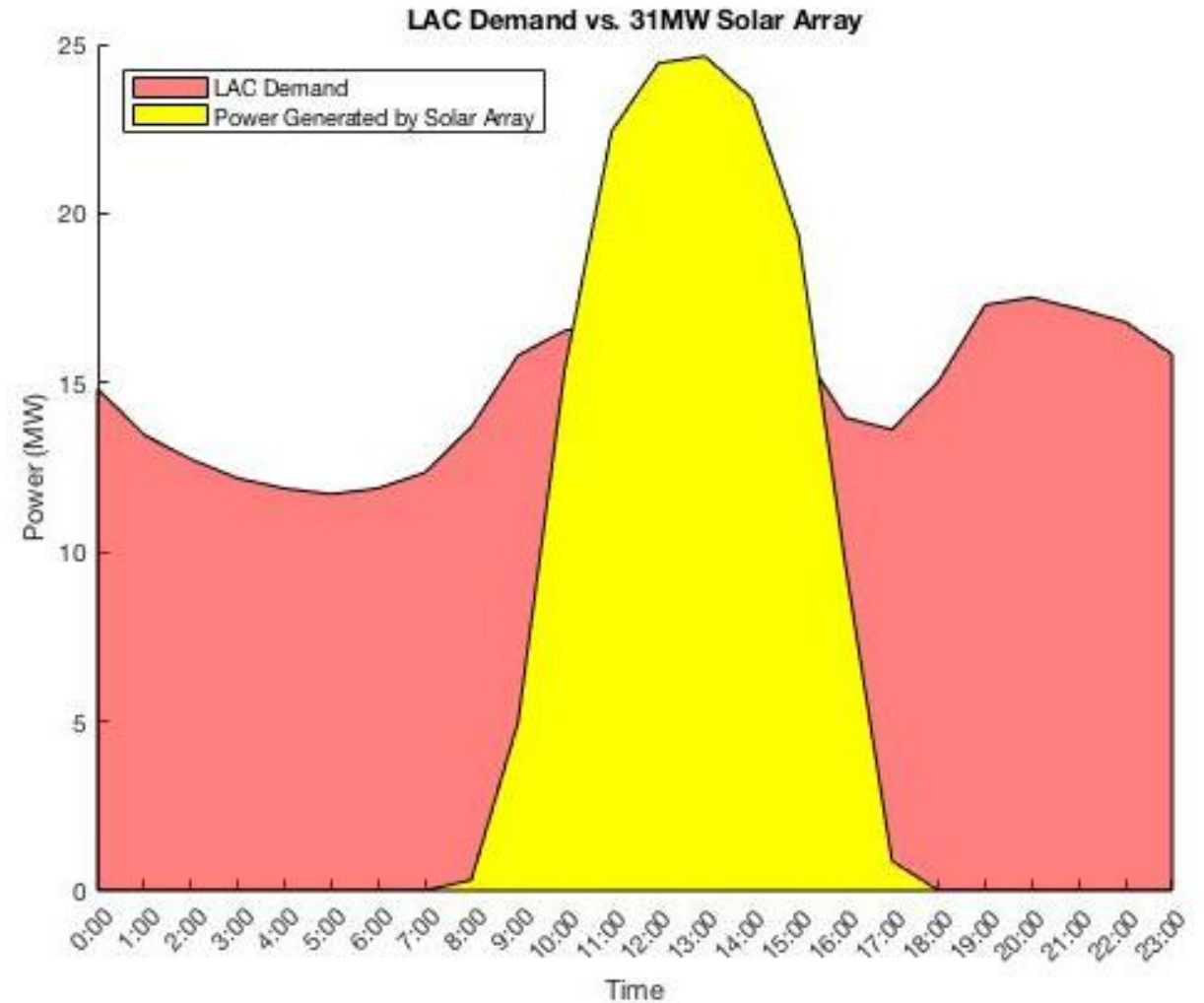
Large Size

High capital cost

# Applications

Peak Shaving

Renewable Energy Storage



# LAC Generation Resource Options

Hydroelectric plants backbone of supply (FER Directive #5)

8MW CFPP (FER Directive #8)

Pumped hydro storage (FER Directive #11)

Plan to match pumped hydro storage with renewable PV array per carbon neutral goal

# Generation vs. Load

Abiquiu & El Vado 10-yr. avg. 62,000 MWh/yr.

CFPP (8 MW @ 95% cf) 66,000 MWh/yr.

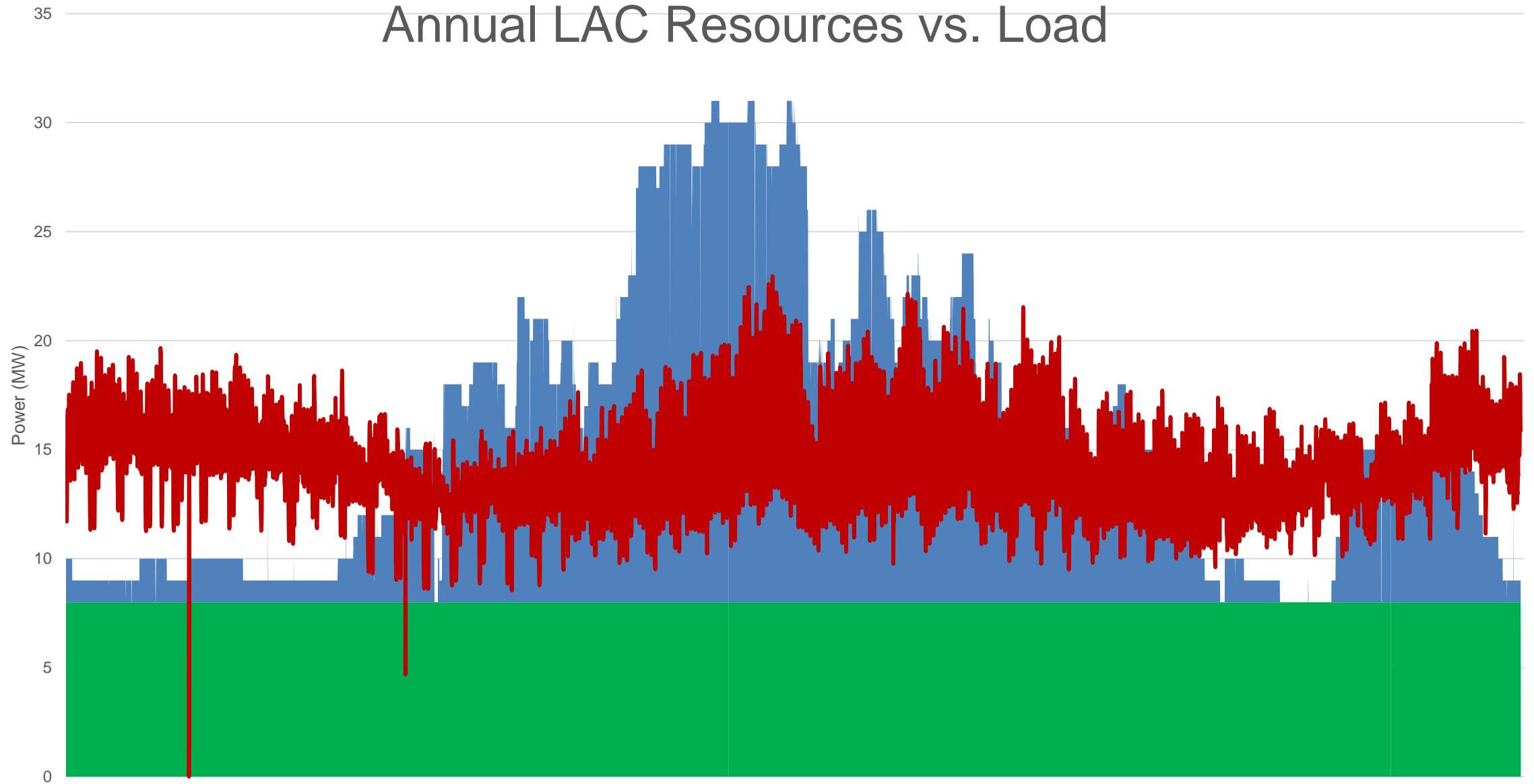
Total carbon free generation 128,000 MWh/yr.

County Load 120,000 MWh/yr.

Excess of 8,000 MWh, 6.7% positive reserve margin



# Annual LAC Resources vs. Load



CFPP

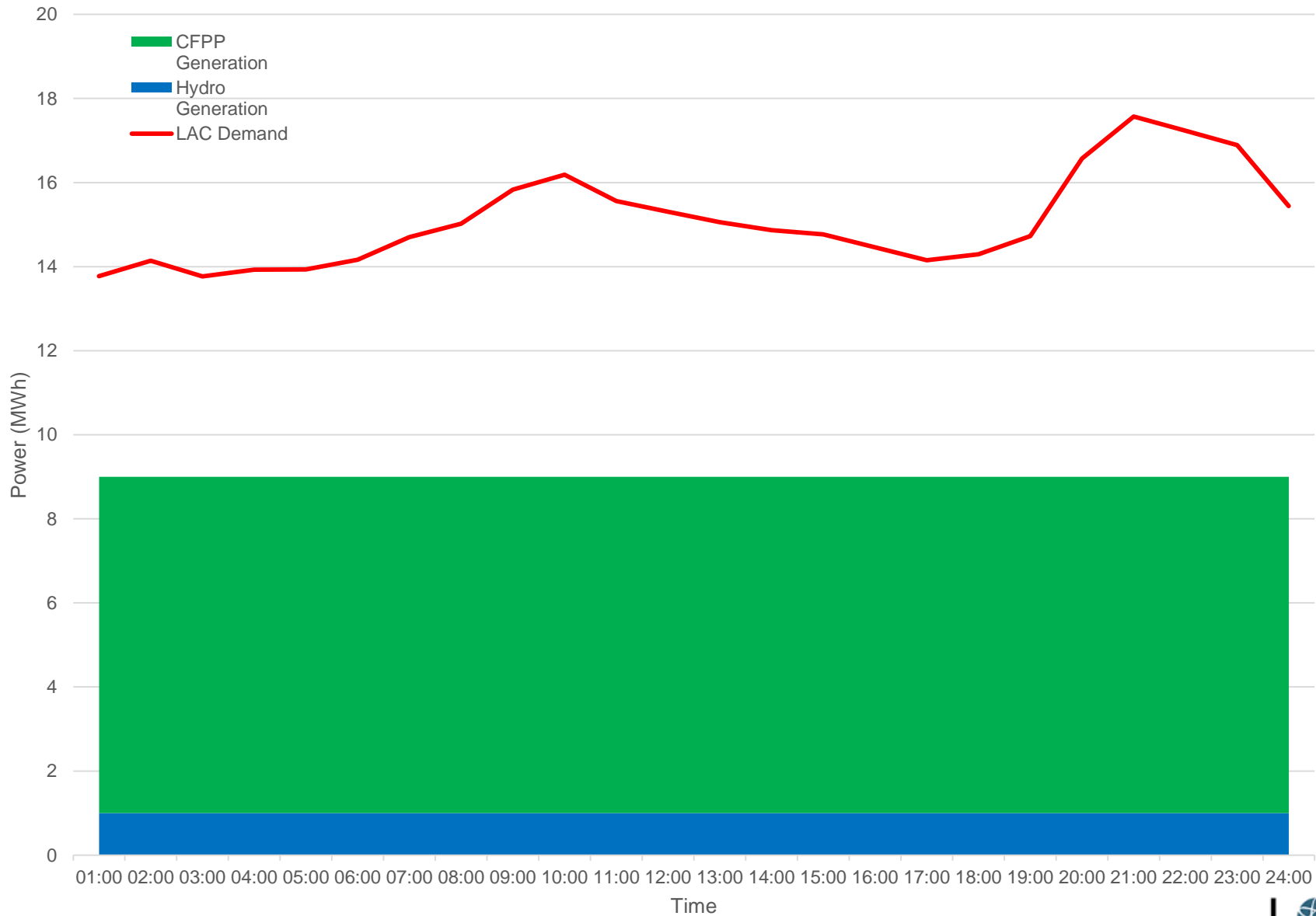
Hydro

LAC Demand

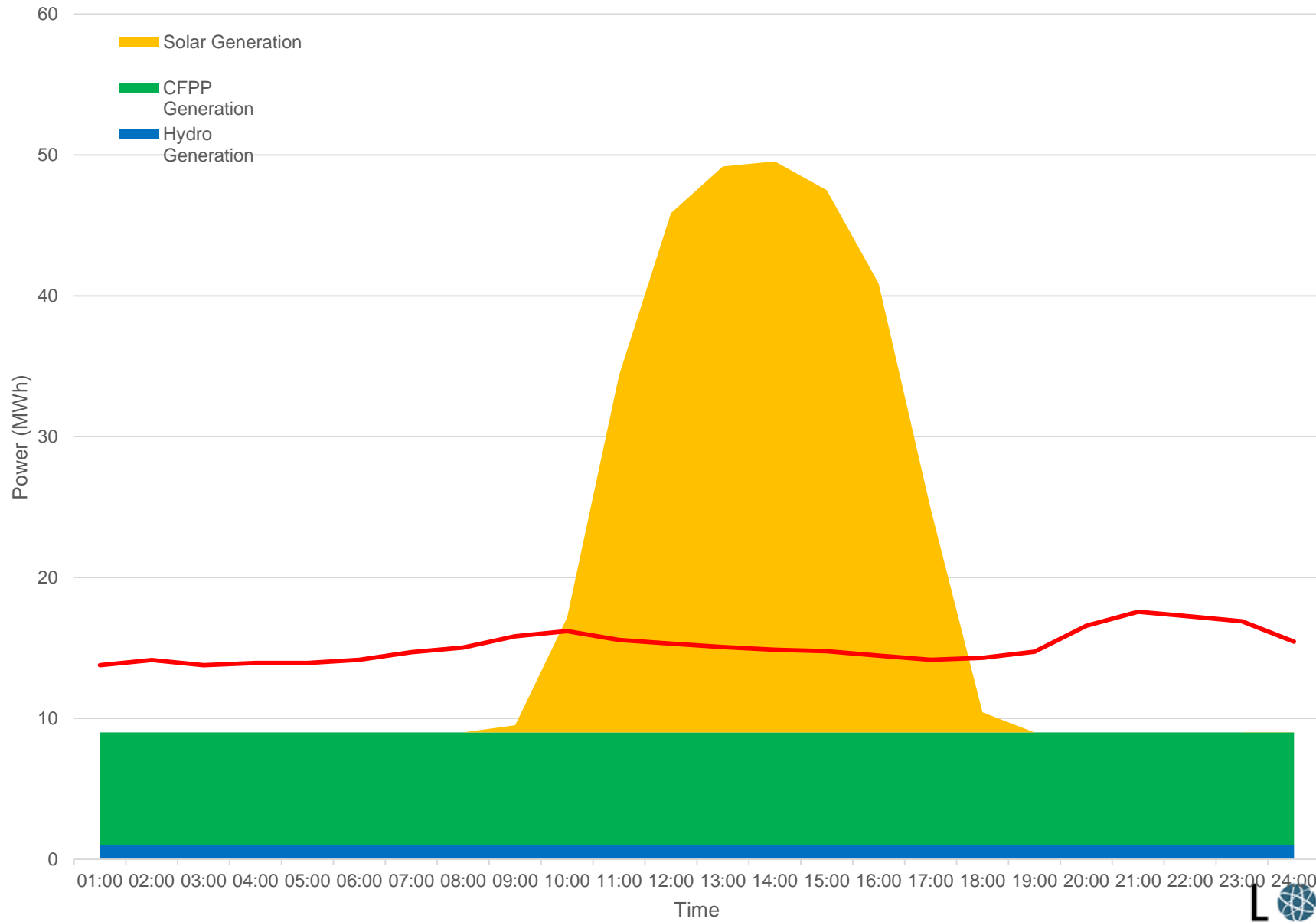
# Generation Deficit

Month	Generation Deficit (MWh)
January	3067.83
February	3282.102
March	2288.303
April	-3521.85
May	-5234.47
June	-7261.36
July	-1920.44
August	-3653.95
September	-524.43
October	1405.247
November	1352.947
December	5.144923

2/1/2012



2/1/2012



# LAC Pumped Hydro System Design Parameters

Designed to store power to meet county load

Solar array oversized to provide excess power to be stored

Only needed 4 months out of the year due to runoff through the hydroelectric plants

# Site Plan



# Project Cost

Pond Qty 2 (/cuyd)	\$4	531,000.00	\$2,124,000.00	Calculated based on amount of water
Pond Liner (/sqft)	\$0.72	1,440,000.00	\$1,035,360.00	Vendor Quote
Turbine	\$2,885,000	1.00	\$2,885,000.00	Vendor Quote
Electric Generation Line (/mi)	\$150,000	5.00	\$750,000.00	T&D Estimate on /mi installation cost 69kV line
Substation	\$2,500,000	1.00	\$2,500,000.00	Estimated from installation cost of WR2 Sub
40" Pipe + Microtunneling (/ft)	\$1,200	3,748.00	\$4,497,600.00	Research from vendors
Access Road	\$4	185,186.00	\$740,744.00	Calculated based on earth moving 45 degree slope 12' wide road, not exceeding 6% grade
O&M (/yr)	\$200,000	25.00	\$5,000,000.00	Based on O&M cost of current hydroelectric facilities
Environmental Review	\$250,000	1.00	\$250,000	
Property Acquisition	\$0	0.00	\$0.00	
Installation Infrastructure	\$0	1.00	\$0.00	
Energy for Pumps	\$0	0.00	\$0.00	
Pumps	\$0	0.00	\$0.00	
Electric Line Right of Way	\$0	0.00	\$0.00	
Financing Cost			\$0.00	
Contingency			\$1,953,270.40	
<b>Total</b>			<b>\$21,760,974.40</b>	

# Energy Storage Cost - \$60.16 /MWH

Price per MWH calculated using only power demanded by the county

Excess power is assumed to be curtailed

Cost is calculated using County energy requirements over the 25 year life span



# Feasibility

Land and easements would still need to be obtained from DOE/LANL

Project would need to pass environmental review

Large enough pumps were not readily available from vendors

Reversible turbines are not manufactured on a small enough scale to be feasible

# Conclusion

Pumped hydro does not work well with our current generation resource profile

With the limitations of current technology, pumped hydro is not economically feasible within Los Alamos County

Other alternatives will provide superior value