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Utilizing Solar+Storage to Obviate Natural Gas Peaker Plants

Puente Power Project: A bridge to nowhere

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Making Clean Local Energy Accessible Now

07 June 2018

Why this is urgent: Climate Change

THÉ LONDON, EDINBURGH, AND DUBLIN PHILOSOPHICAL MAGAZINE AND JOURNAL OF SCIENCE. [FIFTH SERIES.] APRIL 1896.



I. Introduction : Observations of Langley on Atmospherical Absorption.

A GREAT deal has been written on the influence of Tyndail † in particular has pointed out the enormous importance of this question. To him it was chiefly the diurnal and annual variations of the temperature that were lessened by this circumstance. Another side of the question, that has long attracted the attention of physicists, is this : Is the mean temperature of the ground in any way influenced by the presence of heat-absorbing gases in the atmosphere? Fourier‡ maintained that the atmosphere acts like the glass of a hothouse, because it lets through the light rays of the sun but retains the dark rays from the ground. This idea was



122 years should be enough time to deal with climate disruption



We have:

- less than 3 years to end carbon emissions to keep temperature rise below 1.5°C
- less than 18 years to end carbon emissions to keep temperature rise below 2° C

Mercator Research Institute

Energy storage changes the game in three ways

- New grid architecture for a renewable future
- New ways to the renewable transformation
- New ways to meet local reliability needs

...today's talk focuses on the third of these

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Changing the game: 1. A new distribution-centered grid architecture

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- Tomorrow's energy grid will be based on flexible local resources
- We will forecast generation and dispatch load.





The Clean Coalition is working to use energy storage within a suite of Distributed Energy Resources in **Community Microgrids** to meet these needs.

Energy storage facilitates dispatch of local load to balance local generation



Storage + Energy Imbalance Markets: a robust alternative to CAISO expansion

• Solar curtailment at 50% RPS:

80% caused by inflexible reserve resources.

Nelson & Wisland (2015) UCS https://www.ucsusa.org/clean-energy/california-and-western-states/achieving-50-percent-renewable-energy-in-california



Three ways to integrate inflexible fossil fuels during the transition to 100% renewables.

- Use energy storage to dispatch load to capture generation.
- Require fossil fuel generation to be flexible = sensible reserve/regional requirements.
- Engage in region-wide market (exports).

Changing the Game: 3. Energy Storage as key to resilience & reliability

Thomas Fire 2017 Ventura and Santa Barbara:

In an overly transmission-reliant system, a single transmission link can **bring down the whole grid.**

In a distributed system, **no single piece can crash** the whole grid.







Seven hours after

When was the last time more than a million customers lost power from a DER failure?



This is what an inherently brittle, overcentralized grid looks like.

Before 2003 black out



USA EDITION

California rejects gas peaker plant, seeks clean energy alternatives

Events - Archive About

Subscripti

Anything fossil fuels can do, distributed energy resources can do better Cancelling natural gas peakers



Puente gas plant should not be approved, California energy committee says

Moorpark had ~264 MW Local Capacity Requirements

Retirement of Ormond, Mandalay to stop ocean pollution



N-2 Contingency:

Loss of 2 of 3 lines

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April 2015: SCE applies for certification:

Puente Power Project, a natural gas plant

- Locks in decades of natural gas
- <u>Carbon-stranded asset after 2035</u>

2015 on: Environmental, EJ groups, local municipalities oppose, recommend DER alternative

April 2017: CPUC ALJ rejects 54 MW Ellwood plant

July 2017: CAISO issues study of DER alternative.

CAISO study



Local Capacity Requirement net of remaining transmission

Presented three different load profiles



CAISO Modeled meeting LCR with DER

- Used 100% storage
- Used 2014 cost estimates



Puente replacement:

- 125MW/1,125 MWH batteries
- <u>\$805 million (2014 prices)</u>

Puente + Ellwood replacement:

- 240 MW/1,875 MWh batteries
- <u>\$1.1 billion (2014 prices)</u>

Natural gas plant: ~\$299 capital cost CAISO deemed this "feasible."



CLEAN COALITION study





Make two improvements from CAISO Model

1) Meet the same LCR need with Solar+Storage

- Use solar to meet needs during solar window
- Provides energy locally to avoid charging load
- Co-located and sized to capture Investment Tax Credit (70% charging from solar)
- Note: We did not include Demand Response in the suite

2) Apply Full-cost analysis

- Account for cost trends
- Account for Operations & Maintenance
- Account for fuel costs



Key elements of first pass model

- Evaluated over 50 solar+storage combinations.
- Included 15 MW margin above net load
- Used CAISO solar profile data for solar*
- Eliminated combinations failing to qualify for ITC for storage (< 70% charging from solar)
- Used groundmount solar costing

CLEAN COALITION study results





Puente replacement:

- 120 MW solar + 135 MW/225 MWh
 - CAISO compared: 125MW/ 1,125 MWh batteries
- \$267 million v. \$805 million



Solar + storage looks cheaper in capital costs!



CLEAN COALITION study results





Puente replacement:

- 120 MW solar + 135 MW/225 MWh
 - CAISO compared: 125MW/ 1,125 MWh batteries
- \$267 million v. \$805 million

Puente + Ellwood replacement:

- 220MW solar + 135 MW/520 MWh batteries
 - CAISO compared: 240 MW/ 1,875 MWh batteries
- \$406 million v. \$1.1 billion (2014 prices)

Solar+storage competitive on capital costs



	Puente Power Project (Iow gas cost)	Puente Power Project (higher gas cost)	Solar+storage (Puente Only)	Solar+storage (Puente and Ellwood)
Operations & Maintenance (\$/MWH or \$ per kW)	\$4.72	\$4.72	2 \$50.00	\$50.00
Fuel Costs (\$/MWH)				\$0.00
Nameplate (MW) (natural gas, solar)				220
Operating Hours per year**				2,190
MWH/ year				481,800
Annual O&M and Fuel Battery Capacity (MW)				\$11,000,000 5 130
O&M Cost per kw				\$20
Annual battery O&M	\$8,630,280	\$15,646,640	\$675,000	\$1,170,000
Installed cost	\$299,000,000	\$299,000,000	\$267,619,333	\$406,458,621
otal 30 year O&M and Fuel costs	\$258,908,400	\$469,399,200	\$215,250,000	\$365,100,000
Nortality and Illness costs				
otal non-levelized nominal cost*				
Levelized" costs (\$/MWh)				
*Assumes constant nominal costs of fuel and maintenance over 30 years. Totals are illustrative of overall trends, not actual cost estimates.				

Solar+storage superior with all costs included



	Puente Power Project (low gas cost)	Puente Power Project (higher gas cost)	Solar+storage (Puente Only)	Solar+storage (Puente and Ellwood)
Operations & Maintenance (\$/MWH or \$ per kW)	\$4.72	\$4.72	\$50.00	\$50.00
Fuel Costs (\$/MWH)	\$28.22	\$55.00	\$0.00	\$0.00
Nameplate (MW) (natural gas, solar)	262	262	130	220
Operating Hours per year**	1,000	1,000	2,190	2,190
MWH/ year	262,000	262,000	284,700	481,800
Annual O&M and Fuel	\$8,630,280	\$15,646,640	\$6,500,000	\$11,000,000
Battery Capacity (MW)			75	130
O&M Cost per kw			\$20	\$20
Annual battery O&M	\$8,630,280	\$15,646,640	\$675,000	\$1,170,000
Installed cost	\$299,000,000	\$299,000,000	\$267,619,333	\$406,458,621
Total 30 year O&M and Fuel costs	\$258,908,400	\$469,399,200	\$215,250,000	\$365,100,000
Mortality and Illness costs	¢85.021.500	¢1/ 167 00/	ድሳ	<u> </u>
Total non-levelized nominal cost*	\$643.829.990	\$782.566.424	\$482.869.333	\$771.558.621
"Levelized" costs (\$/MWh)	\$81.91	\$99.56	\$56.54	\$53.38

*Assumes constant nominal costs of fuel and maintenance over 30 years. I otals are illustrative of overall trends, not actual cost estimates.

**The actual operating hours of the peaker plants is confidential and may vary widely.

Solar+storage better energy value



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Clearly, solar+storage is a lot more viable an alternative than common myths suggest.



As a result of this and a lot of other work...





SCE proposed to use a fourth transmission line in the same footprint as the three existing lines





SCE LCR Plan: what could possibly go wrong?



Solar+storage instead of transmission?



	<u>Solar +</u> <u>Storage</u> <u>Alternative</u>	<u>Moorpark-Pardee</u> <u>Transmission line</u>
Nameplate (MW) (solar)	240	
Additional storage (MWH)	825	
2019 Installed Cost	\$696,227,384	\$45,000,000

CAISO's view: O&M doesn't matter and PV generates no value

Solar+storage instead of transmission?



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Nameplate (MW) (solar)	240	
Additional storage (MWH)	825	
2019 Installed Cost	\$696,227,384	\$45,000,000
With ITC	\$487,359,169	
MWH/ year (1,600 MWh/year/MW)	384,000	
30 year energy	11,520,000	
Operations & Maintenance (\$/MWH (gas) or \$ per kW capacity (solar))	\$50.00	
Annual O&M (\$50/kW solar)	\$12,000,000	
30-year O&M, return, and depreciatior Total Cost	\$360,000,000 \$847,359,169	\$175,950,000 \$220,950,000

Reality I: O&M, etc., over 30 years represents over 80% of ratepayer costs

Solar+storage instead of transmission?



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	<u>Storage</u>	Transmission line
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(solar))	\$50.00	
Annual O&M (\$50/kW solar)	\$12,000,000	
30-year O&M, return, and depreciation	\$360,000,000	\$175,950,000
Total Cost	\$847,359,169	\$220,950,000
Energy Long Run Cost (per MWH)	\$54	
Total Energy Value	\$626,409,170	0
Total Ratepayer Cost	\$220,949,999.16	\$220,950,000.00
Net Cost of DER Reliability service	-\$0.84	

Reality II: Solar+Storage is a generating asset that can pay for itself in ways transmission never can

Changing the Game: 3. Energy Storage as key to resilience & reliability

Energy Storage (+ solar, DR, DERMS):

- More reliable, cheaper alternative to natural gas peakers
- More reliable, cheaper alternative to transmission









Storage + Energy Imbalance Markets: a robust alternative to CAISO expansion



Use energy storage to dispatch load to capture generation.

- Addresses grid integration needs
- Without expense and vulnerability of transmission
- Without risks of an Regional Transmission Operator





Energy storage will be critical to allowing dispatch of local load to balance local generation so that the entire energy system is more robust and simpler to manage.

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Any questions?



Puente gas plant should not be approved, California energy committee says