Analyzing California's Proposed "Clean Peak Standard" *(in prep.)*

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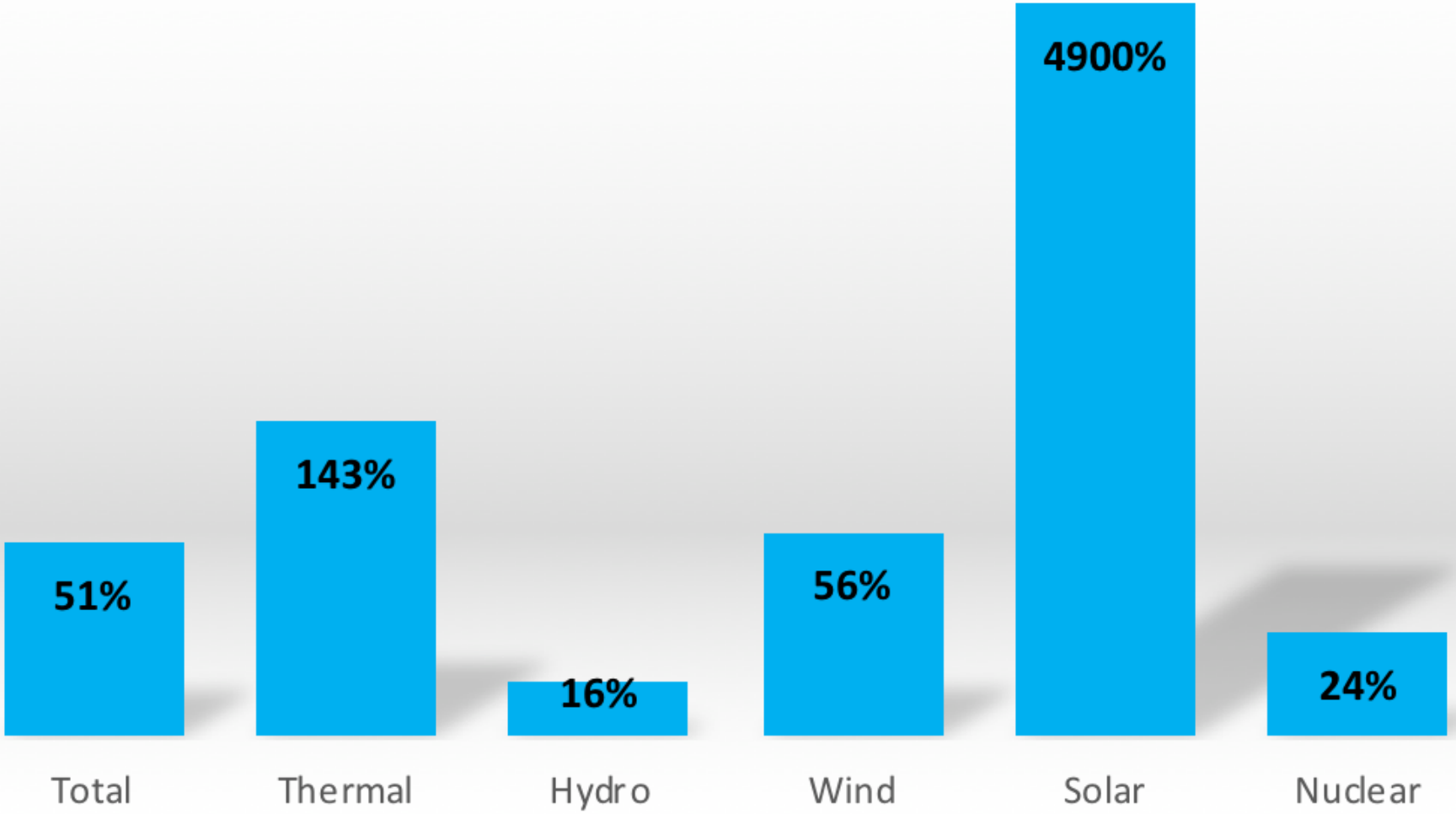
California's Generating Capacity Relative to Brazil's



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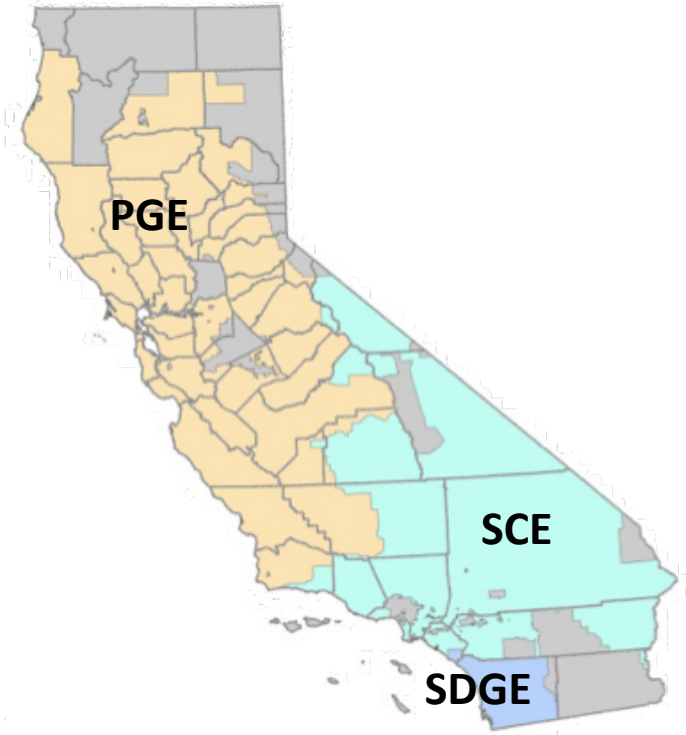
California Independent System Operator (CAISO)



http://www.dcsystems.com/wp-content/uploads/2014/08/theISOgrid_ca.jpg

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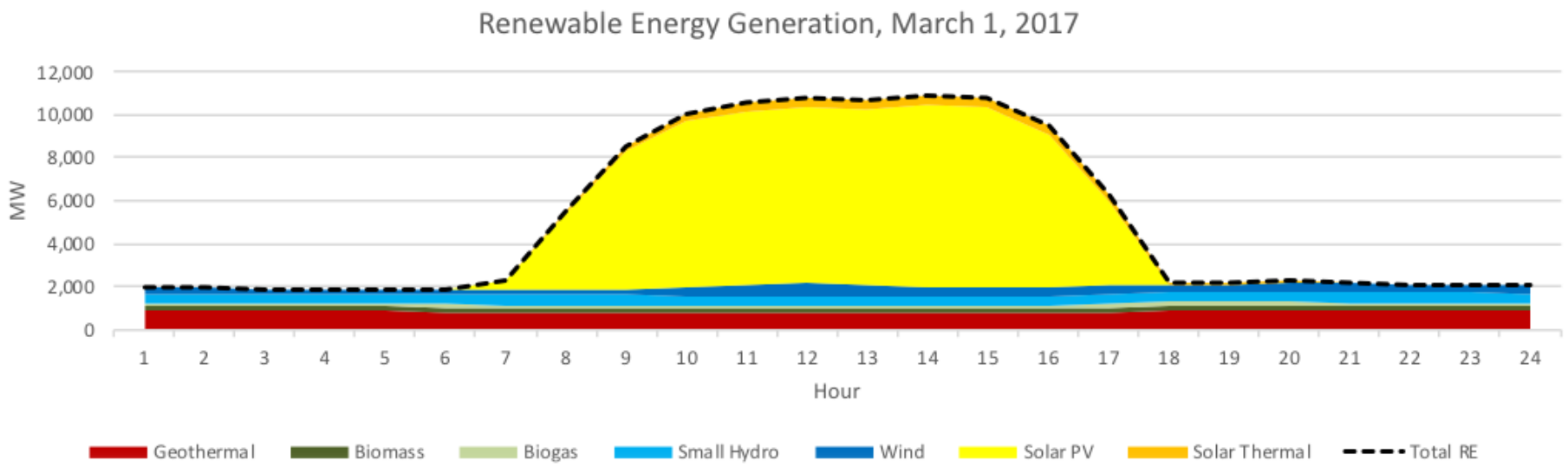
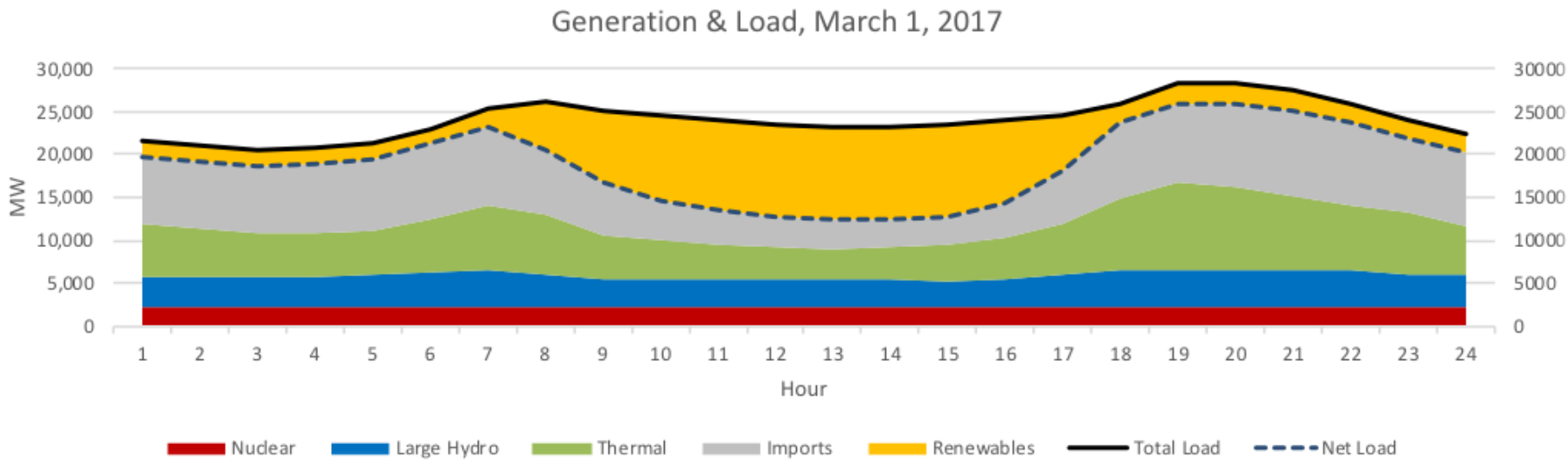
Example Day in CAISO





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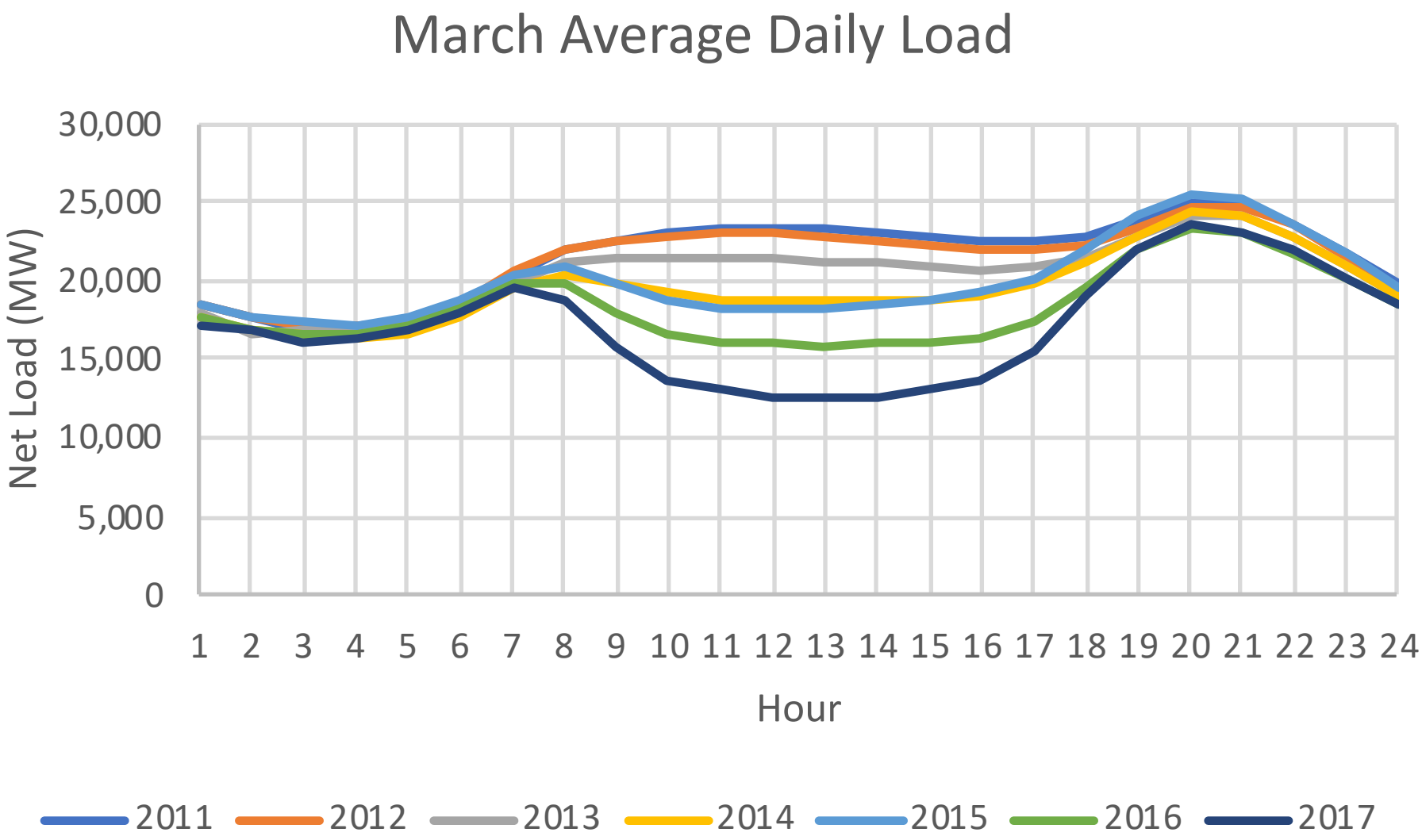
The Evolving “Duck Curve”



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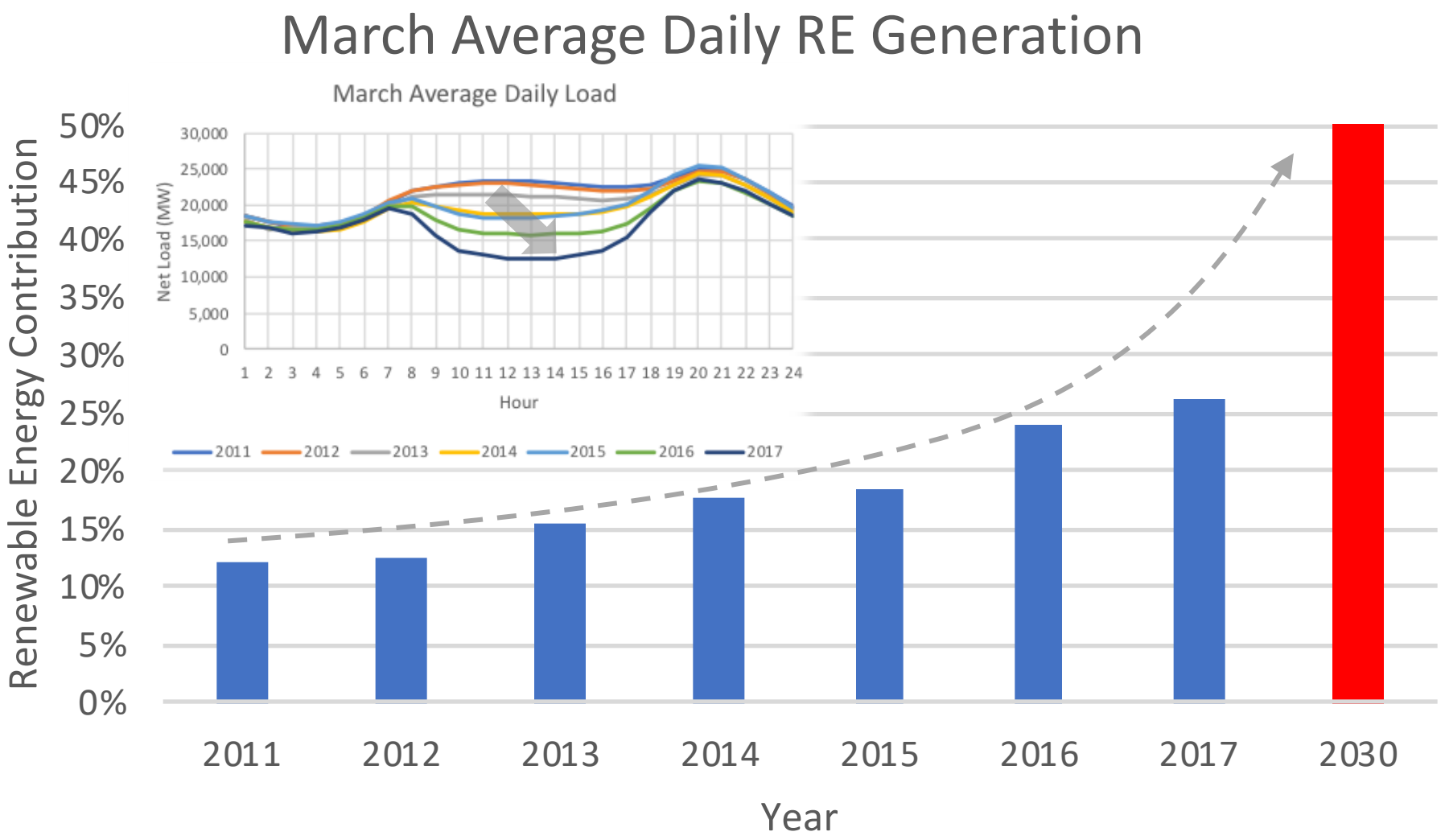
The Evolving "Duck Curve"



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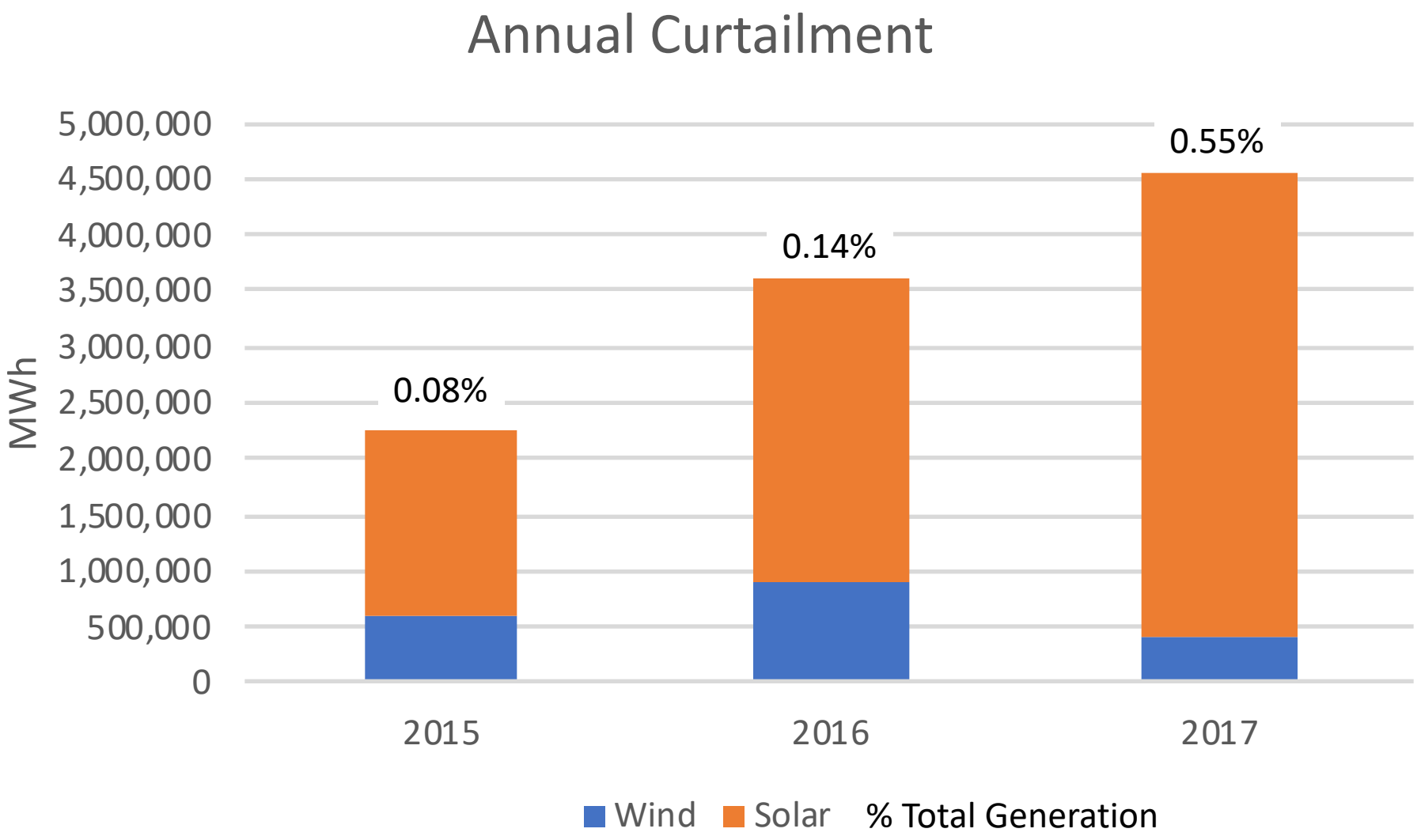
Side Effect: Rising Curtailment of Wind & Solar



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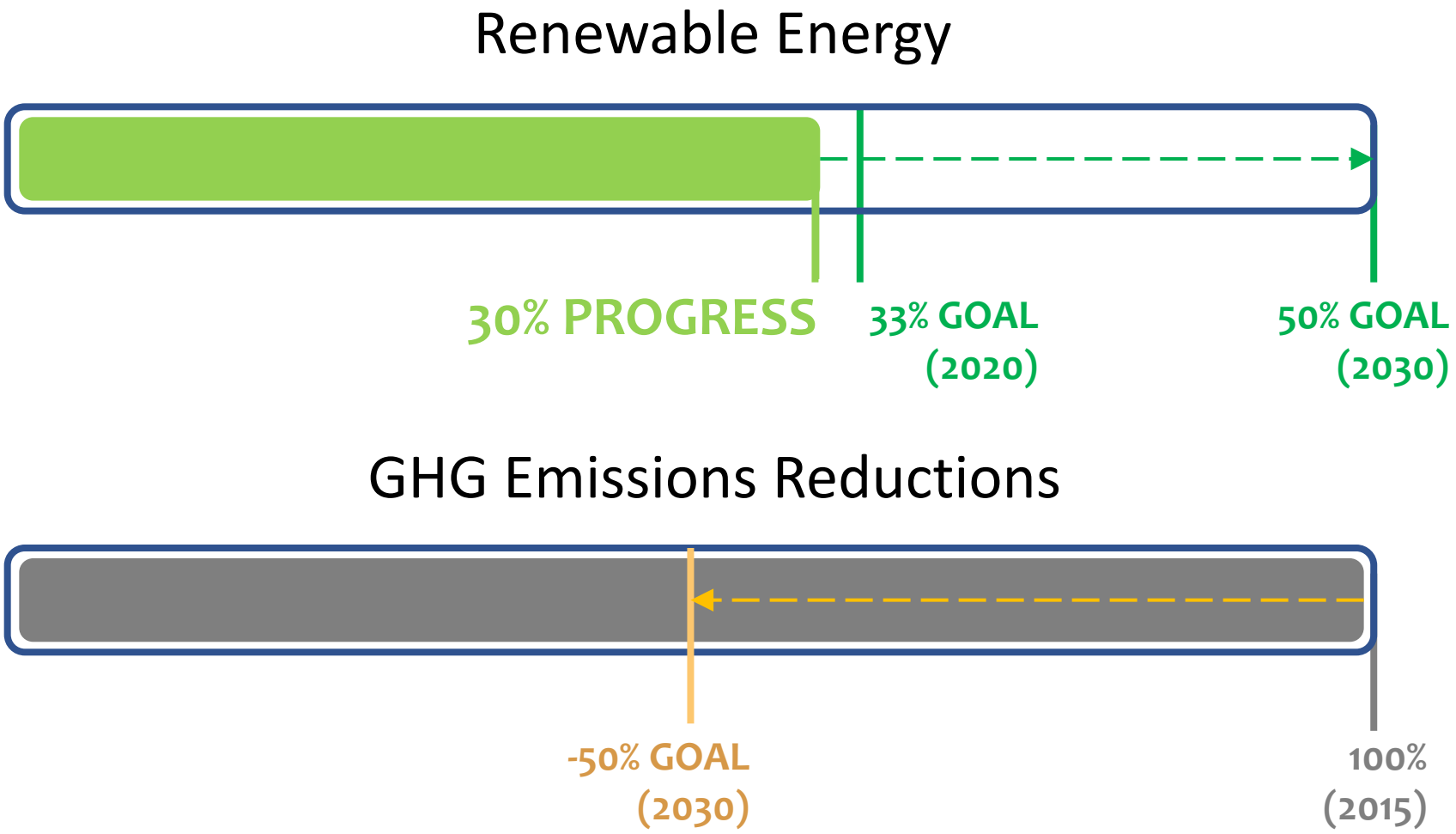
Moving Forward: California's Electricity Sector Goals



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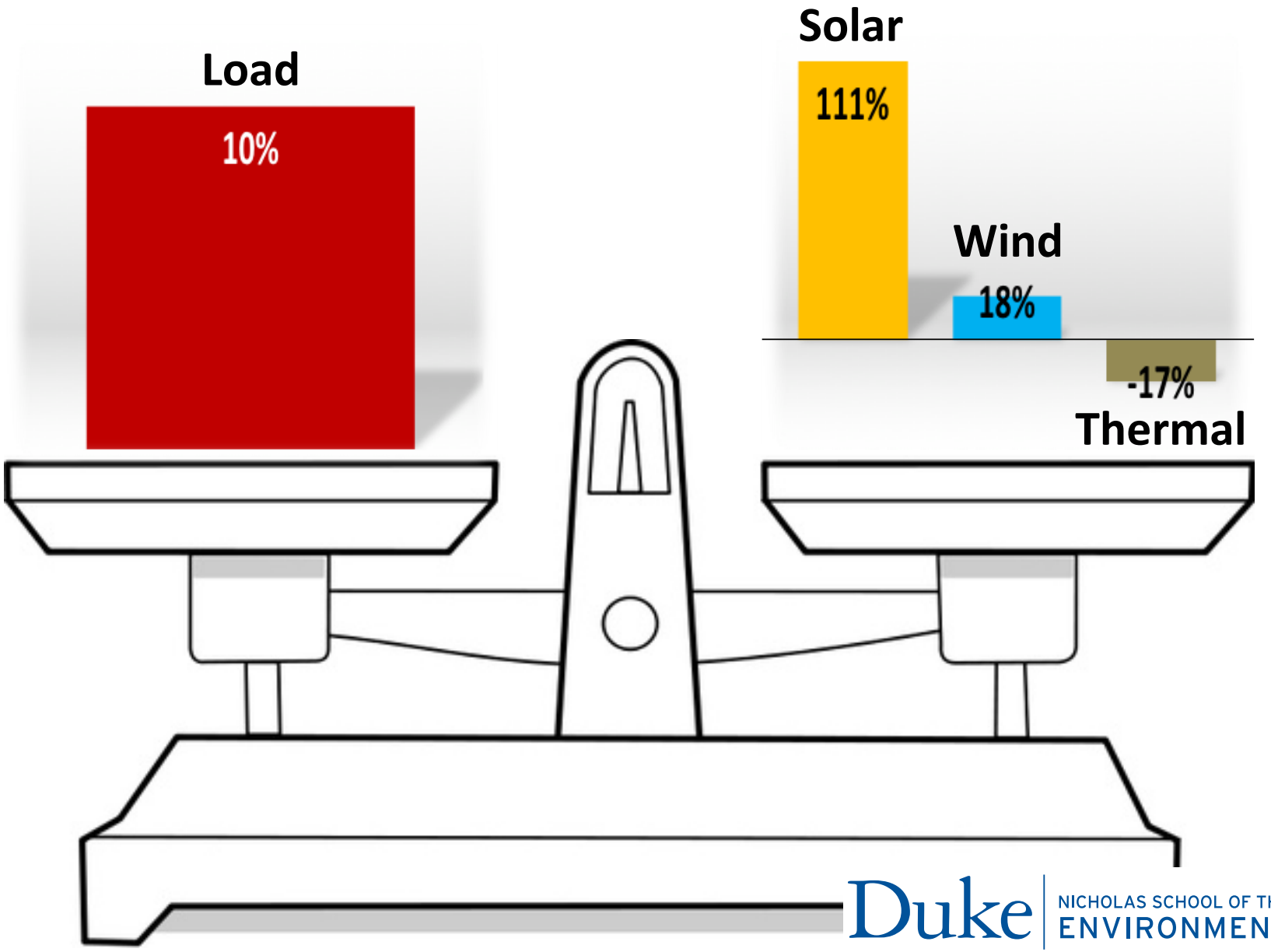
Projected Changes in Load & Generation by 2030



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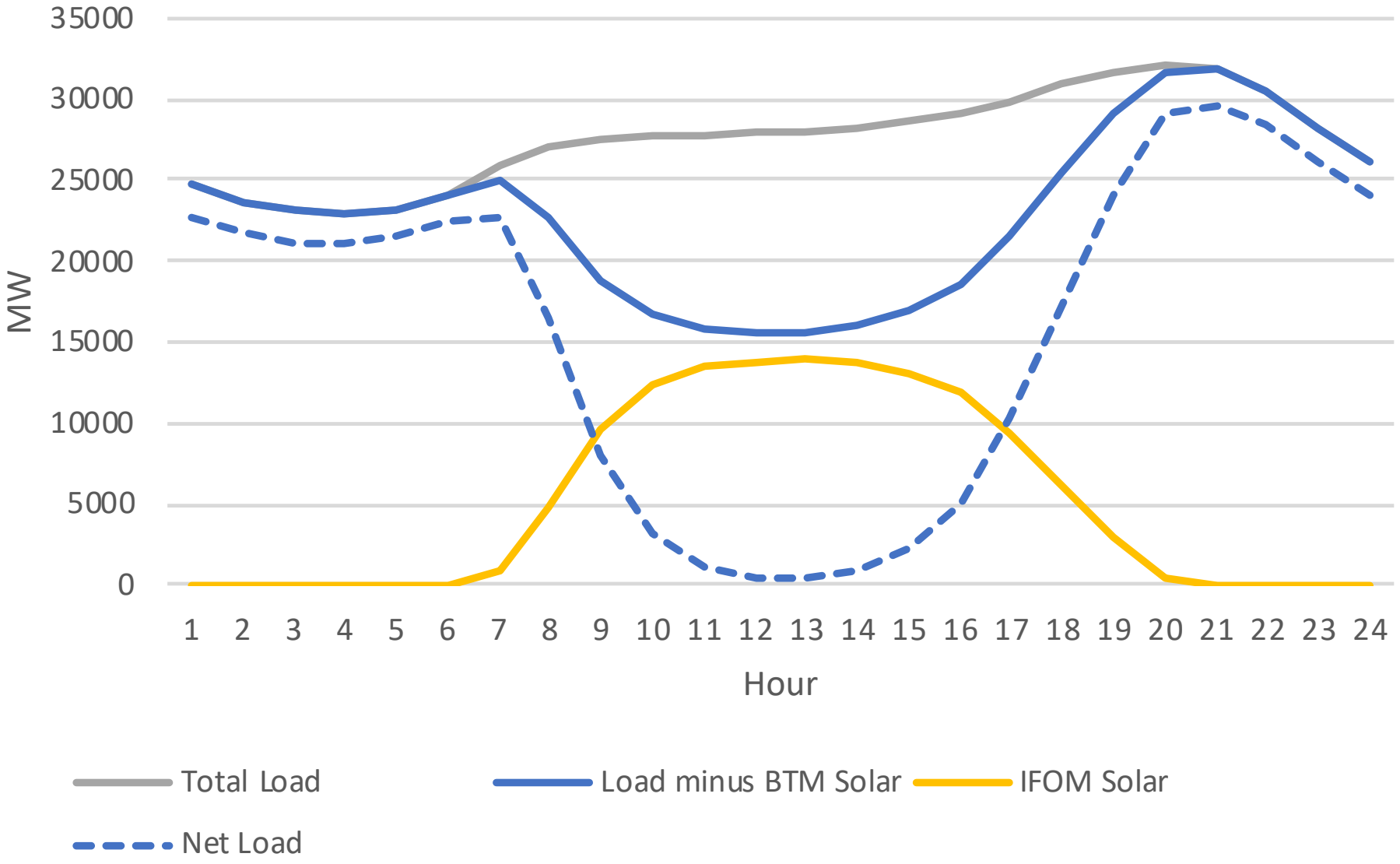
2017 Load & Generation Scaled to 2030 Projections



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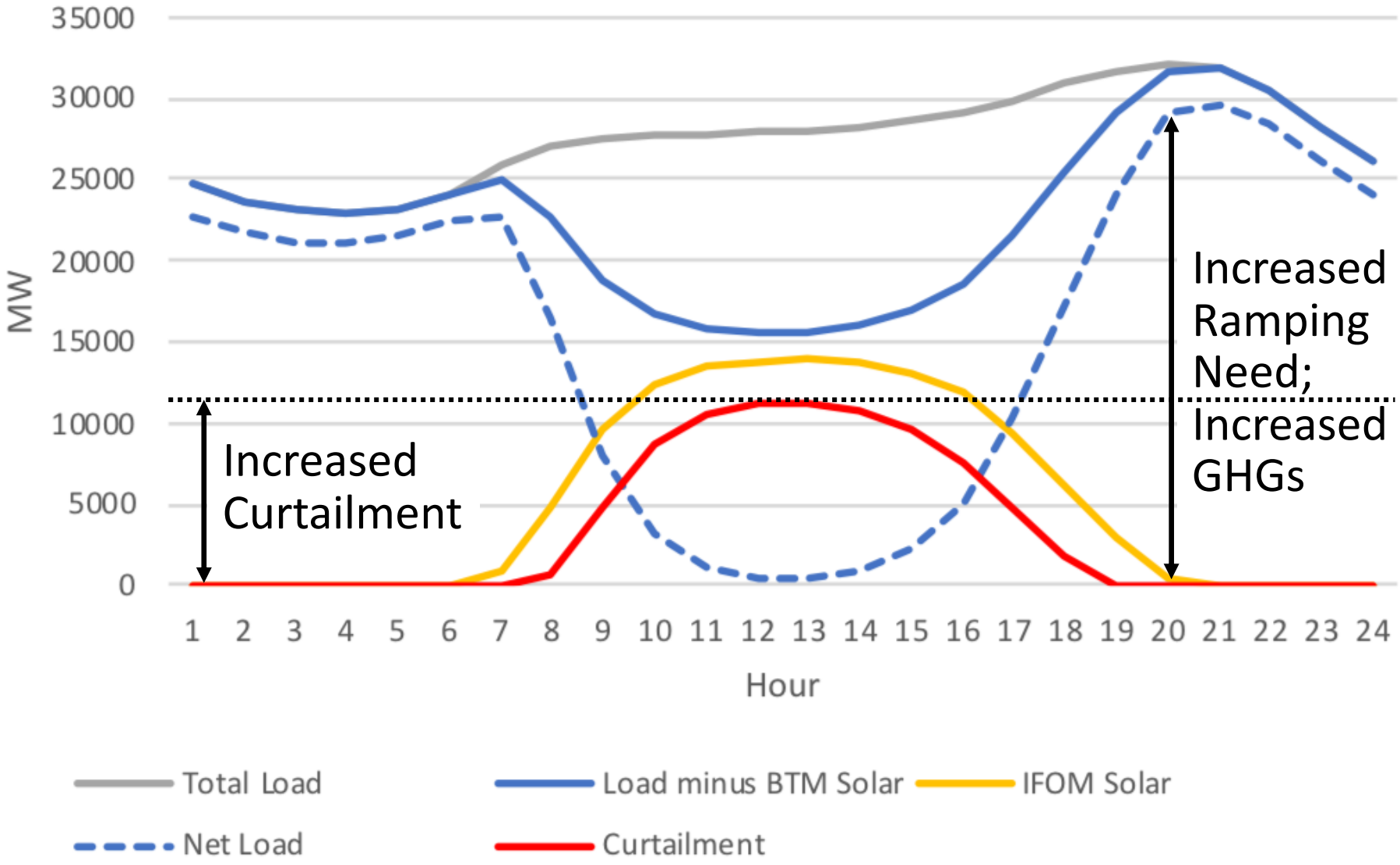
2017 Load & Generation Scaled to 2030 Projections



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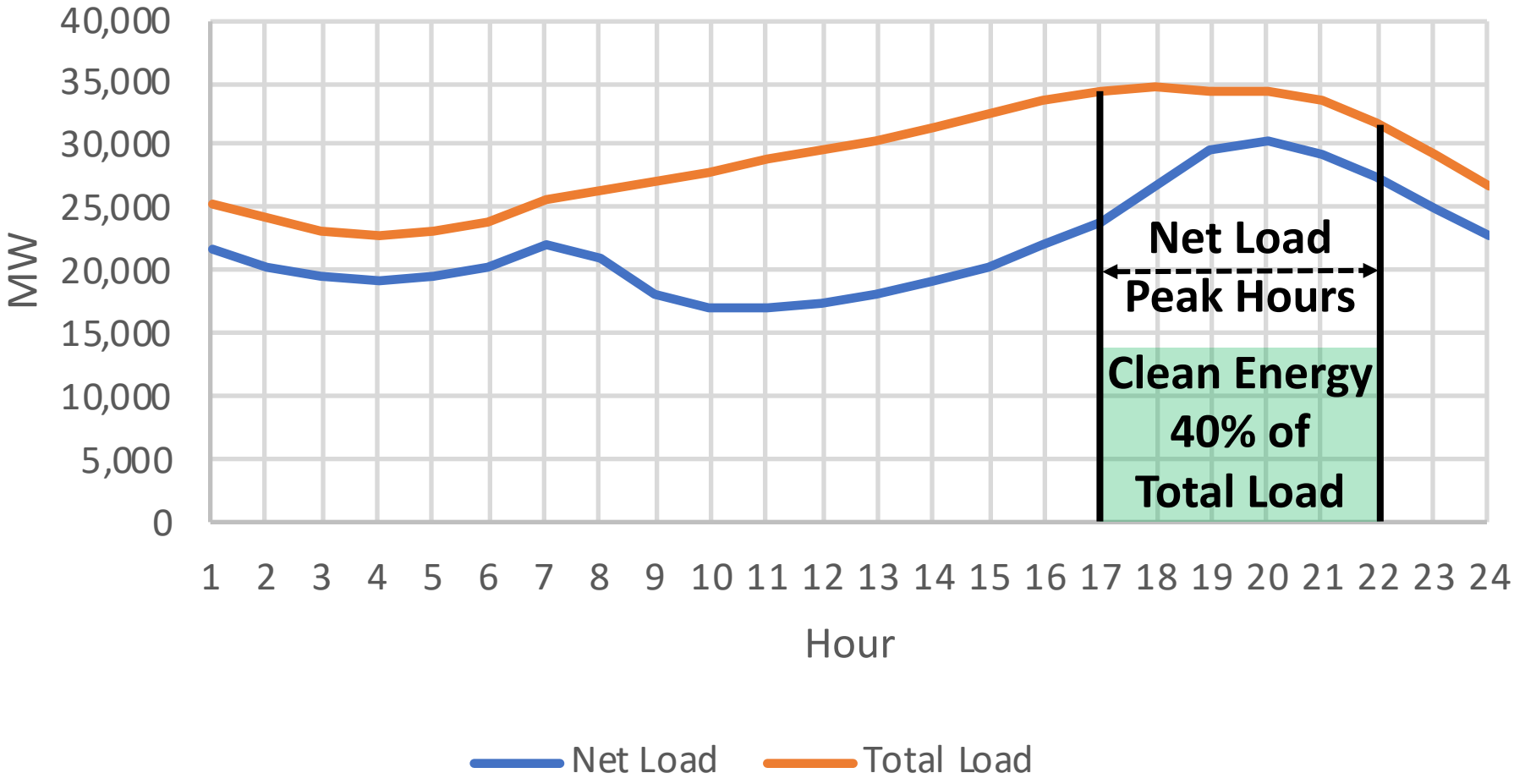
A Proposed Solution: The Clean Peak Standard



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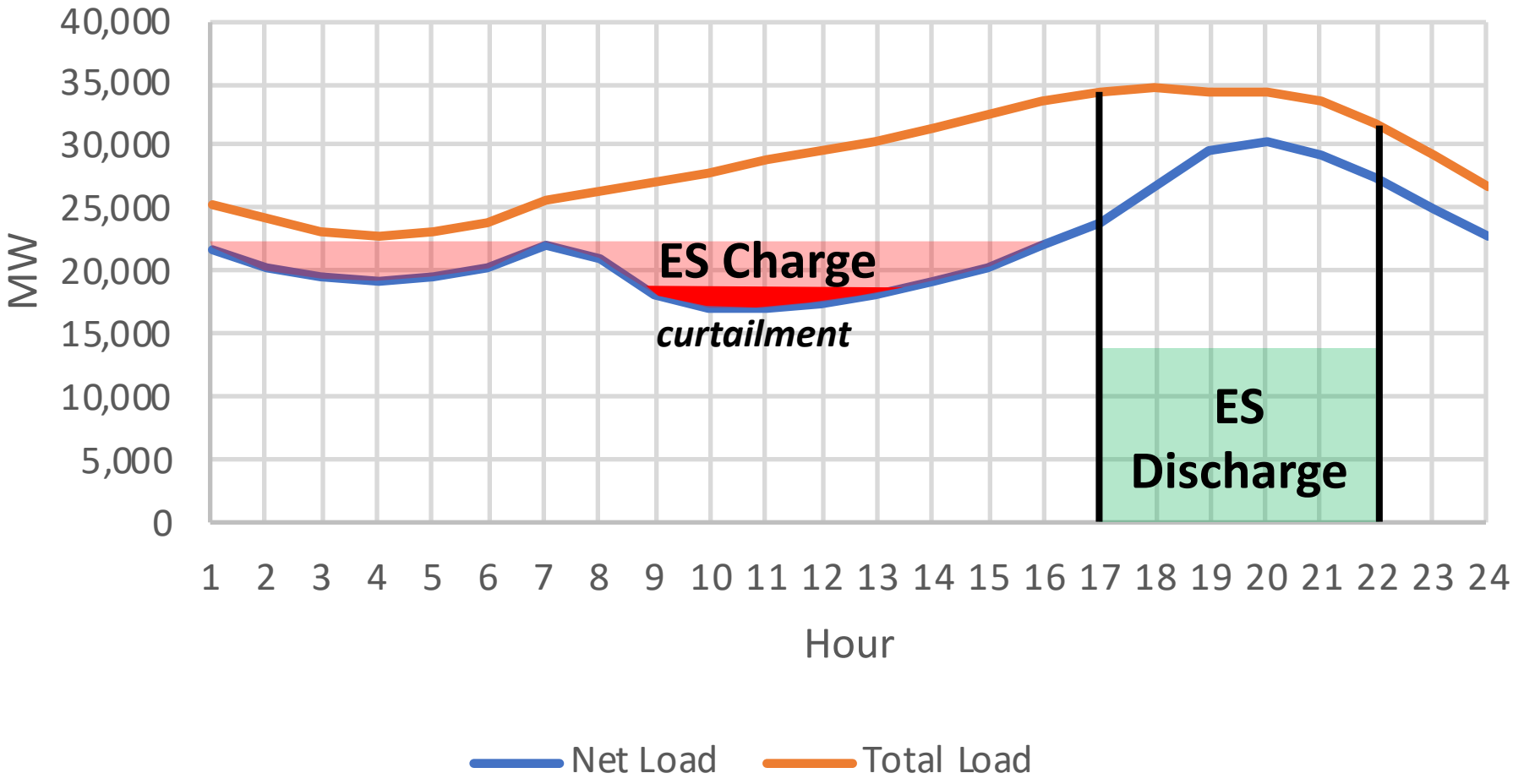
How Storage Would be Work under a CPS



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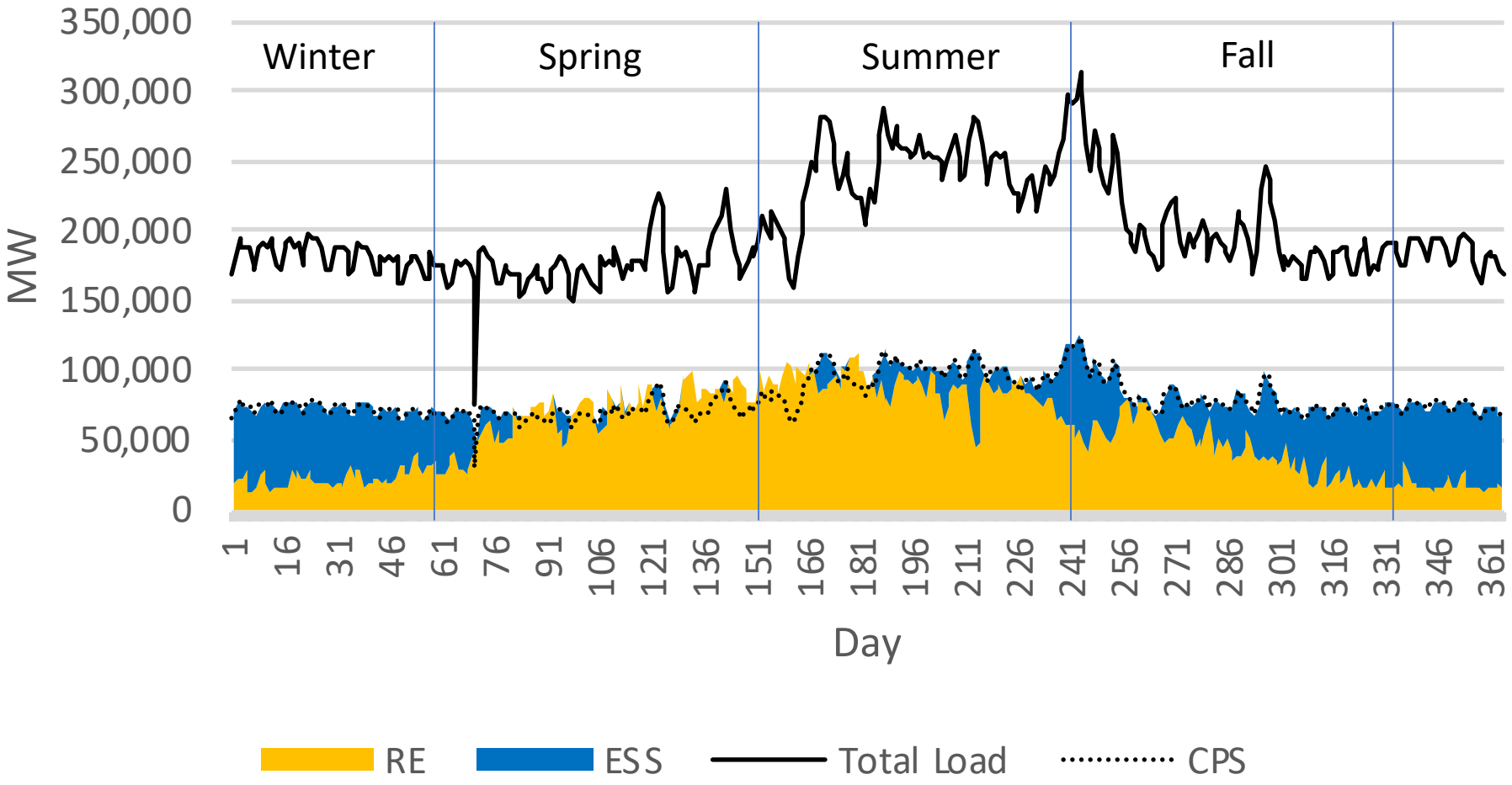
Projected Storage Needed by 2030 to Meet CPS



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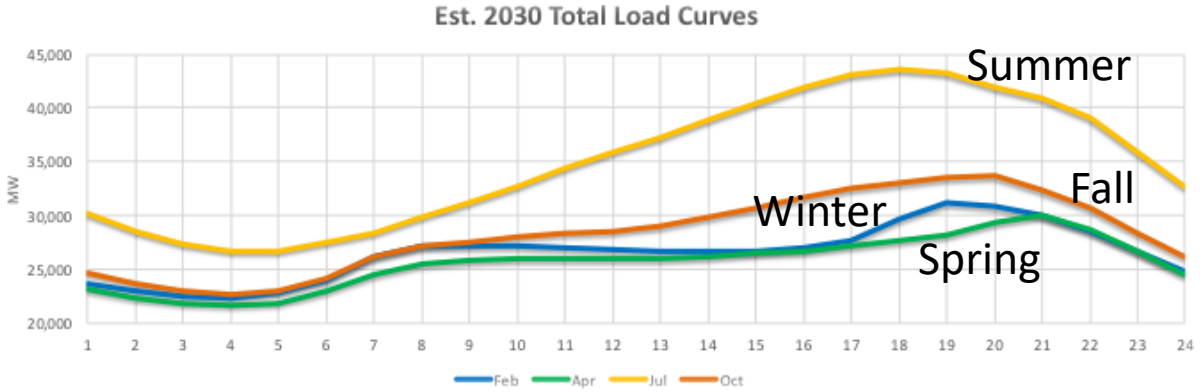
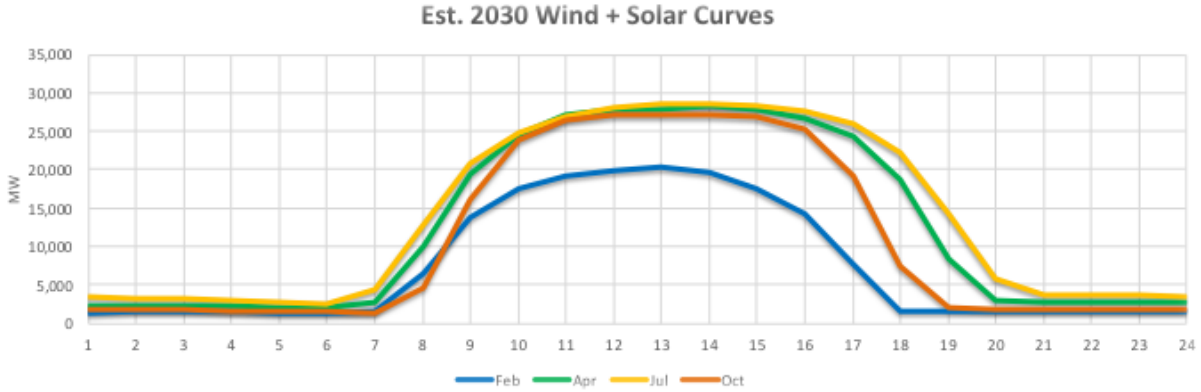
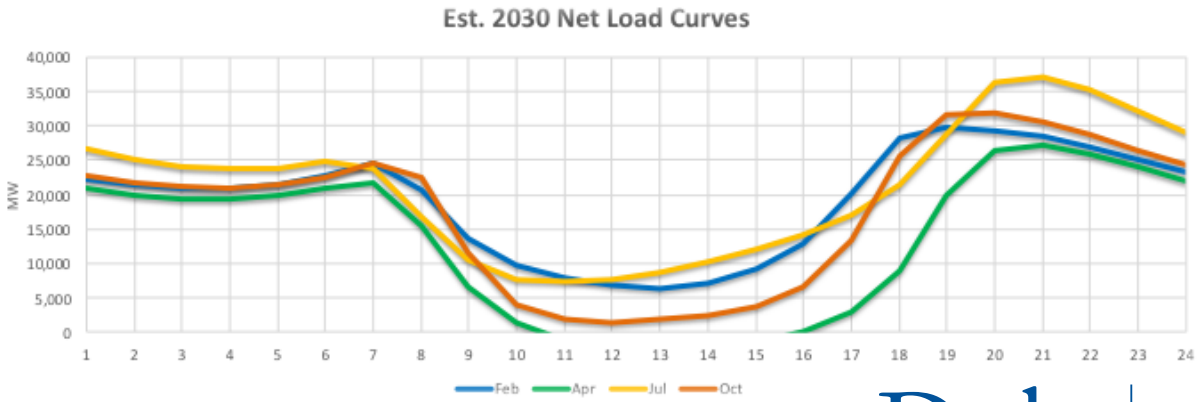
Seasonal Variation Due to Load & Resource Changes







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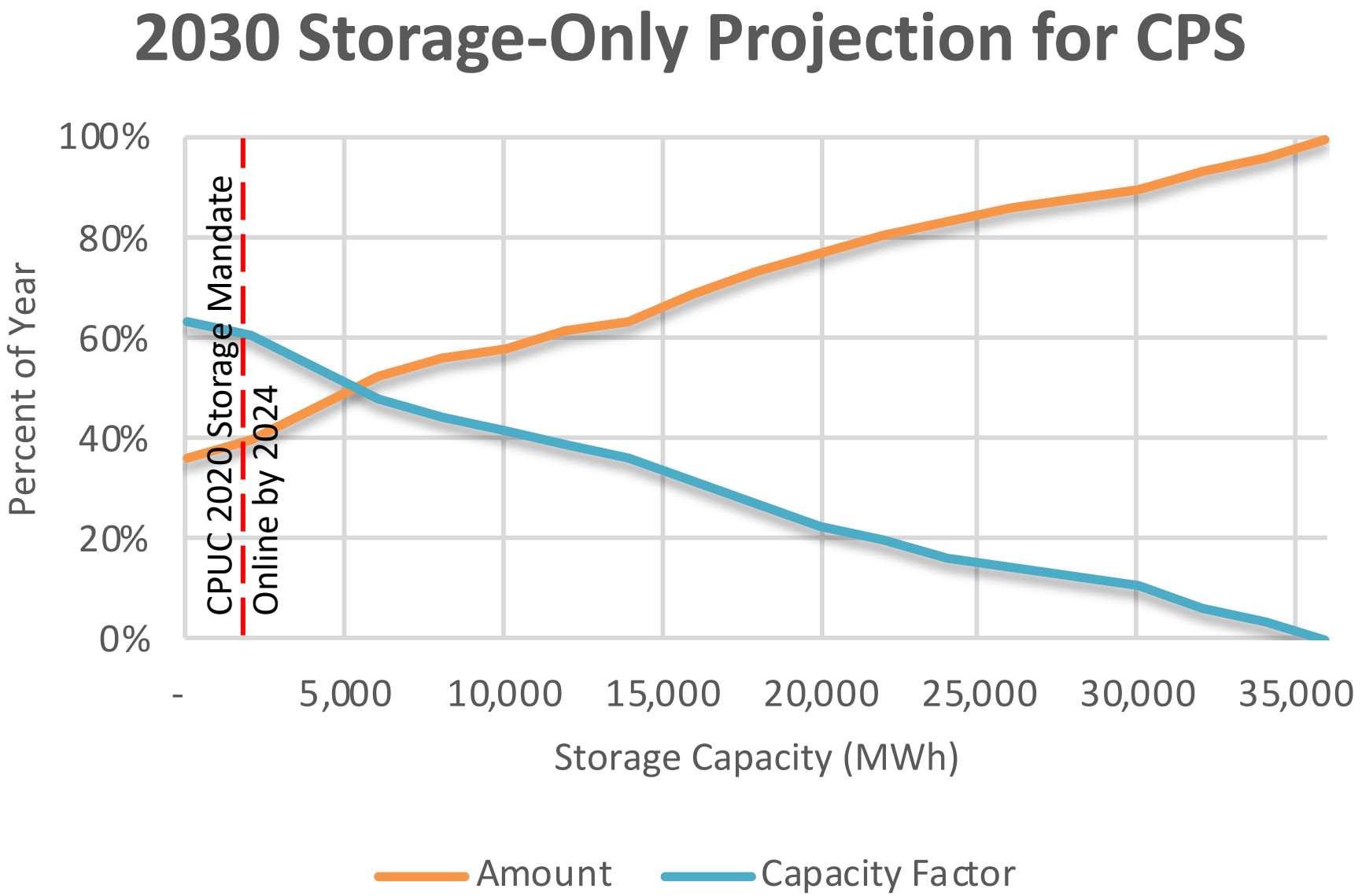
As Storage Rises, CFs for Marginal Storage Fall



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PPAs for Storage? Recent Examples of PV + Storage

NextEra Energy, Tucson Electric Power
100 MW Solar PV
50 MW, 120 MWh Battery
20 y PPA @ < $45/MWh (w/o subs. $90/MWh)
Signed May, 2017

Previous Low:
AES & Kauai Island Utility Coop
28 MW Solar PV
20 MW, 100 MWh battery
??? Y PPA @ $111/MWh
Signed January, 2017

First Solar & APS, Arizona Public Service
65 MW Solar PV
50 MW, 200 MWh Battery
15 y PPA @ ???
Will deliver 50 MW from 16:00-20:00 h
Signed February, 2018

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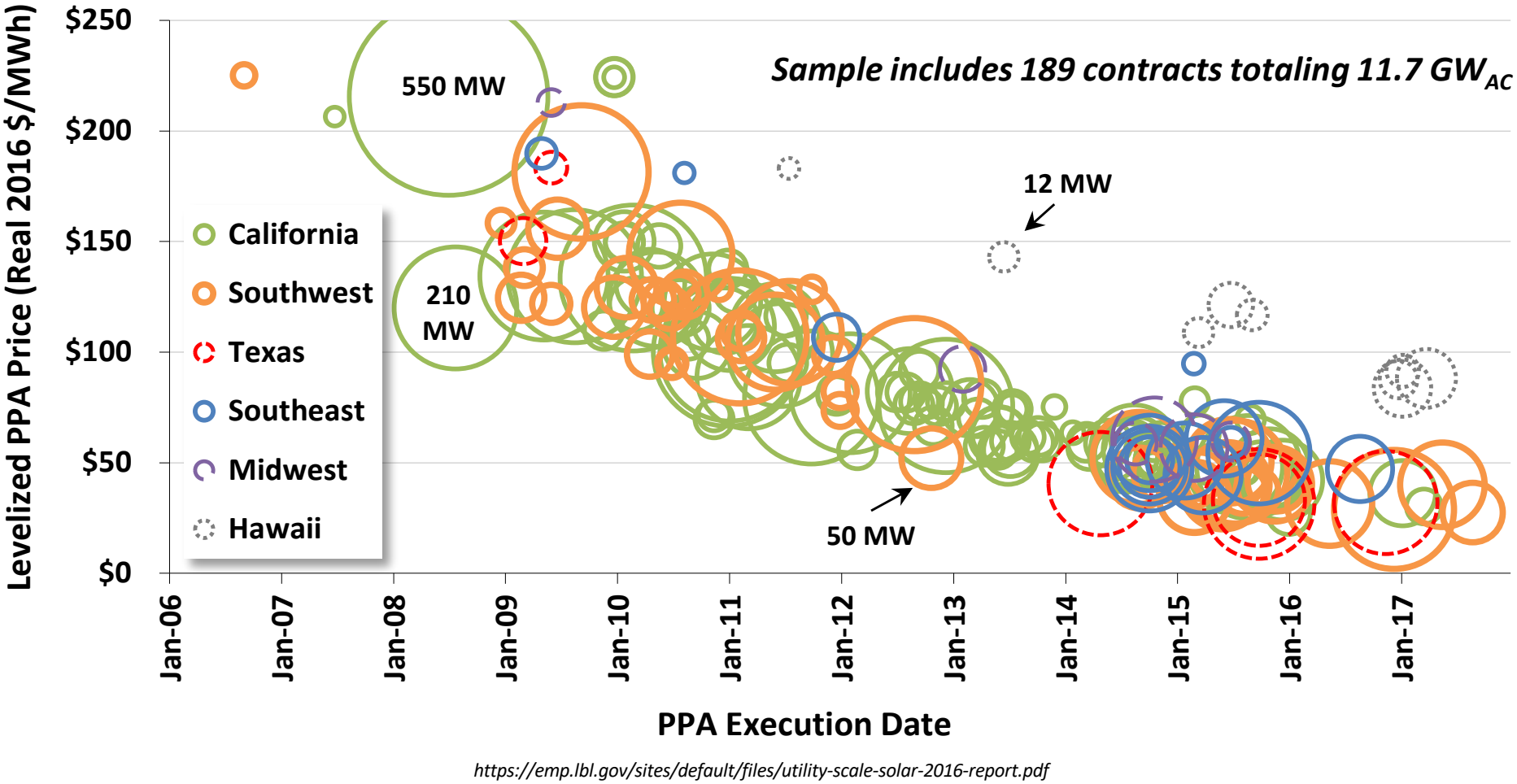
Low Solar+Storage PPAs Driven by Solar PPAs



https://emp.lbl.gov/sites/default/files/utility-scale-solar-2016-report.pdf

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Simple 10-y IRR Analysis of Storage Only

PPA ($/MWh)	$50.00							
Size (MWh)	5							
Capacity (MW)	**1**							
Installed cost ($/kWh)	$385.00							
O&M costs ($/kWh)	$2.75							
Tax rate	39%							
Inflation	0.0%							
5-y MACRS	20.00%	32.00%	19.20%	11.52%	11.52%	5.76%		
365 day Revenue	**$91,250**							
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Revenue	$0	$91,250	$91,250	$91,250	$91,250	$91,250	$91,250	$91,250
O&M	$0	$13,750	$13,750	$13,750	$13,750	$13,750	$13,750	$13,750
EBITA	$0	$77,500	$77,500	$77,500	$77,500	$77,500	$77,500	$77,500
Depreciation	$0	($385,000)	($616,000)	($369,600)	($221,760)	($221,760)	($110,880)	$0
EBIT	$0	($307,500)	($538,500)	($292,100)	($144,260)	($144,260)	($33,380)	$77,500
Taxes	$0	$0	$0	$0	$0	$0	$0	($30,225)
Net Income	$0	($307,500)	($538,500)	($292,100)	($144,260)	($144,260)	($33,380)	$47,275
Add back in depreciation	$0	$385,000	$616,000	$369,600	$221,760	$221,760	$110,880	$0
Installed cost	($1,925,000)	$0	$0	$0	$0	$0	$0	$0
Tax Shield		$119,925	$210,015	$113,919	$56,261	$56,261	$13,018	$0
Cash Flow	($1,925,000)	$197,425	$287,515	$191,419	$133,761	$133,761	$90,518	$47,275

…only showing the first seven years

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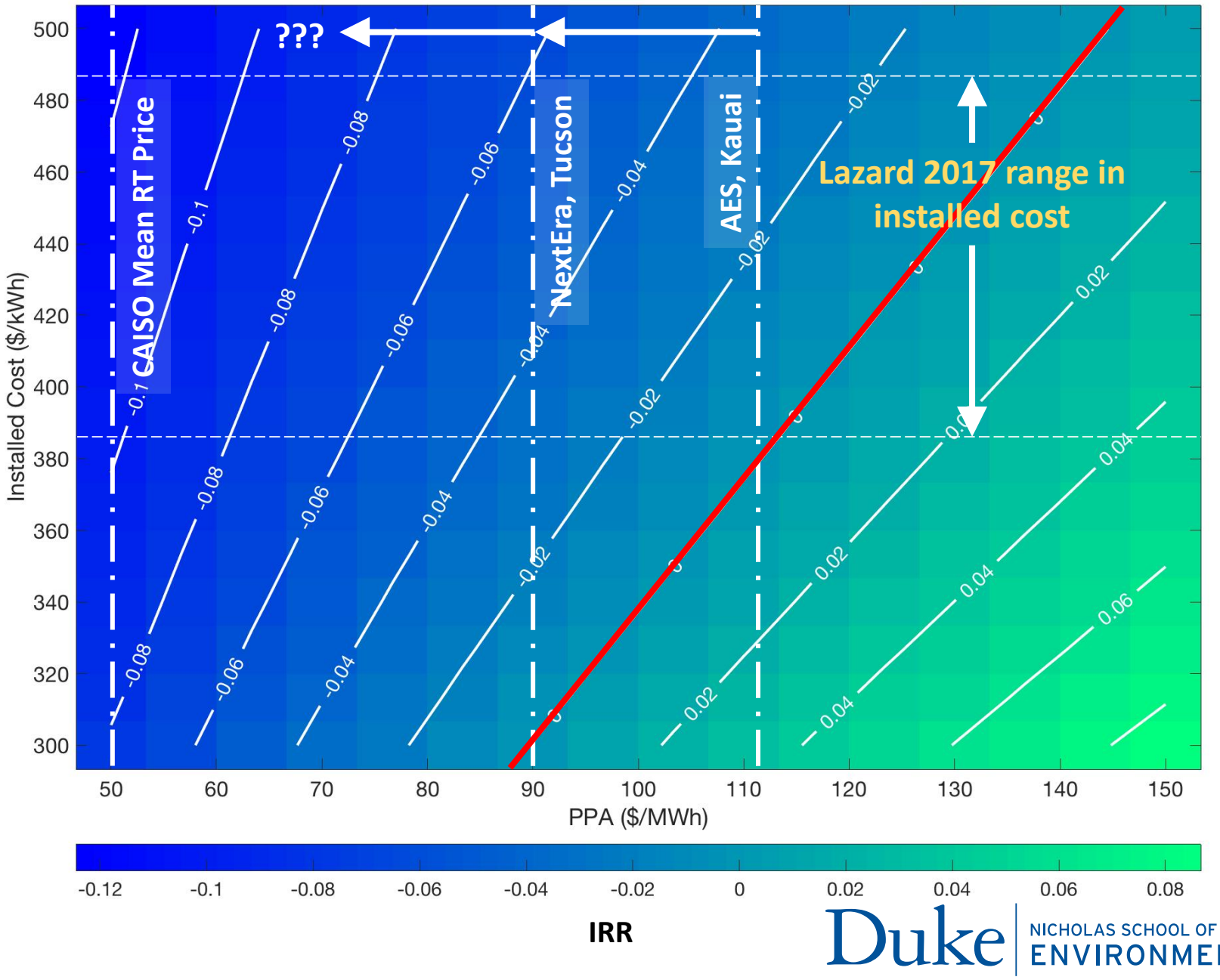
Complete Discharge During CPS Hours Only



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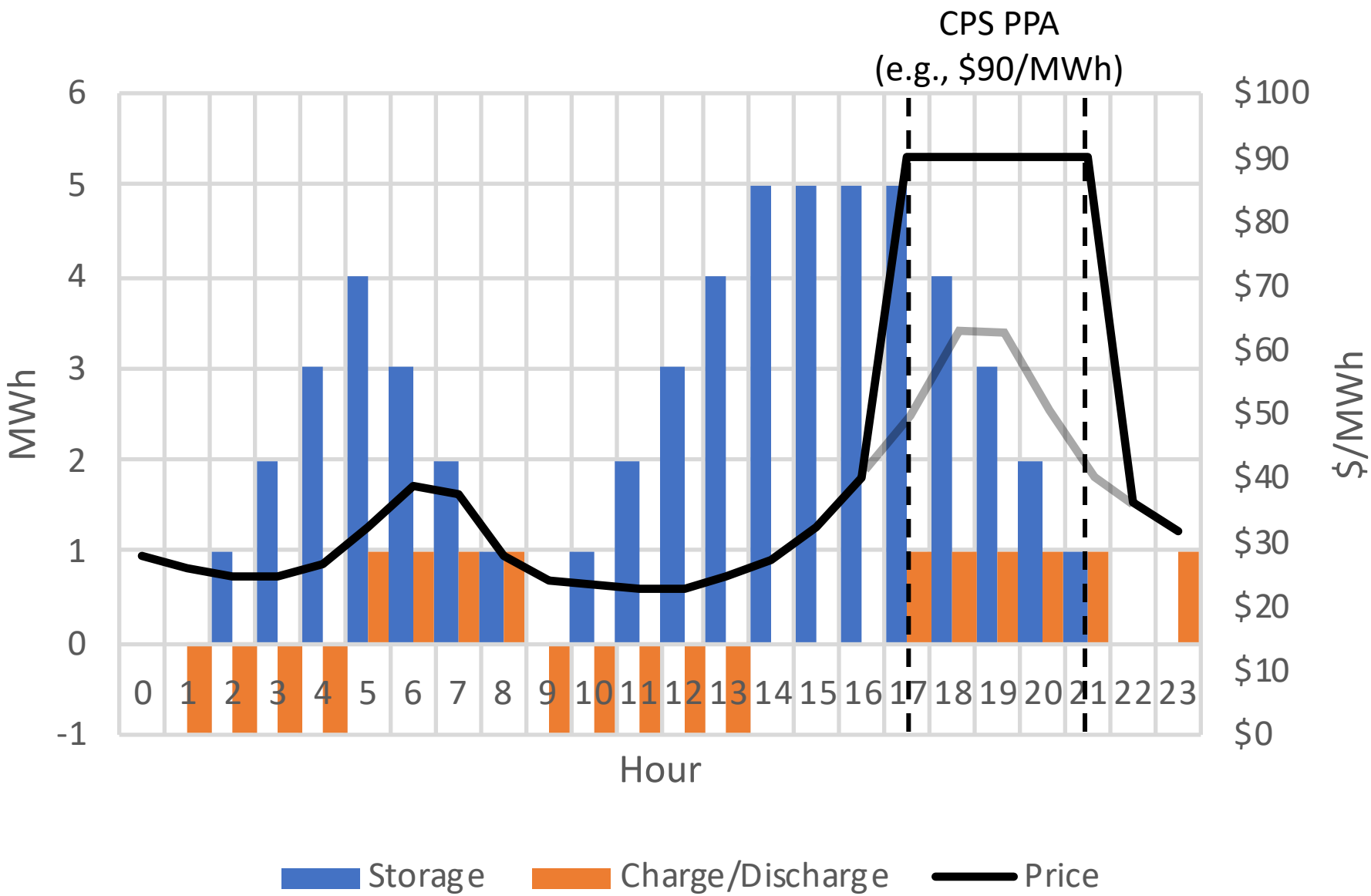
Using Storage to Arbitrage Hourly Prices Outside CPS



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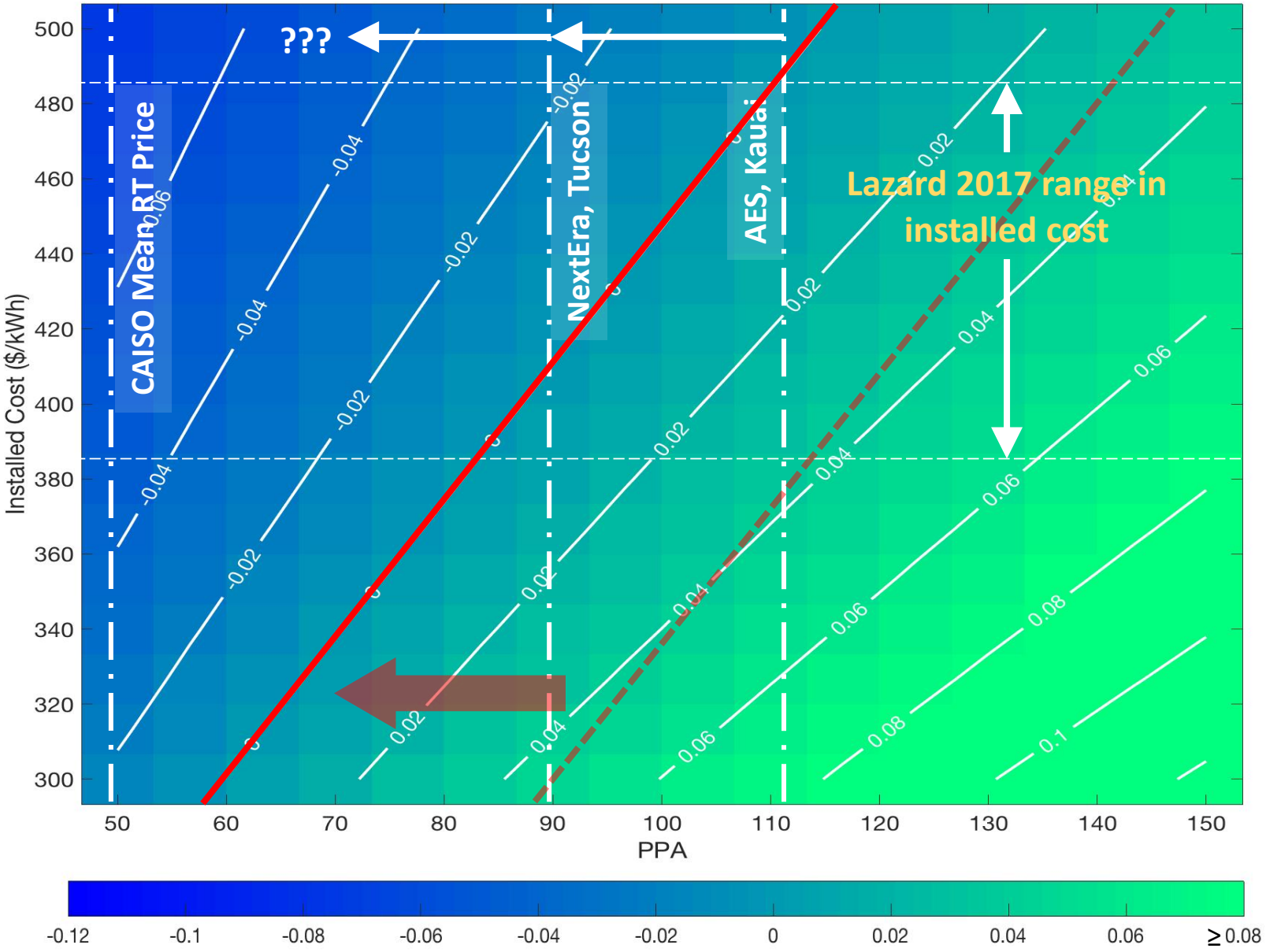
Complete Discharge During CPS Hours + Arbitrage



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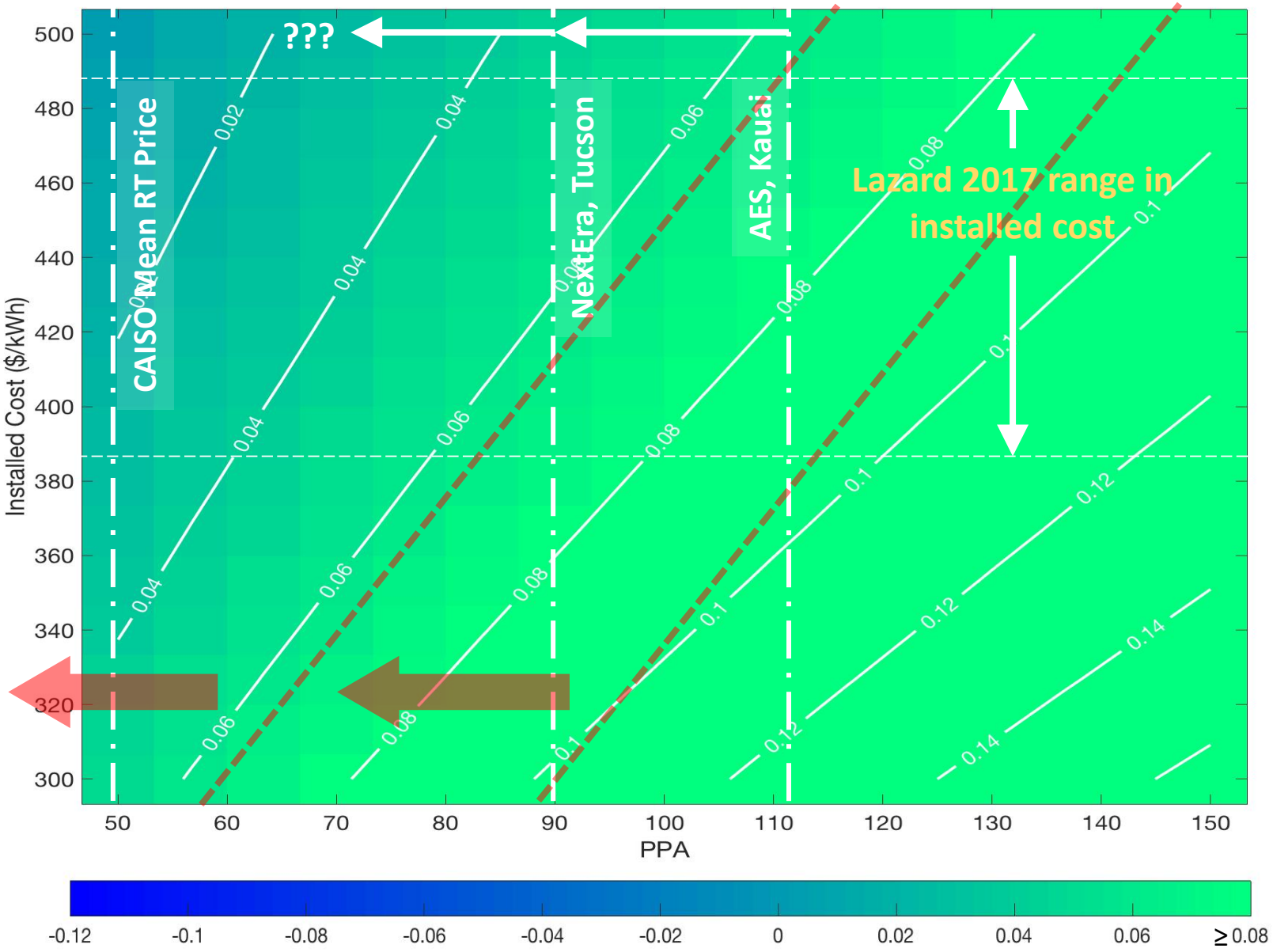
As Before, but over 20-y Rather than 10-y Period



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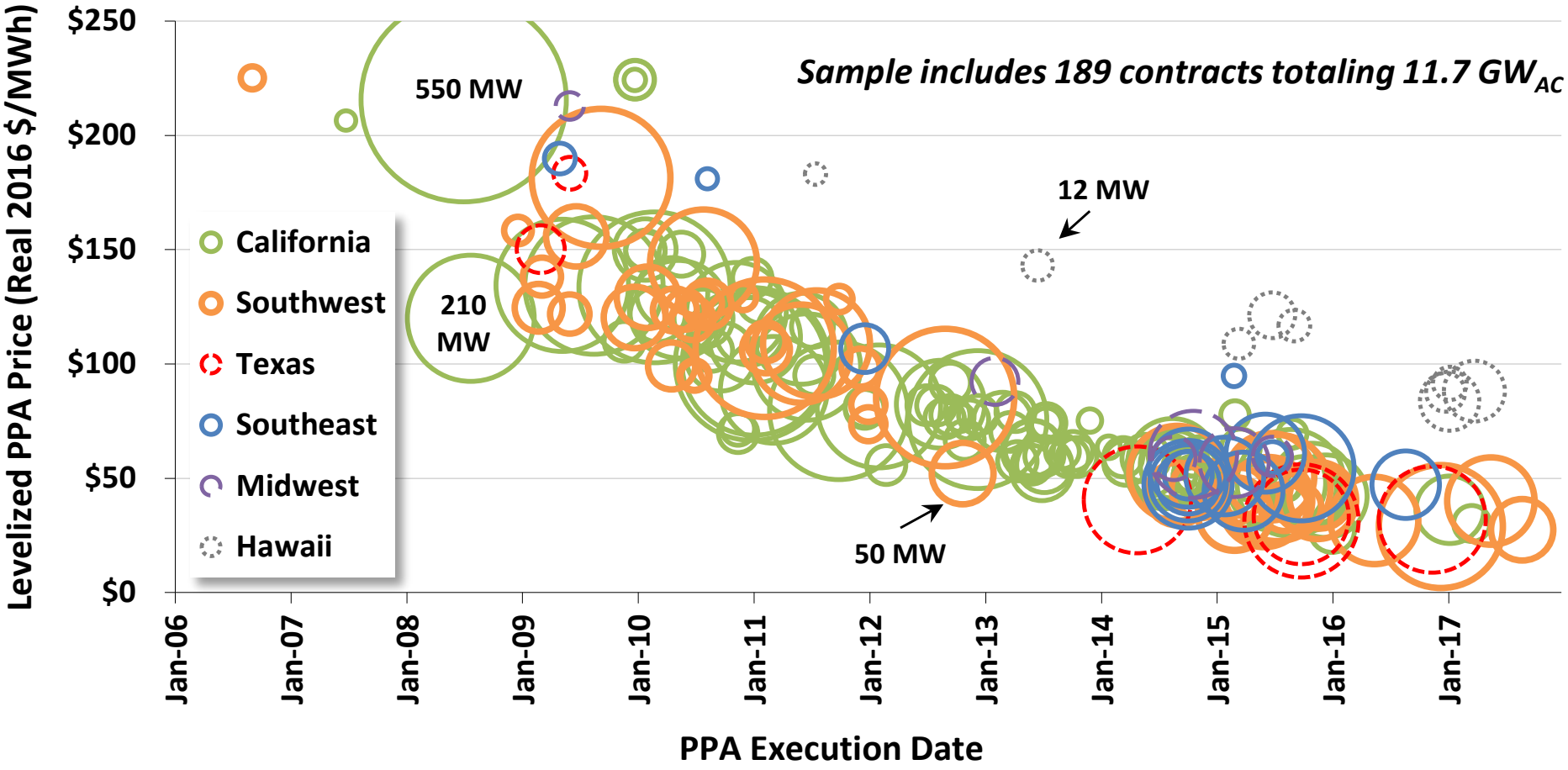
Coupling w/ Storage Will Likely be for New PV Only



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