IEEE PELS / SVPVS : Renewables Meet Energy Storage

November 9, 2017 Aloke Gupta

NuTech Solutions

Energy Storage...





CPUC* Storage Mandate Issued in Oct 2013

>CA major utilities to procure 1.3 GW of storage by 2020

(All figures in MW)

	CUM TARGET
Southern Calif Edison (SCE)	580
Pacific Gas & Electric (PG&E)	580
San Diego Gas & Electric (SDG&E)	165
Totals	1,325

*California Public Utilities Commission

CA Storage Procurement Progress

(All figures in MW)

	CUM TARGET	% UNDER CONTRACT	PENDING
Southern Calif Edison (SCE)	580	90%	20
Pacific Gas & Electric (PG&E)	580	16%	115
San Diego Gas & Electric (SDG&E)	165	71%	50
Totals	1,325	55%	185

Rapid Decline In Storage Cost



2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025

Source: Bloomberg New Energy Finance

Cell Pack

Exponential Growth in Storage Deployment

Cumulative 40 to 60 GW by 2025

(not including EVs, pumped storage)



Applications Driving Growth



Cost Implications of Deploying Storage?

- ➤US annual demand peak ~ 1000 GW
 - 10% storage ~ 100 GW → ~ \$100B
 - 20% storage ~ 200 GW → ~ \$200B

Damage due to power outages, surges and spikes

~ \$150B per year

Potential Mobile Storage Available to Grid?

- Chevy Bolt ~ 60 kWh battery
- >2M cars sold per year in CA
- >50% avail → 60 GWh storage → 15 GW peak @4 hours
 - ~ 30% of CA demand peak

- ≻25M total cars in CA
- >50% avail → 750 GWh storage → 188 GW peak @4hours
 - > 3x CA peak
 - ~ 20% of US peak!

Looking Forward

Develop non-battery energy storage options at scale

•Thermal, hydro, mechanical, renewable gas, renewable fuels

Integrate energy storage into resource planning

Adapt policies and utility models to leverage storage capabilities

Displace natural gas power plants (w/ storage + renewables)

•120 GW of simple cycle peaker plants

High penetration of distributed energy resources (DER)

Evolve to 100% renewable energy, economy-wide!?

Thank You! Aloke Gupta