

US Electric Utilities & IPPs

The Storage Inflection Point?

Equities

Americas
Electric Utilities

Combination of declining cost and new business models causes tipping point

We hosted meetings with Sam Jaffe from Navigant Research following our recent popular conference call [\[link\]](#) where we dove into a host of storage related issues. *Sam continues to emphasize that we are nearing an inflect point in battery storage* where the economics on high-quality Lithium Ion batteries is unlocking new business cases that were previously unavailable just a few years ago (driving development efforts to at least seriously evaluate storage solutions as alternative to future urban peaking needs). While residential storage is still generally uneconomic (at least ~\$2,500/kWh), [Units are /kW per hour of operation], AES' recent award in California shows the favorable trajectory on grid-scale battery installations at ~\$1,500/kW in costs (for a load-shifting system of ~4 hours) by late this decade once fully developed. This represents a shift from \$500-700/kWh today vs ~\$250/kWh estimated by the end of the decade, pre balance-of-system costs [~\$400-500/kWh]). In conjunction with improving component costs, declining costs of capital, and the potential for utilities to ratebase the investment, the mix of factors are ripe for continued growth in storage as the market nears a tipping point with storage deployment reaching critical mass.

Lithium Ion remains dominant technology player (for now)

Sam estimates that in ten years (2023) 'next-gen' batteries will only have 10-15% of the overall market with lithium ion continuing to represent the vast majority of installations. Even if new chemistries begin to take hold (lithium sulfur and metal air were highlighted as promising technologies) it will take quite some time for lithium ion to be displaced given the high sunk costs which allow manufacturers leeway to produce at-scale & below cost. The sensitivity to commodity price movements for lithium ion remains real, particularly with cobalt and nickel, the latter contributing to a potential ~\$20/kWh increase in costs following the recent recovery in prices. While we would have thought grid-scale storage solutions would diverge from transportation sector solutions seeing differing 'needs' (energy density, volume, and operational characteristics), the scaled-up economics of Li-Ion batteries remains compelling for now for both solutions..

Not just a renewables story either – it's about more efficient dispatch

Many investors focus on the application of battery storage to complement renewables (ex. storing cheap off-peak wind energy) but this commodity arbitrage is just one of the many uses. For example, AES' 100MW (~360MWh) of California storage could be used as a buffer for its conventional generation, essentially using the batteries to dispatch at ramp-up and recharge during ramp-down, essentially allowing to more efficiently utilize natural gas (~60% efficiency vs ~25% efficiency). We continue to expect that more diversified utilities and IPPs will explore this application for batteries.

What is the life of a battery? Key value driver in utility-scale economics

A key risk is less than the contemplated ten year life expected from batteries as the constantly cycle is an unknown challenge. While it is possible to accelerate testing of batteries under stress, there is no substitute for a ten-year, 90% daily charge cycle to assess the impact on the battery degradation. While car batteries have to deal with more heat and vibration compared with stationary storage, the discharge cycle is far lower which makes cycling easier on the battery. In Brattle's report on Oncor, the group assumes a 15-year life for the batteries and 30-years for balance of system components. Sam thinks the 15-year assumption could be optimistic and points towards the recent RES Americas plan in IL (2 x 20MW) where RES is ordering twice the battery capacity from BYD to compensate for concerns regarding the lifespan.

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For further details on our Storage coverage, please refer to notes below:

The Storage Opportunity

In Search of the Storage Solution

Digging Deeper into Storage

Re-opening the DOE's Loan Guarantee Program

What do we think of the storage opportunity?

We continue to see this opportunity as playing into the hands of infrastructure developers who have largely been first movers in solar. We see the solar development analogy as relevant read through, with likely robust returns offered initially (likely high teens) as technologies are developed. We expect compression amidst more competition, particularly in the manufacturing value-chain with multiple technologies likely at play, to squeeze down the cost of storage later in the decade.

Key questions/opportunities for storage to resolve:

- **Regulation market opportunities** – while modest, we see 'shorter' duration batteries (~15-minutes) to meet the intermittency of renewables and other shifts in grid dispatch as a key opportunity. *This appears to be economic today and the source of the bulk of the installed storage asset base to date.*
- **Can storage be included in ratebase?** Oncor appears poised to challenge the definition of what is conventionally defined as T&D vs. generation, with its legislative effort to allow it to develop storage resources in ratebase. As a reminder, the California utilities have already been authorized to ratebase up to half of their 1.3GW mandate.

Who will pursue storage? We see developments as playing into the hands of contracted IPPs and the infrastructure thesis – as well as YieldCo's eventually. We expect this novel technology to provide yet another opportunity for third-parties to develop generation assets on behalf of utilities. We look to IPPs to benefit (namely AES and NRG more meaningfully), with integrated utilities (like NEE), and California utilities too (SRE, EIX, and PCG). AES' meaningful competitive advantage in this business remains its most appealing lever to the upside to garner greater market share in coming months – and could yet become a more meaningful contributor to consolidated EPS growth.

Most meaningful potential for AES as it leverages incumbent position to revitalize EPS growth

What storage is *not* necessarily clear to us

Amidst much discussion in the industry of battery deployment, we do *not* see batteries as a solution to going 'off-grid'. Rather, we see greater penetration of EVs as actually *accentuating* the need for the grid, seeing homes as largely unable to both charge their homes and their cars in a given day (or at least reliably). Moreover, we don't believe economics for long-duration charges – particularly at the residential level – as being economic for some time.

Please see our recent note: *Are EV's the Antidote to the Utility [Death] Spiral?*

Where is cost trending? Still downward although rate of improvement is naturally slowing

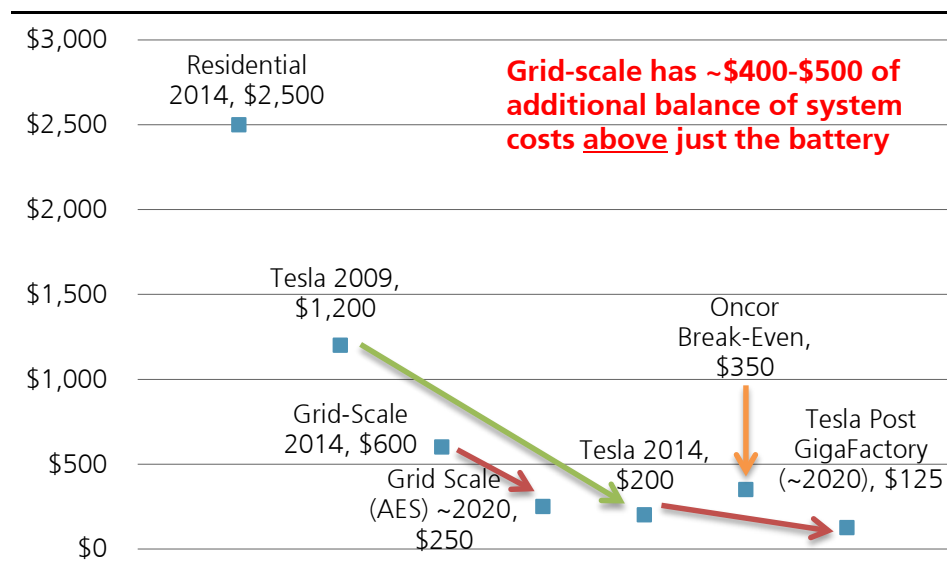
Below we present a summary of recent cost datapoints, which shows the delta between automotive and grid-scale applications. The rate of improvement for both use cases is improving the economics in each respective arena, with the grid-scale declines helping to facilitate our first real-world applications on scale. Figure 1 below just presents the battery cost and excludes the balance-of-system costs which are estimated in the \$400-500/kWh range.

Residential storage products still remain significantly more expensive based upon the lack of scale currently, pouring cold water on the idea of any material adoption at least in the short/intermediate-term. The forecast of Tesla's annual production of 35GWh of annual production leaves ~15GWh of surplus for stationary storage applications which should improve the cost profile of residential and grid-scale in tandem.

Cost declines in just the last five years and projections through the balance of the decade are facilitating an acceleration in storage adoption.

Residential application still out-of-the-money.

Figure 1: Battery Cost Datapoints (\$/kWh) – largely ex-balance of system



Source: Navigant Research, Company Filings, and UBS Estimates

Where can cost continue to decline? Scale, materials, and expertise

Underlying chemical component costs should continue to decline as the scale increases as more ingredients move towards becoming a commodity chemical. As mentioned above there could be cost pressure on some commodities if anticipated four-fold increase in capacity comes to fruition; however, the vast supplies of lithium mineral deposits should help alleviate pressure. The most obvious other area for improvement relates to scale and continued focus on manufacturing expertise.

CPUC Casting Cloud Over California Solar

Last Monday the remaining California utilities issued their first RFOs which are targeted to meet the October 2013 CPUC decision target of 1,325MW of storage by 2020 (Decision 13-10-040).

- **Pacific Gas & Electric (PCG):** 74MW target (Min size: 1MW)
- **San Diego Gas & Electric (SRE):** 25MW minimum (Min size 0.5MW)
- **Southern California Edison (EIX):** 16.3MW minimum (Min size: 1MW)

Last week's actions are the first of four targeted biannual requests with the next three coming in 2016, 2018, and 2020. As indicated below, the RFO process will span the bulk of 2015 and we will likely not see concrete datapoints until late 2015/early 2016. At a conference last week Commissioner Pickering stated the Commission "might punt" on the "first couple of rounds" of storage RFOs if the costs are too high but expressed confidence in the ability to meet the 1.3GW 2020 target.

Could CPUC 'punt' on the first rounds of storage RFOs if costs are too high?

Figure 2: California 2014 Energy Storage RFO Schedules

California 2014 Energy Storage RFO Schedules			
Event	PCG	EIX	SRE
RFO Issuance	12/1/2014	12/1/2014	9/5/2014
Deadline to Register for Participants' Conference	12/16/2014		10/11/2014
Participants' Conference	12/18/2014	12/17/2014	11/10/2014
Notice of Intent (NOI) Submittal Deadline	1/5/2015	2/2/2015	11/14/2014
Offer Submittal Deadline	2/17/2015	4/1/2015	1/5/2015
Participants Notified of Eligibility for Shortlisted Offer Negotiations	4/24/2015	5/15/2015	6/5/2015
Negotiation Deadline		7/31/2015	
Final Offer Deadline		8/10/2014	
Target Deadline to Execute Agreement	10/1/2015		
Final Selection & Execute Agreement		9/14/2015	
File Application w/ CPUC	12/1/2015	11/6/2015	1Q16

Source: Respective Company Filings

Relevant Links are Below:

[CPUC Decision 13-10-040](#)

[PCG Energy Storage Program](#)

[SRE Request for Offers](#)

[EIX 2014 Energy Storage Request for Offers](#)

Bringing Batters to The Windy City as Well

Last month Renewable Energy Systems (RES) Americas announced two grid-scale storage plans for Illinois (near Chicago) coming online by August 2015. The two assets will be 19.8MW each with a collective 7.8MWh of capacity fulfilling needs in the PJM frequency regulation market as well as being compensated via other revenue streams interconnected with Exelon's ComEd service territory. The underlying technology is lithium iron phosphate and supplied by BYD Americas.

Frequency regulation remains the low hanging fruit.

Frequency regulation market tapped out? Not yet

Frequency regulation has been among the first use cases on the grid to prove its economics but could similarly be the first to reach saturation. PJM can likely support ~400MW of capacity with perhaps 2GW total in other markets, indicating that while the return profile is meeting return thresholds, there is a finite capacity here at least until we see a significant increase in renewables penetration in the

Regulation opportunity depends on renewable penetration

What can the economics translate into? Comparing California Peakers to Storage Solutions.

Below we present a comparison of our estimates for NRG's proposed Carlsbad Energy Center with AES' latest California battery storage award, with the most significant difference being the limited life of the battery storage assets. While a conventional asset has the luxury of spreading the capital costs over 30+ years, the expected lives for batteries could be in the neighborhood of 10-15 years, materially increasing the revenue requirement. We flag the battery contract is for 20-years and likely includes two separate battery installations (ie – a subsequent \$1,000/kW investment for years 10 through 20). We estimate a conventional new build peaking unit in California would require a PPA price of ~\$196/kW-yr (or \$16/kW-mo), vs. projected economics of a battery at ~\$299/kW-yr (or ~\$25/kW-yr).

Figure 3: Estimated Economics for NRG's Proposed Carlsbad Energy Center

Carlsbad Energy Center (\$/kW Analysis) (UBSe)	
1,250	\$/kW
15%	ROE
30%	Cap. Struct (Equity)
56	Net Income (\$/kW)
30	Taxes
87	Pre-Tax
48	Interest (\$/kW)
5.50%	Cost of Debt
135	Op. Inc (\$/kW)
42	D&A (\$/kW-year)
20	O&M
20	Fixed (\$/kW-year)
3	Var. (\$/MWh)
196	Rev Req (\$/kW-year)
538	\$/MW-day
176	EBITDA (\$/kW)
196	Gross Margin (\$/kW)
600	Capacity (MW)
106	EBITDA (\$ Mn)
650-850	Total Construction (\$ Mn)
750	Midpoint (\$ Mn)
225	Equity Contribution
525	Project Debt

Source: Company Filings and UBS Estimates

Figure 4: Estimated Economics for AES'

AES Battery Storage (\$/kW Analysis) (UBSe)	
1,000	Battery Cost (\$250/kW x 4 Hours)
500	Balance of System (\$/kWh)
1,500	\$/kW
18%	ROE
30%	Cap. Struct (Equity)
81	Net Income (\$/kW)
44	Taxes
125	Pre-Tax
58	Interest (\$/kW)
5.50%	Cost of Debt
182	Op. Inc (\$/kW)
117	D&A (\$/kW-year) [10 & 30 year lives]
	O&M
	Fixed (\$/kW-year)
~Minimal	Var. [Charging costs ~offset by arb.]
299	Rev Req (\$/kW-year)
819	\$/MW-day
299	EBITDA (\$/kW)
299	Gross Margin (\$/kW)
100	Capacity (MW)
30	EBITDA (\$ Mn)
100-200	Total Construction (\$ Mn)
150	Midpoint (\$ Mn)
45	Equity Contribution
105	Project Debt

Source: Company Filings and UBS Estimates

Why would California utilities pay the premium for Storage?

- Reason #1: It enables a lower-cost CCGT dispatch nimbly like a peaker (as is the case, with AES constructing the battery next to its proposed Alamitos CCGT)
- Reason #2: Ability to deploy in urban areas. Seeing meaningful permitting issues for even new gas plants in Southern California – among other areas – we see the ability to deploy batteries in relatively developed urban areas quickly, with limited site needs
- Reason #3: Environmental permitting ease: Complementing our argument around urban deployment are the corresponding benefits to NO_x /Ozone reduction to urban areas. With new gas plants in Southern California effectively required to buy emission rights from retiring units, we see limited ability to construct further units in this region to backstop retirement of SONGS.
- Utilities are not actually contracting much yet. We flag with prices still at a meaningful premium, utilities are holding off on actual procurement. We flag CPUC Picker's comments of late, suggesting they would *delay* the formal selection of resources arising out of the RFP process for storage units 1-year for the three IOUs (at least), and with LIPA on Long Island cancelling outright its procurement efforts, cost remains a frustration.

Further detailed are available in our note, ['The Storage Cycle Starts in California'](#).

Texas could steal the pole position from California

Oncor grabbed the spotlight at EEI last month when it announced its plans for a significant battery investment across Texas which could include up to 5GW for \$5Bn (not entirely an Oncor investment but likely spread across other incumbent Texas utilities). The initial plan would include 25,000 large batteries across the state premised on a partnership with at least one large battery manufacturer (Tesla was mentioned in the original news article). Tesla would be a likely partner given its ambitions to scale the business as well as its expertise in power electronics. The plan would include a three-hour battery dispatching during the peak hours and capturing the arbitrage. The objective as detailed in the Brattle report is to have net customer savings and essentially receive the T&D stability/reliability and environmental benefits essentially for free. It remains to be seen exactly how the investment would be structured but Oncor could own the batteries in ratebase and then lease them to a counterparty that operates and dispatches them independently. A minor (less than 1% according to management) capacity holdback would be required in order to provide reliability benefits for customers in the event of a storm or similar outage.

Under the baseline assumptions the entire battery investment would have to be replaced every 15 years, including the core infrastructure that hosts the batteries (unlikely but this does offer a cushion for the economics). The break-even number cited was \$350/kWh (down from \$500-700/kWh) and as it approaches \$200/kWh it becomes more a "no brainer" according to management, based upon 5GW installed. **Sam generally agrees with the recent Brattle report on Oncor's proposal to build ~5GW of batteries in the state but takes issue with the plan to distribute the battery storage, instead preferring a centralized solution would.** On a run-rate basis, distributed systems could cost 40-60% more than centralized systems.

Subject to regulatory approval, Oncor is poised to deploy up to 5GW of batteries which it views as cost competitive at \$350/kWh.

A key hurdle will be getting legislation changed as currently Oncor is unable to own assets involved in the competitive markets (although batteries are a net energy consumer given inherent inefficiencies), seemingly necessitating a legislative change. We would expect significant generator pushback on such a proposal so the probability of Oncor succeeding in the next legislative session is far from clear, a reality that Oncor admits. However, even if unsuccessful in the near-term, Oncor believes that it will continue to educate regulators and stakeholders making the argument far more compelling in the 2017 timeframe when the cost competitiveness will be even more attractive (potentially even below \$350/kWh. Brattle estimates that the super-peak hours will still exist even in a post-battery world but it remains to be seen how much of a dampening impact such an investment will have on the peak scarcity hours. Companies with baseload coal and nuclear capacity could actually benefit in part due to the increase demand being placed on the off-peak hours which should provide some degree of improvement there. The likes of TXU's higher heat-rate plants and other steamers are likely the assets most displaced by such a move, further pressuring these assets.

For further details, [please refer to the Brattle report on Oncor's proposed investment.](#)

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Risks for Utilities and Independent Power Producers (IPPs) primarily relate to volatile commodity prices for power, natural gas, and coal. Risks to IPPs also stem from load variability, and operational risk in running these facilities. Rising coal and, to a certain extent, uranium prices could pressure margins as the fuel hedges roll off Competitive Integrations. Further, IPPs face declining revenues as in the money power and gas hedges roll off. Other non-regulated risks include weather and for some, foreign currency risk, which again must be diligently accounted in the company's risk management operations. Major external factors, which affect our valuation, are environmental risks. Environmental capex could escalate if stricter emission standards are implemented. We believe a nuclear accident or a change in the Nuclear Regulatory Commission/Environment Protection Agency regulations could have a negative impact on our estimates.

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