US Electric Utilities & IPPs
Breaking Down the Value Proposition of US Storage (Includes Conf Call Transcript)

Operational installed storage in the US ~850MW in 2019: quadruples from 2015

We held our latest conf call with Matt Roberts of the Energy Storage Association (ESA), discussing latest trends in storage solution adoption: markets for storage are expected to expand for grid scale, distributed scale, and also behind-the-meter systems. Globally, his expectations of storage are to increase from ~3-4GW of operational systems right now, to about ~6GW+ installed operational storage by 2020. In the US he projects installations to increase from sub 100MW levels in 2014, to ~850MW by 2019. Markets with favorable policy are in focus: California continues to be the leader for adoptions, along with PJM (Mid-Atlantic) the other market of focus for quick ramp capabilities; and northwest Texas could continue to ramp up its share of the pie as well.

Costs continue to decline: increasingly from BoS savings

Most industry participants we speak with expect the cost trajectory to continue its downward trend – this will come from not just the actual cell costs or improved efficiency of the underlying technology for electrochemical storage; but increasingly, a big part cost savings in the US will be from the balance of system: given ~60% of the cost of a storage system is the switches, inverters and those technologies - there is significant delta to be achieved as those costs continue to decline. Projections used by ESA suggest -5.8% BoS CAGR over the 2014-30 period.

Three key avenues for storage investments: where's the value proposition?

We see storage deployment as broadly framed into three separate buckets of ‘economic’ opportunity: 1) behind-the-meter storage solutions for C&I customers seeking to reduce their peak consumptions, effectively acting reducing total bills in the case of high charges and providing a demand-response capacity market to the grid. 2) We see utility-scale solutions, including both deferral of transmission projects as well as other solutions designed to effectively load shift around the solar peak to address early evening hours, etc. Finally 3) the most economic investments in storage to date remain oriented towards the short-duration frequency response market in PJM. We see this as providing an effectively ‘merchant’ investment opportunity with high current returns; this is likely to drive the most significant immediate investment in grid solutions driving down the economics to more reasonable levels. The key question is whether other regions will adopt the PJM frequency and voltage support markets, such as in Texas. Lastly of course, we add to this the value proposition purely from a transmission perspective where storage can be used to solve for grid congestion.

Grid scale dominates; but distributed potential to grow

Grid scale systems dominate the playing field amongst current deployments, but penetration of behind the meter localized installations should increase; they could in fact be the fastest growing market segment, given the small base it is starting from. This demand could come from the need to pair storage with solar systems, but also just on its own to regulate consumption at the consumer side (such as with C&I to manage demand charge - in this case systems can have a low 3-5 year payback period depending on how large their demand charge is). That said, neither we, nor ESA, really expect mass grid defection – just lesser dependence on the grid. Specifically on the residential side, ESA expects significant uptick in installs in the 2018-19 period.
Storage qualified as a generation asset: a major rate basing challenge

Although storage can work both ways (delivering electricity into the grid and also transmission congestion problem; it is generally seen only as a generator from a regulatory point of view. In ERCOT, Oncor has identified need of ~5GW of storage assets on their systems solely on the basis of their transmission benefits; but they won’t be allowed to sell energy from those assets since they are a T&D company. In the end, both the wholesale market values and the T&D system values associated with a storage system need to be captured to enable effective investment.

Regulatory approaches: States take the lead via funding, mandates, procurement targets

A number of FERC initiatives have really paved the way for energy storage: these are listed below – Order 755: Pay for Performance (related to ancillary services such as procurements of frequency regulation) / Order 784: Third Party Services and Accounting / Order 792: Small Generator Interconnection / Order 794: Frequency Response / Order 1000: “Non-Transmission” Alternatives.

However states have mostly led the way on the storage front. California which is the leader sets procurement targets for the investor owned utilities in California, and Oregon has sought to implement a similar program. In the Northeast, Connecticut, New York, New Jersey, Massachusetts, and Vermont are approaching storage more from a reliability/resiliency angle.

Other Datapoints on Storage Deployment

We include a few further points of focus following other recent conversations on the sector.

- **Warranties matter a lot:** We hear continuing concerns around the differing terms of warranties – and costs – around different battery chemistries. We note that some battery makers sell their cells in the US for a meaningful discount ($50-100/kWh) vs. other peers on account principally of this factor. We also see some risk around developers offering warranties that are meaningful potential liabilities should product fail; this remains a potential risk for a product that has a limited life of 5-10+ years depending on cycling characteristics.

- **‘Financeability’:** Without the ability to warranty a product, the batteries tend to garner substantial challenges to financing. While untested and lesser known chemistries can still indeed be pursued, the cost of capital could indeed be meaningfully higher. Bottom line, quality of assets – and warranty duration – drive significant bifurcation in pricing points.

Latest Pricing Points

With batteries continuing their meaningful deflationary trend, we flag latest prices for fully developed utility-scale systems appear to be trending towards the $400-500/kWh mark for future US deployment (~2018). We see the market as ever competitive with price quotes to US developments. Key players into the US market remain LG, Samsung, Panasonic (via Tesla), and BYD. Consistent with trends in the PV Solar space in past years, we see a wider trend towards commodization of the battery leading to meaningfully competitive market in the US.
What's the latest from Tesla on Stationary Storage?

Tesla remains very bullish on the stationary storage opportunity. In Q2, the company guided to storage sales of $40-50m in Q4, $400-500m in 2016, and $2-5bn in 2017; recall it’s typical product is targeted at 2-hours. In our view, TSLA’s storage guidance sets investors up for disappointment as we see the storage market taking much longer to ramp (see Will Storage Fall Short of Expectations?). In addition, full Gigafactory production by 2020 is expected to be 15GWh for stationary storage. In our view, it’s unclear if TSLA will have enough available capacity by 2017 to hit its sales target. The list price of the Powerpack (non-resi) is $250/kWh and the Powerwall (mostly resi) is ~$350-425/kWh; however the Powerpack is sold with supplemental services (maintenance, upkeep, etc.), which can bring the all-in price up to $500-750/kWh. We understand price points remain largely competitive with peers, however, without deployment history thus far we sense some caution from developers (suggesting a need for a discount at least initially).

The C&I Behind-the-Meter Opportunity: Key Challenges

We see the following as the principal challenges in executing on continued growth in the C&I battery opportunity:

- **Fire considerations**: We see stringent commercial building fire codes as a key impediment to battery deployment; while not necessarily a limiting factor, the corresponding cost of solutions appears quite substantial. For instance, at present, there appears to be just one FDNY approved application for NYC commercial buildings focused on lead-acid based chemistry.

- **Space considerations**: Finding adequate room in basements of commercial office buildings in urban markets remains the key to deployment. We continue to perceive better deployment opportunities in less crowded West coast applications.

- **Demand charge tariffs**: The key to C&I is both the duration of the peak period (in NYC, established over 15-minute period), as well as during what hours that peak is incurred. While the shorter the peak demand window the better (eg – the shorter peak period, the cheaper/smaller the battery that can be deployed to clip the peak).

- **Supplementary compensation**: We see several programs as key to bolstering C&I deployment, including most notably California’s SGIP program. We suspect growing attention will be placed on available programs to encourage adoption.

- **Qualifying for such compensation**: Meanwhile, limitations on when such demand reductions are needed limit the ability for storage to help, with potential mismatch between utility-system and specific battery-user peak hours.

What's the latest on the long-term opportunity?

Having spoken with a variety of battery developers, manufacturers, and policy makers (like Matt Roberts) of late, we are incrementally more constructive on the deployment opportunity. We see the near-term as remaining dominated by more 'capacity'-like plays, including fast response markets, which depend upon short duration of batteries to ensure deployment. We see this playing out in the US context most notably in the PJM market today with its frequency response/Reg D...
scheme, but could well expand to other organized power markets like ERCOT in Texas and California. The key remains to providing a market incentive for battery integration. While compensation remains lucrative today, we see this as a fundamentally small niche market, likely limited to ~1% of peak load.

We see software deployment schemes as potentially the winning play in the US, with growing attention to both Stem and Green Charge networks selling software schemes that can monetize battery products via not just customer-side peak shaving, but also in clipping payments from demand reduction in US capacity reduction schemes (somewhat fungible with existing Demand Response products). Batteries can effectively ‘monetize’ multiple revenue streams from the same installation with appropriate (predictive) software solutions.

**Shift towards energy solutions seems the likely play**

In the medium-to-longer term, the opportunity set for batteries shifts to the ability for the product to deliver at a cost effective cost durations of 4-6 hours to meaningfully address renewable balancing. While costs today would appear too costly to address this need – nor is US penetration of renewables seemingly adequate anywhere aside California to warrant these concerns – we suspect this could well play into the next decade’s continued deployment of systems.

**How will US regulators allow for storage in utility planning**

A further key question will be the uptake of storage solutions into T&D system planning; will it be treated as generation or a T&D deferral tool. While such questions will not prove troublesome in still vertically integrated environments, we see this identity question as problematic in restructured markets in the US. While much of the procurement of utility-scale projects in the US appears more generation oriented in nature, the question remains to what extent storage will be coupled with traditional T&D planning and integrated resource planning as an alternative to substation upgrades, etc in a more consistent manner. We read comments from industry participants as relatively moderate here; we flag our previous report on this angle evaluating Oncor’s Battery Efforts in Texas with the Brattle Group consultancy responsible for the proposal.

**Different chemistries for different solutions: Flow batteries play a role too**

What is increasingly clear in the US context is the potential application for different technology solutions to different solutions, including opportunities for Flow batteries. While these remain generally expensive, their ability to continue to bring down cost for protracted durations, and potentially long-lives could well prove attractive to full peak shaving solutions. We further caution other chemistries could yet emerge to fill both quick start and long-duration niches, including other metal technologies.
Please click on the links below to read some of our recent reports around the storage theme:

The real battery storage opportunity
Exploring the Frequency Regulation Opportunity for Batteries
The Storage Infection Point
The Storage Opportunity
In Search of the Storage Solution
Digging Deeper into Storage
Re-opening the DOE’s Loan Guarantee Program

Key Charts from ESA Presentation:

Figure 1: Global planned storage (non-hydro): ~6.3GW by 2020

![Figure 1: Global planned storage (non-hydro): ~6.3GW by 2020](image)

Source: Energy Storage Association; slides used on UBS conference call

Figure 2: US installations: ~850MW by 2019

![Figure 2: US installations: ~850MW by 2019](image)

Source: Energy Storage Association (Sourced from GTM research); slides used on UBS conference call
Figure 3: Where are the projects in the US?

Source: Energy Storage Association; slides used on UBS conference call

Figure 4: How are costs expected to evolve?

Source: Energy Storage Association; slides used on UBS conference call
Conference Call on Energy Storage

We held our latest conf call with Matt Roberts of the Energy Storage Association, a DC-based advocacy organization, to discuss national, RTO, and state-level policies around storage adoption. We present below the transcript of the call which has been edited for grammar and ease of reading.

Please let us know if you would like to receive a copy of the slides that were used on the call.

To listen to a replay of the call, use the dial in details below:

Replay Info:

Toll Free: 800-633-8284
Toll: 402-977-9140
Passcode: 21775520

Julien Dumoulin Smith: Hello everyone, I appreciate you joining us for our latest conference call on energy storage. We are joined today by Matt Roberts, Executive Director of the Energy Storage Association in D.C; who has a lot of relevant experience in the sector - I’ll let him provide more background.

So with that I’ll turn it over to Matt. Good afternoon, thank you for taking some time with us.

Matt Roberts: Great, thanks so much, Julien, and thanks everyone who is on the call today. My name is Matt Roberts, I’m the Executive Director at the Energy Storage Association. As Julien alluded to, I’ve spent some time in policy and energy here in Washington, D.C. working on renewables, working on vehicle infrastructure and other topics across a range of technologies. Energy storage of course is a very hot topic. It’s being talked about quite a bit and is becoming increasingly a major part of long term resource planning and other decision making on our grid and on our infrastructure. It’s becoming a big part of state and market plans.
So what I’ve been asked to talk about today is related to markets and policy and what we’re seeing currently for energy storage and other fast responding resources that look and perform similarly to storage (like demand response). And also, what are the opportunities we’re seeing on the horizon. So there are a lot of strong indicators and we’ll get into some of those details.

There was a slide deck that was provided, I’m going to loosely follow that and give a briefer version of the information contained therein. There are a number of charts and graphs and some other resources there. And after this call if you have any follow up questions that we’re not able to get to always feel free to reach out, I’m happy to address questions when I can.

So we’ll jump right into it. So first thing I always like to say on this and it’s in one of the first slides is energy storage is already deployed and providing services now. When we talk about this we often talk about when is this going to start taking place? When is this going to accelerate? And the answer is these systems are out there now. Markets are expanding and opening up for storage, and increasingly it’s being deployed at grid scale, at the distributed scale, and also behind the meter. So we’re seeing all three facets of the energy storage market accelerate.

Energy storage association is about 25 years old. We have about 200 members. We’ve been growing rapidly over the last couple of years. And we have members working in all parts of the grid - big transmission scale, or at site of generation scale systems, distributed systems, behind the meter, installed in homes and businesses, commercial industrial facilities.

And we have members from across the spectrum so everyone from manufacturers and product developers to those who are project developers; and on the implementation side other than the utilities, big customers, multinational IPPs. So we cover the full spectrum of engaged and invested stakeholders in the industry.

There are a couple slides contained and this references information that is available from the DOE’s energy
storage database (for those interested in more - that is a great resource). It’s very flexible. You can search by different technology types, different states of deployment etc.

**Operational energy storage that we’re seeing out there right now is maybe in the 3-4GW of rated power range.** And we’re seeing those all over the world, primarily the US, Europe, Asia, and increasingly Australia is becoming a big part of this equation as well. To a limited extent we’ve seen some installs in both Africa and South America. But those two continents are also starting to engage in storage more and more as more technologies and more solutions come online.

Over the coming years there are a number of different organizations that do market surveys and market studies and provide projections. I won’t pick any winners or losers as it is for projections but there definitely is an accelerated growth curve that we are on right now. And we expect this to continue to rapidly expand.

**We can expect installed operational storage systems to be up well over 6GW once we get to 2020 and beyond.** So we are expecting this to effectively double in size and this is installed operational systems. So it is coming on quickly and there’s a lot of projects in the pipeline.

Projects all over the US in particular - I know that’s a lot of the focus area for this call - these are out there already. They’re providing service. You’ll see a density of them in the west; **California’s been a big leader in this area; PJM is a leader in this as well and is deployed a lot of systems.** And to a lesser extent we’re starting to see them in some of the southwest - northwest Texas continues to play a big role in this as well. **Systems are going where there are good market structures or favorable policy conditions that enable storage to come into play.** And that’s going to be a big focus of what we’ll talk about today.

We partner with Greentech Media Research to develop quarterly reports. And actually the timing of this call
worked out very well. Today we are releasing the Q2 2015 quarterly report so you’ll probably see some news articles about that out and about and I’d be happy to distribute the executive summary to Julien so he can pass along to participants today as well. That will give some more insights into what we’ve seen this year.

So we saw about 41MW installed in the US and while that does not sound like a lot on the surface definitely is a continued increase in installations for energy storage technologies. This is an emerging market place but we are seeing continued growth.

On the other side of that coin we’re also seeing costs continue to fall. We are seeing a continued decrease in not just the actual cell cost themselves or the underlying technology for electrochemical storage, but the big part of this is also the balance of system.

About 60% of the cost of an energy storage system is actually the switches and the inverters and those technologies that complete the system. So there is much more ground to be gained as those costs continue to come down.

And many of those technologies are used in other sectors. They’re very similar to the technology used in solar and other places, so there’s the uptick in renewable integration and deployment at large which also impacts the cost for energy storage and helps to lower the cost of these systems.

But the main thing to focus on is the value. What is the value to the system for energy storage? Energy storage can perform any number of applications. Electric energy time shift or arbitrage is probably one of the most commonly understood facets, this would be soaking up solar energy during the day and using it at night or otherwise capturing what would otherwise be spilled wind energy during the evening and then being able to use that during the day. Arbitrage is probably the most straightforward application for energy storage.
But one of the big advantages is storage is a very dynamic resource. It’s able to respond incredibly quickly, much faster than other technologies deployed on the grid. And so some of these technologies are millisecond response time. But many of them or almost all of them are under a minute in response time.

So as soon as the grid identifies a need for energy storage, it is able to respond and deliver that energy. And it’s also very exacting. You’re not ramping a storage system up the way you have to ramp up a generator. When you call for a megawatt you get a megawatt. And that is another facet of energy storage that is very valuable, the accuracy of storage system.

To that end, energy storage has found a lot of success in ancillary services. For those not familiar with grid operations, ancillary services are really just about balancing out generation and demand to make sure that those are in sync and in harmony. Fluctuations caused on both sides of those equations can use some balancing - and energy storage, because of its intrinsic values, is able to provide that in a least cost manner and also able to provide that much more efficiently.

There’s also some big concepts like transmission upgrade deferral or congestion relief. The EIA anticipates that we’re about 50% overbuilt - we have way more infrastructure than is needed to service the load. What causes this excess infrastructure is peaking, which is very limited hours during the year where we need to meet excessive demand, the hottest of hot days. These spikes in demand and these peaks on our demand curve cause us to need to build infrastructure to address that. So energy storage is a way to help defer some of those costs because you’re able to generate energy when it makes the most sense and you’re able to consume the energy when you need it, where you need it, in a very efficient manner.

There’s also behind the meter or end user need - however you want to describe it. For power quality, reliability, that’s preventing blackouts and brownouts and those types of things.
And also energy tariffs arbitrage so buy low, sell high is in effect one of the concepts of being able to buy energy at more affordable times and deploy it to offset more expensive energy consumption.

So **energy storage is able to function as a capacity resource.** As I noted, it’s able to help address peaks and deliver that peak power when needed. And so that is a capacity function on the grid. And it’s also able to help out with deferral of upgrades as we discussed. Also, as a flexible resource, energy storage is able to respond much quicker than, say, a gas peak or plant with much less emissions put out. And also much more accurately so it’s able to effectively replace peakers on the system and those are some of our most expensive energy assets that often become stranded - because we only need them for such a small percentage of the year.

Some of these are operating at 5%, 6%, 7% capacity of what they’re able to deliver and these are multimillion dollar installations. So energy storage has a role to play in helping to offset the need for those types of things as well.

And also a good thing to note is **energy storage doesn’t idle, it’s not losing energy while it just sits there.** A storage system does have a round trip efficiency so based on basic thermodynamic laws you can only move so much energy through it.

There’s resistance in the system so you will have round trip efficiency losses but you don’t have idling energy losses that you might see from a power plant. But it’s also able to use its full flexible range. So it can go from zero all the way to, let’s say, 50MWs very rapidly as we discussed and also very accurately. But that same system can also absorb up to 50MWs as well and that is also a very valuable feature that **it can absorb energy when the grid needs energy absorbed.** And there is value in that, it can help prevent what’s called spillage for renewable resources when there’s just no where to put it - you will ramp down a wind plant because there’s nowhere to put that energy, there isn’t demand for that energy.
And instead of losing those renewables we’re able to capture them and then be able to use them when it is needed. And that’s a very valuable facet of storage as well.

There was a major study that was done by the Brattle group in November of last year. And, one of the big takeaways from that was looking in particular at the Texas marketplace, which is primarily ERCOT. The takeaway was seeing all these significant benefits that it brings to the system figuring out mechanisms for cost effective investment in energy storage will require regulatory framework changes, both on wholesale market, T&D system value, and associated values throughout the electric grid.

So that’s one of the big things that we’ve identified is that there is a need for modifications to the policy landscape and the regulatory landscape to help storage continue to be deployed on the grid. So I want to talk a little bit about understanding the policy landscape and then we’ll talk about some of the particulars that we’ve seen.

**On the policy landscape one of the big influencers on this topic is the Federal Energy Regulatory Commission (FERC).** And that commission is able to impact ISO and RTO markets. Also at the Fed level is US Congress and obviously the EPA as well. All three of these bodies have jurisdiction over impacting energy storage and energy markets at large.

I’ll start with FERC and the ISOs. FERC is Federal so they’re able to participate as a regulatory body whenever commerce goes across state lines. So FERC has jurisdiction over MISO, PJM, New York ISO, and some of these big areas. FERC does not have jurisdiction over ERCOT because ERCOT is entirely self-contained within Texas.

So since it doesn’t cross a state border they don’t have jurisdiction there. But ERCOT and other self-sustained or self-contained markets tend to follow FERC’s lead in many regards. A **number of FERC initiatives have really paved the way for energy storage - Order 755 focused on pay for performance, Order 1000 opening up non-transmission alternatives.** These have all been really positive developments. I’ll explain
pay for performance as one of particular note as an example of how regulatory changes are positive for energy storage.

Pay for performance is related to ancillary services so the procurements of frequency regulation, which is a very important function on the grid. This is traditionally been provided with a gas power plant. And as we noted before, those systems can take minutes to respond. And once they’ve responded they may be following the grid in the signal in the wrong direction.

So, five minutes ago we needed 10MWs extra so a system starts ramping up for that. By the time they’re ready to deliver that energy 100,000 homes shut off their TV and decided to go have takeout so there’s much less demand all of a sudden so now it’s delivering energy in the wrong direction. And so now I need to correct for that.

So that was one of the challenges that was identified in frequency response. And although some big markets are able to absorb some of these changes, it still doesn’t mean that we’re delivering this service in the most efficient way possible. And so FERC identified this as a place to say, okay, if we’re going to use a dynamic resource like storage, like demand response, that’s able to respond more efficiently - so let’s say that it only takes that energy storage system 9MWs to correct that deviation, that frequency response problem - then under current tariff structures you would actually be paid less for delivering a better product because you would be paid by megawatts.

So a slow, sluggish, thermal plant that has trouble following the signal will get paid for 10 or 11MWs in this example I’m making up but a storage system that did it with 9 would only get paid for 9MWs. So you’d be more efficient, more accurate, more timely but you receive less payment.

So what FERC ordered was that the ISO markets, develop a pay for performance scheme that would allow for additional compensation reflective of the value being provided. And we’ve seen that take off to great success in multiple markets. And it has definitely been a driver
for energy storage. That’s just one example of how Federal influence impacts markets across the US.

There are a number of more breakdowns included in the slides, things like flexible ramping, capacity performance, these are different types of products that really are benefited by energy storage’s characteristics, its ability to respond so fast so dynamically. And these are additional products that are being developed for systems that perform like energy storage.

In the US Congress, there’s some hope for an energy bill in 2015. There’s more than 40 pieces of legislation that are being circulated and being integrated into these master energy storage bills - omnibus bills. Looking for MLP parity. As many of you are familiar with finance, you’ll probably be familiar with MLP structures, but it’s just more equitable financial treatment for storage, that tax benefit is provided to other energy but not to storage technology.

The investment tax credits, currently energy storage systems can participate in the ITC if they are built along with a solar development so that would imply that the storage is simply a add-on, very similar to an inverter, just a part of the system that’s being deployed. But energy storage is not able to qualify for the ITC on its own so that is something that we would be looking for parity in how these systems are treated in that regard as well.

And then there’s also things that maybe are farther reaches like the Heinrich bill, which proposes a nationwide storage portfolio standard or some mandated structure. These are good conversations to have on the hill and have definitely driven conversation. But these aren’t necessarily something that is going to be at the top of the list for energy legislation moving forward.

The other place, many of you may be familiar with the clean power plans and the environmental protection agency, the EPA. We are expecting additional information to keep coming out of that.

We have started to get a better sense of that information; a lot of info was released by EPA. Energy
storage is seen as a part of that, seen amongst the solution that can be leveraged to help reduce emissions. And so we expect as those clean power plants continue to be developed and we see more and more limitations being put on emissions that that will only be favourable for energy storage moving forward.

So I talked about it at Federal level and how those three bodies can influence what’s going on in energy. Obviously the Department of Energy plays a role as well. Usually in research and development, in modeling, in helping to better understand how storage can be used on the grid, but those other three bodies in a regulatory legislative sense have pretty big impact on storage.

Looking towards the states - states really have been leading the way in many ways. Some of these FERC orders have had immense impact on what’s going on within energy storage but state programs really do highlight some of the different ways that we’re approaching this.

Let’s look how storage is being deployed. Many of you may be familiar with California’s energy storage mandate, AB 2514. The state identified the value of energy storage but looking at market structures it also became apparent that there weren’t effective market structures to drive deployment, even though there was a defined need to see storage on the grid.

And so they approached it from setting procurement targets for the investor owned utilities in California. And that has driven a lot of enthusiasm, excitement for the industry and also has really helped drive deployment.

And we’ve seen some record breaking procurements come out of that program including southern California Edison procuring about 250MWs of energy storage when they were actually asked or they set the target of just 50MWs during this year.

So a five-fold increase over what was identified through the legislature and the CPUC is we saw deployed. So that was a very big news day in what was going on in energy storage.
Oregon has sought to implement a similar program as well on their system. Obviously it’s a bit smaller system but they are looking to require procurements by their investor and utilities on to the grid as well. So in the west we’ve tend to see storage assisting and replacing capacity in playing a role in that way in the electric grid.

When we look in the northeast, states like Connecticut, New York, New Jersey, Massachusetts, even Vermont as well, these states are approaching it more from a reliability and a resiliency angle. Super storm Sandy has really influence a lot of decision making on the east coast around the grid, how to better address potential storms that may happen or will happen at some point in the future.

But maybe on a very short time horizon we may see more instances like this relatively soon. So we’ve seen different programs that look to highlight resiliency.

In New York, a big thing in the energy industry is what’s called **New York REV**, Renewing the Energy Vision I believe is the acronym. And this is a big program that looks to expand the use of distributed energy resources.

So that will undoubtedly have big impacts on how storage is deployed in New York but with the leadership that Richard Coffman and Audrey Zibbleman are showing there, that will undoubtedly influence many other markets as well as they start to move of their long term planning.

So we’ve seen those markets play a big role in driving energy storage. Others like Arizona and Hawaii have been taking this on as well. Sometimes through funding, sometimes through mandates, sometimes through procurement targets.

So there’s a number of different approaches that states have been taking to energy storage deployment and integrating on to the grid.
So overall states are really going to be a driver in this. And states will largely determine how to enable many simultaneous services. Energy storage is incredibly intelligent system wise, but all the storage system knows its doing is pushing electrons. It doesn’t know if you’re calling them for frequency response or var support in the literal sense. It’s just pushing electrons out when asked to.

So it can perform multiple services at once or sequentially and it’s very flexible in that regard. So a storage project is not dependent on a singular value stream, they’re able to tap into multiple value streams at once and what we call stacking the benefits to help expand the value of any given system.

And also **states are taking different approaches to how to quantify the value of energy storage**. What is emission’s reductions worth in a dollar per kilowatt sense of the word? What is a T&D deferral worth in an open market competitive marketplace? How do we define and capture that value and develop products and mechanisms for remuneration for energy storage system developers?

And then also looking increasingly at how energy storage is going to be used to meet reliability needs. Reliability is a core function of the grid. The utilities are required by law to meet certain standards and energy storage can help prevent blackouts, can help prevent brownouts, other system malfunctions, and even has been mandated by NERC, which is National Energy Reliability Council, focused on the reliability of the system. **At times energy storage has been deemed the solution to reliability issues** - increasingly states are leveraging storage as a reliability solution.

We have some policy basics on things that we actively pursue, **storage should be treated as a wholesale resource, storage when acting as wire should be eligible for rate based cost recovery**. Operating rules should allow storage to maintain a state of charge that is a good thing to note in this is that energy storage is not a generation asset. It absorbs energy and expels energy on command but you do have to allow it to absorb energy as well to be an effective participant.
It should be a capacity resource, should be a part of long term planning, and should be modelled side by side with traditional resources.

When we’re looking at solutions to our energy needs, whether it’s peak power or frequency response or some of these more arcane system operation markets we need to model storage side by side with other solutions and do that in a fair and cost competitive way to make sure that we’re leveraging all of our assets as best as possible.

And third parties and IPPs should be able to contract with utilities to provide energy storage. And there are some limitations on that now that we’re looking to expand upon. And with these policy changes in place we’ll continue to see investment and market growth in for US innovators and manufacturers.

A big takeaway from this is also the optimization of all resources on the grid. One of the promises of energy storage as it were is this idea of system wide optimization we want to see our thermal plants, our coal power plants, our natural gas powered plants, those should be maximized resources.

We should be using them at 99.9% of efficiency whenever we can on the system to make sure that we are reducing their environmental impact, reducing their fuel consumption. And energy storage can help enable that, can help balance out the modulations on the grid and allow our generators to generate because that’s what they do, that’s what they’re designed to do best. And leave rapid response to more dynamic resources.

So I know that this was relatively brief, I hope not too rushed and that’s good information. My contact information is included on the last slide as well, please do feel free to reach with any questions that we may not get to today or if you’d like more information about our organization. With that I’ll turn it back over to Julien for next steps, any potential questions.
Julien Dumoulin Smith: Yes, great, well, thank you so much, Matt, really appreciate it. First quick question on the residential side – are there storage systems that can be included with solar panels on a home that can keep a home totally off the grid? And what is that cost for the total package?

Matt Roberts: So behind the meter storage systems, homeowners, businesses, others can deploy storage cost effectively today. It’s already being installed in a lot of systems. There’s some drivers there beyond just the actual value of the system itself. But that could probably take up an entire separate call focused on virtual power plants and this idea of aggregating distributed resources together, energy storage is an enabler in that sense.

So these systems are already going in behind the meter and actually that’s probably going to be the fastest growing market segment. Currently grid scale technologies and grid scale systems tend to dominate the playing field of systems being deployed.

But I think we’re increasingly going to see more and more behind the meter localized installations and increasingly what we would qualify as distributed installations as well.

So on the behind the meter side, yes, it can be paired with a solar system, but it doesn’t have to be though. There is a good cases for putting in a storage system on its own to regulate consumption at the consumer side. The one example of that would be in San Francisco, one of the big hotels there has done a couple of installs with energy storage.

And they use it to manage demand charge. Demand charges are usually the bigger part of a commercial customer’s bill. And it’s representative of the infrastructure it takes to deliver peak demand for your facility.

So if you’re able to shave off your peak demand and your own peaks and prevent yourself from going over a certain threshold - you’re able to avoid some really
substantial costs. And those systems have three, four, and five year payback periods. So depending on how big the demand charges are they can be paid for really quickly.

So on the behind the meter, one of the other questions was on going off grid. It depends on where you are and if that is really the goal. I don’t necessarily think that there’s going to be a mass exodus from the grid because of energy storage. I don’t think that there’s going to be a bunch of wire cutters.

Grid defection does work in some instances. If you’re in Hawaii, if you’re in a place with a lot of sunshine, if you’re a military base or a university and you may want to try and take yourself off line and be more self-sustaining, that is a possible application of energy storage. But the bigger thing to look at is load defection. And that’s the bigger reality that we’re going to need to address is that more and more consumers will just be more independent.

They will be less dependent on the grid as a whole, which means increasingly we’ll have even more stranded infrastructure, that means that there will increasingly be less need for certain wires, less need for certain transmission as we see this flattening out and maybe even decrease in consumption of electricity across the US.

So I think that that’s a bigger idea than necessarily taking ourselves off the grid entirely, that we’ll see more of this load defection. That doesn’t mean that you can’t use the storage system for reliability.

So if there is a black out and you have a storage system, usually the way that you would try and set that up would be to keep the storage system connected to critical loads so maybe just your basic AC, your fridge and freezer, maybe half the lights, a third of the lights in your house or just one light per room. You would develop more of that plan so that you could extend your ability to use your own energy and be self-sustained during those blackouts.
So we see systems deployed for that particular reason. Now when you look at that you have to do a cost benefit analysis. So that makes sense for some homeowners that they’re going to want to see that or some businesses that they’re going to want to have that.

But it is meaningful to have that reliability so there are many consumers who will adopt it purely for that reason as their driver.

Julien Dumoulin Smith:  
Lets talk about the opportunity here. How do you think about that evolving by customer class? How much is behind the meter C&I versus utility scaled projections?

Matt Roberts:  
If you look at Slide 8 there’s a chart that has that broken out by sector. Utility is one of the largest customer bases right now. Increasingly we’ll see what we call nonresidential, which means commercial, industrial, hospitals, hotels, all that stuff, continuing to play a role but not being a primary driver.

But once we get into 2018, 2019 you’ll start to see much more residential installs and much more of those behind the meter installations. So, utility applications, grid scale as it were, which is a nebulous word, but grid scale applications will be a large part of this and will continue to be the lion’s share for the next few years. But after that I think we’ll increasingly see behind the meter installations.

Julien Dumoulin Smith:  
Got it. Excellent. Moving on to the next question here, can you comment on how would utilities make storage as part of their rate base? And perhaps this cuts back to the last question - to what extent can you have for instance, Texas or PJM-like deployment on the utilities side of storage solutions, without running afoul of this utility versus generation paradigm? How do you address that from the policy side?

Matt Roberts:  
Yes, so it actually is a challenge and part of the problem - that energy storage is qualified as a generation asset. It wears that label even though it doesn’t generate any electricity it does deliver electricity to the grid. So therefore it functions part of the time as
if it’s a generator. Other times it functions as load and is absorbing energy. Other times it functions as a transmission asset and it’s just helping to defer some transmission. So it looks different but it’s always qualified as generation. So the questioner is correct that this is a policy challenge in some ways.

I’ll take ERCOT as an example because Oncor has talked a lot about this and there’s a lot of resources you can find on the web about their perspective on this. But Oncor owns the transmission and distribution and help manage and regulate power flow, that’s what they do. They don’t own power plants, they don’t do any of those other services. So it creates an open and competitive marketplace, which is a good thing. But what they’ve done is they identified the need for about 5GWs of energy storage on their system which is obviously a lot of energy storage. And talking about how this would be deployed and the value that it would provide across the system. They see transmission distribution benefits. They’re the wires folks. They see those benefits. And they can realize those benefits with the storage system.

But at the same time they are not legally allowed to sell the energy from that system into the marketplace. And that gets into the generator versus wire utility debate. So there is resistance to in effect reregulating the market and allowing a wires company to own generation.

And so we’ve worked on this from a couple of different ways and ERCOT in particular and in other states also just trying to make sure that scheme or markets can be put in place where in the Texas example, Oncor is allowed to own storage, they’re allowed to reap the T&D and locational benefits.

But then they may be able to auction that energy or provide that energy to someone else to auction off. And still an IPP or third party would still be able to leverage that energy in competitive marketplaces and effectively just pay Oncor for a warehousing service for being the ones to store the energy for them while they’re effectively competing.
So there are mechanisms by which this can be addressed and we're working on fleshing those out better. But that is a challenge that does lay ahead in terms of rate basing these systems.

Julien Dumoulin Smith: Got it, excellent, and actually maybe let me just tie that back, how much of the projections that you are showing here reflect that side - the truly rate based own utility?

Matt Roberts: I don’t have it broken out that well. I apologize. I would anticipate it would be lower on the spectrum but a lot of the California utilities are looking at rate basing and even with third party folks doing PPAs and things like that would be the other mechanism.

Julien Dumoulin Smith: Excellent. A lot of on the Reg D front in PJM and I know that’s a lot to talk about but what do you make of the rule makings underway at the end of the day in terms of some of the rule changes.

Matt Roberts: Absolutely, we’ve worked with PJM as have other stakeholders as well to see improvements in the Reg D market. The Reg D market is reserved for fast responding resources but there’s basically a performance standard that’s in place and if you can meet that performance standard you can participate in Reg D. Reg D gives an accelerated payment which gets back to pay for performance that I referenced earlier from FERC.

There is a senior taskforce that is going to be taking up this issue here, probably in a couple of months, looking at potential signal changes, looking at market structure changes, changes to the benefit factors curve. All of those are influential in how storage is treated and how it’s rewarded on the system.

And Reg D also includes demand response and others that are competing in that space. So these taskforces can take a little while so I anticipate this will be a multi-month - hopefully less than a year - revision process but we are expecting some changes coming from that senior taskforce and that will be a multi-stakeholder process.
Julien Dumoulin Smith: Is there any direction that they’re going to be taking just to maybe provide a little bit more context? Like, what’s the purpose of the revisions if you can provide some context?

Matt Roberts: In effect they are saying we built this market, we’ve seen it operate now for a while, we’ve seen some of the benefits, and now let’s come back and regroup and say, okay, what’s working, what isn’t, what changes would be meaningful. Actually there was a great article by Terry Boston and some staff of PJM that was released yesterday actually through IEEE.

And the two of them just are talking about the big role that storage is playing and how much value it provides. So PJM senior leadership is looking for ways to continue to improve upon the marketplace there.

And so, **what we anticipate is maybe some changes to the tariff, those types of things involve FERC review, maybe some changes in how the signal is operated. But more tweaks to the market rather than any massive reforms** would be what we anticipate on the horizon.

Julien Dumoulin Smith: Got it, all right, that’s fair. Another very simple question, - **which technologies win?** Is there any way to bucket out at least generically the technologies that between utility scale versus behind the meter; or, say, fast response?

Matt Roberts: Well, things like compressed air energy storage - you’re not doing that at your house unless you have an empty salt cavern underneath your house that you’re going to tap into.

**So, batteries tend to be in the two to four hour range, that’s where you start to really maximize their value.** A flywheel is good for 15 minutes, 30-minute range. It can do up to an hour as well but that’s its sweet spot is in those faster responding applications.
So at the homeowner side though you’re going to see mostly batteries but both electrochemical batteries, which everyone here is very familiar with in your phone, that type of battery, but also flow batteries have shown some promise for behind the meter and commercial installations as well.

Flow batteries are a mix of fuel cell and battery mixed together, a bit more to it than that but that’s probably a fair generalization. So that technology breakdown - one breaks down here these technologies will play on the grid. And many of them are better suited for one application than the other so in long duration we’re going to see flow batteries, compressed air, pumped storage - those types of technologies.

In the transmission and distribution grid support we’re going to see batteries. Flow batteries still work there, flywheel’s work there more. And then once you get down to the high-energy stuff then you’re looking at more maybe high energy, super capacitors, and those types of technologies.

So in terms of a particular winner - that is as you said a little bit of a complex question. But it’s a big field. energy storage is a big concept and there’s a big market opportunity on the horizon. And different technologies are going to find their niche and find their most suited place over time.

Julien Dumoulin Smith: Got it, all right, excellent. The CPP doesn’t explicitly encourage energy storage because it doesn’t necessarily decrease the amount of CO2 per say. What other policies - especially on the Federal level - encourage storage outside of state specific procurement?

Matt Roberts: Yes, so on the Federal level - obviously we are participants in the ITC so there is some benefit there. We’ve also seen the quadrennial energy review come out from the Department of Energy which is going to help guide DOE’s investment in how they’re deploying research and development funds. So we’ve seen that as well.
We expect continued engagement from FERC on these issues, especially around some of the market structure issues - things like demand response that are being debated pretty heavily right now. Those are under FERC’s mandate.

Under the clean power plans - the questioner is correct that energy storage is not identified as a specific individual asset. It is identified as an enabling asset, which I think is an appropriate fit for what storage is. Storage helps enable the deployment of renewables, which will help states meet their clean power plant target. Storage enables more efficient operation of thermal plants, which will help reach state targets.

So while it’s not identified as a buy this and you get ten points on your clean power plant, it is identified as enabling assets. So that will continue to be influential for storage.

And obviously the time horizon for the CPP has been pushed back so its impact will be felt a little bit farther down the road but it will be influential on storage technology.

I’m optimistic that progress will continue to be made in Congress around energy. As we’re getting into election season it is difficult for Congress to pass big pieces of legislation. So it could be tricky to see an energy bill that is successfully completed by Congress but that doesn’t mean that the dialog and the different proposals being put forward won’t help influence decision making. So it will be challenging for Congress to pass a big bill but we continue to work with Hill staffers and many others on the Hill to help progress these issues as best we can.

Julien Dumoulin Smith: Excellent, all right. When you’re thinking about your members and what they’re also saying - to what extent are they banking on different value streams and perhaps which value streams do they receive that are most lucrative?

Maybe this comes back to your personal view. what are the most immediate opportunities in your mind? Where do you see your member constituents heading in terms
of investment opportunities and just the size and scale of the market that is most attractive?

Matt Roberts: I think it’s a bit of a low hanging fruit question of what it is that really defines energy storage as being a valuable asset and then where are those market opportunities? And that’s what we’ve seen so far. So the things that really define storage where it far outpaces any other solution out there are things like frequency response or ancillary services.

So on these ISO market opportunities - **PJM obviously is out front** but also MISO, SPP, New York ISO, ISO New England – all those opportunities are definitely very much so on the radars of our members that they’re interest in seeing those continue and that’s where they spend a lot of their effort. But, the other value - that timeliness value, the ability to store and arbitrage energy makes peaker replacement or peaker alternatives I guess is a better way to put it a very attractive market opportunity as well.

So when states make a call for some of these massive peaking facilities, energy storage companies are getting engaged in those dialogs and offering alternative solutions. And we’re increasingly seeing those will be a big part of company’s plans as well.

And then lastly it’s that multifaceted value of being a distributed energy resource, of being a buffer on the system. We’ve seen ones, like, say the ones that went in the train system in Philadelphia. That’s a multifaceted one that is using absorptive technology for regenerative breaking to charge up using a combination of super caps and batteries to deliver grid services and also manage and modulate the load of the train system there in Philadelphia resulted in an overall savings for the city and an overall savings for the grid as well.

So there are some that are doing more multifaceted installations capturing a number of these value streams all at once. But the big drivers currently are the California program, which is helping to replace capacity, the ISO program and pay for performance, and also this idea of a peaker alternative is also a big driver as well.
Julien Dumoulin Smith: That’s great. Any parting comments? I don’t want to hold you up all day. Anything you think we didn’t hit that is perhaps pertinent to the conversation or any closing comments?

Matt Roberts: I guess I’d say the big takeaway is energy storage is often held up as this Holy Grail which is going to solve our energy problems. That language is just so hyperbolic. Energy storage is a big part of our energy future, undoubtedly. It’s going to play a major role in micro grids and grid efficiency, in the integration of renewables. Storage is here to stay and it’s going to continue to expand its role on the grid.

So it’s better to leave those types of monikers of Holy Grail to things like cold fusion, things that are still ten and 20 and 30 years off down the road that we’re chasing and focus on energy storage as a Swiss army knife. It’s multifunctional; it can perform different things at different times. It is something that you can take advantage of even if you don’t capitalize on all of the differ pieces that are on your Swiss army knife.

I would like to leave people with that understanding that storage is a very flexible, very dynamic asset, and it can be utilized by different parties and different stakeholders in different ways and still get a lot of value for those individual stakeholders.

But yes, I think that’d be closing thoughts and with that I’ll say thank you again to everyone for joining. My contact information is on there. Feel free to reach out with any questions you might have and happy to do my best to address them.

Julien Dumoulin Smith: Excellent, thank you very much, Matt. Thank you all for listening.
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<th>12-Month Rating</th>
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<th>IB Services2</th>
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<td>36%</td>
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<th>Short-Term Rating</th>
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<td>less than 1%</td>
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