Unpacking ERCOT Solar Capture Rates in REsurety's Weather-Smart Forecasts Transcript

DL Oates: Hi everybody, we're going to go ahead and get started here. Seems like there's a few people trickling in. My name is David Luke Oates. Everybody calls me DL. And I lead the power markets research team at REsurety. I'm going to spend a couple of minutes at the outset setting the context for our company and the forecasts we provide, then I'll hand it over to my colleague, Amit, to dig in on solar capture rates, then we'll have a few minutes for questions at the end.

So REsurety is a solutions provider that serves the financial and sustainability needs of the clean energy industry. Our core customers are clean energy buyers, sellers and investors, you can see a selection of those on the right. Even though we're primarily a solutions provider, REsurety has invested a lot of effort into developing the data necessary to support those solutions. We have in-house atmospheric science and power markets expertise, and a fairly broad set of metrics covering clean energy in the U.S.

REsurety has a software platform that provides our customers with insights at various stages of the project lifecycle. So on the left, our Project Explorer is aimed at the initial exploration stage. It provides financial performance and carbon impact assessments for existing and indicative clean energy projects in a map-based view. The Project Evaluator in the middle is aimed a little further along in the lifecycle, and can provide additional detail about specific project types and locations. Think for something like evaluating RFP responses. And the Portfolio Tracker on the right is aimed at existing portfolios and provides a dashboard with up-to-date information on financial and carbon performance.

So all this stuff is powered by our data and today we're going to be diving into some of the implications of one of these - our Weather-Smart forecasts.

With our Weather-Smart forecasting, we start with meteorological data and models, and produce location-specific wind and solar generation time series over a 40 year weather history. We combine that with a production cost modeling platform called Enelytix, which turns fundamentals into price. We have configured Enelytix, of course, to capture things like demand, generating resource details, fuel prices, and transmission constraints, but also other important drivers of price formation, like ERCOT's operating Reserve Demand Curve. By running all that weather-driven data through the production cost model, we come up with price time series that are concurrent with generation and we use that to get a realistic outlook on the value of clean energy assets, both point estimates, ranges, and those flow into all of our solutions. Today's discussion is motivated by a question we've heard from a number of our customers who've looked at our forecasts of the value of solar in ERCOT compared to recent history, and wondered why are forecasts quite a bit lower than the past. So we're hoping to shed some light on that question today. And with that, I'll hand it over to Amit.

Amit Ranjan: Thank you DL. So this is the agenda for today. I will start with an overview of the different drivers you can capture in forecasting solar capture rates. Then we will go over the details of each of the drivers, talk about conclusions, and take your questions.

So the headline number here is by 2030, we are forecasting here at REsurety that the solar capture rates will decline materially and they will get to about 75% and have a wide range of weather variability around that number. So one can forecast solar capture rates in different methods. Each method or approach to forecasting will end up capturing different drivers of change. So the first driver we will look at is increased solar buildout. As everyone on this call is aware, the grid, the ERCOT grid, is changing quite a lot. We only had about 700 megawatts of solar installed in 2016 and right now as we speak, the amount of solar has increased to as much as about 18 gigawatts in 2023. And in our baseline view, by 2030, about 30 gigawatts of solar will be installed on the grid. So if you try to account for this driver, which is the increased solar buildout, and fit a statistical model on it by having the current data and extrapolating it forward, you can get to an answer of what is the solar capture rate by 2030. So that is the first approach we will talk about. The second approach we will talk about is a change in market fundamentals. We can use a system called Production Cost Model, which is able to capture the many drivers that impact our prices and hence impacts solar capture rates. By using an operating demand reserve demand curve, by using unit commitment parameters, and realistic zonal transmission constraints, they had forecast errors. All the things that happen in the real markets, try to simulate that as best as possible and we will look at what kind of results do we get to if we use a Production Cost Model, capture the changing market fundamentals, and do that in a way that's representative of a typical weather year, which is often the case with these models, you have to assume certain weather conditions. The third method we will look at is something that we have developed that REsurety and DL alluded to. So the Weather-Smart forecast, and they captured all the weather variability that exists in the power system. As people are aware, electricity demand is very sensitive to temperature. The wind speeds impact how much wind generation comes about. Solar generation is impacted by solar irradiance. Hydro generation gets impacted by precipitation. So we consider the suite of meteorological variables that change and how that further impacts the power system in this third method, which captures weather variability. And lastly, we will talk about a sensitivity to solar buildout. As people are aware, there is uncertainty in how much solar capacity and solar penetration one can assume in a future year like 2030, because of the many constraints that exist, and of course, uncertainty and forecasting that far out of how much solar will be in the system. So we will cover all of this, but to first level set the whole discussion, let's move to the next slide, and talk about what is a solar capture rate.

We have been using and throwing this word around quite a lot. But by solar capture rate, we are trying to measure the value of solar relative to a baseload unit. So the solar capture rate calculation is all about looking at a solar generated price and dividing that by the average price of power over the same time duration. So on the left here, you have a sample profile of prices, and then a sample profile of solar generation.

If you see on the next slide, the first step to calculating solar capture rates is by aligning both of these time series. Making them concurrent is very important. Not doing that can lead to errors in the calculation. So when you combine both the time series, you end up at how much is the solar producing when prices are higher versus prices are lower.

And then when we move to the next slide, we will see that we end up in this example with a capture rate that's higher than 100%. But what do we mean by that? We first have to start from the basics of weighing the prices. So we have to use the weights, the weights being solar generation, and weight the prices with that, so you end up with the term called solar generation weighted price. And often in the industry, people also call this production-weighted price or As-Gen price of solar. All of those things mean the same thing. You divide that by the power prices multiply by 100, and you get to a percentage that's very indicative of the value of solar compared with everything else. So just to illustrate with another example, if you imagine a baseload unit that operates 100% of the time as 100% capacity factor, it will end up capturing less value than just a solar plant in this very example. But you can easily see the flip side happen where solar is not as valuable as a baseline unit.

So moving on to the next slide, we will dive right into the results. Yep, sorry, the slide was transitioning for me. So now what you're seeing is a solar capture rate on the Y axis. And the X axis covers all the various drivers that impact solar capture rates and what happens - like what are the results that you see when you deploy a model that captures these drivers. So the first bar on the left is just the historical level or the current level where we are at. So if you look at the last seven years, from 2016 to 2022, and take an average of world annual solar capture rates, you get to 128%, which is fairly high. And if you look at the extreme right of this plot, where the other gray bar is showing the REsurety view in 2030, the solar capture rates are at 73%. Everything in the middle is the various approaches we have deployed and how they step through a declining solar capture rate and we will unpack each of them in the next few slides. But I also want to point out the weather variability box over here. That is the range around a mean of 73%. All the other blue plots that you see are just point forecasts, but that will become more clear as we move forward in the slide deck.

Alright, so let's start unpacking what we mean by increased solar build out.

So what you're looking at is annual solar capture rates in the recent history and then forecasted out 10 years. So if you focus on the solid black line, that is the solar capture rate as observed in each of these years. It is fairly volatile, but overall if you try to fit a trend on it, which is the blue line, that's what we did, we fit a linear trend on the solar capture rate data, you see the decline because overall, as more solar is being built, the solar capture rates are falling. And if you represent that with just a purely statistical approach of applying a linear trend, which people in the industry often do with this kind of data and many other kinds of data and is a reasonable approach in getting to a number by 2030, I guess it's way better than using what the current level is. If you were to assume in 2030 your solar capture rate is 128%, you will end up overvaluing solar assets by quite a lot.

So if we move to the next slide, you will see the other kind of statistical model that we fit, which was, if you can assume an exponential curve, you will see more pessimistic outcomes. Something like 79% capture rate by 2030, just by applying an exponential fit. Both the approaches do tend to start to converge, the later in the future that you go, but overall, these drivers are only capturing one thing which is increased solar build out. They are pretty insensitive to any other fundamental change in the grid, and lack any kind of sophistication or explainability, so to speak. So now we will look at the other approach, which is more interesting. Let's move to the next slide.

Now we'll start talking about changes in market fundamentals. As you can see on the plot on the right, this is a further step down in solar capture rates from the other approach that we just talked about. But to really see why do we see further decline, we need to start unpacking how prices are actually found in the market.

So this is a plot of annual power prices. So on the x axis you have all the hours of the day, all the 24 hours of the day, on the Y axis, you actually have scaled prices. So what what I mean by that is if you take an average of all the prices in each of the hours for the whole year, and then divide that by the annual average power price, or in a better way you can say that hour 10 to 11 has about 100% scale price, because averaging all the hours from 10 to 11am in ERCOT in 2016, you get to about $21. And that's what the annual average price was. So if you had an asset that was only producing at from 10 to 11am, it will end up earning exactly the same amount of money as the whole market earns in the whole year. But all that to say that a price profile of recent history, which is 2016, looks not that variable. There is no sign of any duck curves, there is no sign of any ramping going on. You do see that hour 16 is when the prices peak. And as people can guess solar is producing at that time comfortably. But now let's move to the next slide and start to bring in 2022.

So now the diurnal price profile has changed quite a lot from 2016 because so much more solar exists in the system. So you start to see the belly of the curve starting to come about in the midday hours, you will see more curtailment, more negative prices. But another feature of this plot is you still have the power prices peaking at something like hour 16. And overall, this shape although has changed a lot, but hasn't meaningfully changed what it means for solar capture rates. Now take this level forward. So we will move to the next slide and look at what 2030 looks like.

So this is coming straight from the production cost model’s output where we are capturing very realistic aspects to the market, which includes the ORDC, includes constraints on transmission, etc.

So what's happening here. If we move another slide forward - this is roughly when the bulk of the solar is producing. And one can see that when the prices are now starting to peak is when the solar has already set. And why is that happening? So it's all about net loads. So what do I mean by that? If you have electricity demand or load on the system and then you reduce all your output from renewable energy from it, you end up changing, over the course of the day, when do you have the most amount of net load and scarcity, which is also informed by how quickly can assets on the system respond to changes in market conditions. So how quickly can supply inform changes when the demand is changing? And we see that in 2030, the midday prices - there's a more pronounced belly of the duck curve - that happens because of so much solar producing that you end up curtailing some or you end up having negative prices because of wind or solar production tax credits. And once the solar has set, a lot of fast ramping units have to come and take place in the grid, and that ends up shooting higher prices as you walk up the operating reserve demand curve. So all of these changes that are very fundamental with the system, if we move to the next slide, are captured by this system of modeling that's represented here.

So you have some inputs to the model, which are often weather-driven, like the supply and demand, then you have this engine in the middle, which is doing the optimization and considering constraints, like you have to schedule storage at the most optimum times, you have to take care of transmission constraints and not violate them, you have to - or rather you don't have to - but the models that we use are sophisticated, and they can co-optimize energy and reserve pricing. They, for every time step, take care of what is the merit order, how is the marginal supply changing. And that intersecting with demand is what informs the marginal prices that we are used to seeing. And that's what you get from the output side. So all the factors on the sophistication on the input side, the modeling side, get us the best in class, power prices, asset values, emission of the system, and just overall how generation is changing.

So as I mentioned briefly before, this approach of forecasting solar capture rates is very sophisticated, but oftentimes you have to assume a weather condition. And why do you have to do that? Because you have to inform your inputs. So in ERCOT, we use some methods which we can get to if people are interested, and found that 2013 was a very typical weather year. So we used the weather from 2013 and informed what the electricity demand, the wind generation, solar generation, hydro generation needs to be in the model. And that is how the results or the point forecasts for solar capture rates have come about, as we can see in the next slide.

Yeah, so we have so far moved through two methods, increased solar buildout as the first driver, the second one we discussed now is changing market fundamentals with a typical weather year approach. But what if we start wearing the weather, which will happen. As far as we know, the weather is not very predictable, especially in a year like 2030 which is very far out. So in order to inform what are the possibilities of solar capture rates or prices, we at REsurety have studied weather for the last 43 years and you're looking at some meteorological variables of importance like wind speed on top, temperature in the middle, and solar irradiance on the bottom. There is a substantial variability in each of these variables. And while it's not possible to predict weather, it is reasonable to assume that all the weather conditions we have observed in the past are likely to happen in the future, if not more variable. So combining these meteorological variables, we then now move into the space of generation, solar generation, and then price.

So in the next slide you will see a sample profile of solar generation. So you have hours on the X axis, Y axis is the capacity factor of the solar plant. And all these individual lines are a realization of solar production given a weather from each of those 42 years that have happened in the recent past. And the solid black line is the typical weather year that we found through different methods, being 2013 in this case. And just just an example there, so this is from June 24, 2030. These are all the possibilities that can happen, loosely speaking, in like ERCOT North Hub area. So this is all the variability you see in solar. Now think about variability in wind speeds, how that impacts wind generation, then variability in temperature, how that impacts the system demand. Same with hydro generation.

So after accounting for all of those factors, we move to the next slide and see how that materializes in the price space. So you have prices on the Y axis, X axis is the hours of the day. This is still the same day by the way that we covered in the last slide. So you can see for each of those outcomes of solar generation and other types of generation, we see some years where you will end up in scarcity situations and the prices will shoot up quite a lot. So the Y axis on this plot is cut at $200 just to illustrate that many weather years will lead to high price outcomes, but many will not. So 2013 typical weather year would not be as extreme on prices, and hence, the shape of each of these prices will inform what the solar capture rates are, which are quite variable. So the next slide will also help people visualize what kind of variation I'm talking about.

So you have the month of 2030 on the X axis, and Y axis is each of those 43 weather years we talked about. And this gives you a sense of the scale and the range for each of the months that can be expected with the given amount of information we have covered so far. So there are lots of risks involved, but it's just one aspect of risk we think about and cover. So in February of 2030, imagine if weather conditions from 2022 were to occur, you will see capture rates as low as 27%. But on the high side, if you were in May, 2030, and saw weather conditions from the year 2000, you will get to nearly 100% capture rates. So this, again, is showing the importance of looking at the entire distribution of outcomes, and thinking about solar capture rates more deeply. So now we will move to the next slide and cover the last section of our discussion here.

Sensitivity to solar buildout. So this is a chart from ERCOT directly. You have solar capacity on the Y axis and each of the recent years and future years on the X axis. You can see that in early 2010s, 2011, there was not a lot of solar in the system. And that has very quickly ramped up. Sitting in 2023 right now, the blue bar suggests that about 18 gigawatts of solar is synchronized to the ERCOT grid. Not all of it is participating in market operations. But is synchronized right now. And everything on the right side of that for 24, 25, 26, all those years have a huge range of uncertainty or rather, there are queue positions that some of them have posted financial security, which is the magenta block over here. Some of them have signed interconnection agreements, but no financial security posted. If you were to trust the entire interconnection queue, you can end up at 50 gigawatts of solar by 2026, which is massive. But we at REsurety don't think that's realistically going to happen, because there are certain constraints that will slow it down. The first one being the rising cost of capital, the interest rates have jumped quite a lot in the recent past. There are still continuing supply chain challenges. There are IRA benefits, bonus benefits, that are in play which require more solar factories to be reshored into the U.S. All of that will take time and affect how much solar will lead to mechanical completion. So we at REsurety are projecting about 25 gigawatts of solar in 2026. And this is to say that we can't just fix on one number for how much solar is in the system and need to play around with what happens to solar capture rates if you had a different number. So that is what I'll show in the next slide.

So we looked at three total cases. So there's a base case, which is 30 gigawatts in the system. That's the middle line over here. And you have low PV build, which is just 10% less than that - 27 gigawatts. High being 33 gigawatts. And then on the X axis, you have solar capture rates. And the black solid line is the median of the whole weather-driven distribution. But the whole read block gives you just how variable the solar capture is outcome can be, if you consider every weather possibility. So we started with the discussion in the waterfall charts that about 17% of range exists. So the width of the red block here is 17% in the base case. It can be as high as 19% in the low case, and something similar in the high case. So this is all to inform that small changes in how much solar exists can have big changes on solar capture rates. To give you a more near term example, we can move to the next slide and look at what just happened last month.

So August of 2023, we saw price spikes and generally high prices occurring in the system. Lots of scarcity events. But those scarcity events tended to align well with when solar was producing. So that gave us realized capture rates of about 132% in the last month alone. So the two distributions on this plot that you're looking at are the weather-driven range from the REsurety modeling that we do. So both of them have different assumptions of solar penetration. The red range that you're seeing is what would happen if you were to fit how much solar was actually producing in August. So solar production peaked at about 14 gigawatts, so if you try to put as much capacity in the system that actually happened, you see the distribution that you see with the wide red block here. And then 132% actually falls within our distribution. But on the flip side, like if you started with the year beginning expectations, as internally we were thinking about 18 gigawatts might be operating this month or last month, you'll see a range that's much more to the left of that, and not close to the 132% that was realized. Again to stress on the point, solar penetration matters quite a lot for how much solar capture rates occur. Let's move to the next slide.

So now we'll finally conclude by saying that the financial performance of solar assets is very dependent on the timing of its generation relative to price. And that is what we have been trying to show with the metric called capture rate. And we studied four different drivers, the first being increasing solar buildout, the second being changing market fundamentals and capturing that with the sophistication that we can, but using just typical weather year. Then we introduced weather variability on top of changing fundamentals. And then lastly, we looked at how sensitive are these results to the buildout of solar itself. And any party that has exposure to - merchant exposure to - solar value can benefit greatly from looking at the different outcomes that REsurety's Weather-Smart systems are forecasting. So we don't forecast just a baseline view, we also have views for a Net-Zero future, we have a view for a high lithium ion battery penetration future, all of those have very different outcomes. And for each of those fundamental scenarios we, again, simulate 43 years of weather variability. So that gives you a comprehensive set of results to work with as you're making decisions.

And in the last slide, I'll just point out that we have a wide coverage of the U.S. power markets right now. All but two markets are already available in the various products that DL mentioned. The two markets, ISO New England and New York ISO, are still in the works, and people are working really hard on it. And by the end of the year we anticipate that we will cover all the U.S. markets for both prices and marginal emissions rates. And with that, I thank all of you for sticking around till the end and we are happy to take questions.

DL: Alright. Thanks so much, Amit. So there's been some questions that have been trickling in over the course of the discussion here. So I'm going to sort of group some of them together by theme. And then it seems like there's still some questions coming in. So we'll take the ones that came in first and then follow up. So if you could jump to slide 15. Great. So there were a couple of questions here about this increased solarbuild out analysis that we sort of started out with. One of them, sort of funny to fit a trend to historical solar buildout data that's so volatile, is the result really reasonable?

So I think the intent with this first step in the analysis was really just to highlight a really simple approach that folks sometimes use to capture the impact of increased solar buildout. And all we really did here, there was another question about clarifying the difference between linear and exponential solar buildout, all we did was fit some simple relationships between the capture rate and time, and then extrapolated those out into the future. And I think people use this type of analysis because it is *a* way for accounting for the change in solar capture rate that we've seen over time. And as you can see in this data, there is this big spike in 2019, and then a big dip in 2021. And of course, the specific slope that you get is sensitive to that. And I think the point that we're driving at here is really just that this type of analysis tends to be quite sensitive to the limited history that we use. And so it's - at least if you ask us - it's a better idea to use a fundamentals approach to try and capture the impact of things like solar buildout. Hopefully, that's helpful.

Anything to add on those, Amit?

Amit: I think you've covered it pretty well.

DL: Okay. So then there were a few questions here that were really about the assumptions that are behind our Weather-Smart modeling. So if you could jump to slide 21, just to have that up for reference. So the first one was the transmission. Is your model operating at a nodal level or zonal?

That’s a good question. So the way that we represent transmission in our Weather-Smart models is we have an underlying power flow model. And we map our injectors and our loads to individual nodes. But because we're doing long term forecasting, we don't enforce every single constraint. So we don't enforce individual branch line limits, and we don't enforce contingency constraints. But we do enforce the aggregate interchange limits between regions. So in ERCOT, those are called GTCs. So things like the Panhandle constraint. And actually you can see some of these in the diagram kind of in the middle left, sort of bottom left part of the diagram under transmission constraints. So Panhandle West X, Valley export and import. And I think there's also North. So there's sort of about 10 different GTCs that are present in ERCOT and that we enforce in the model. And that allows us to get a reasonable view of congestion. We pay a fair bit of attention to this in ERCOT to make sure that at least in the near term, the level of congestion that we represent is pretty close to what's occurred recently. But it's not a fully nodal model.

So another question we got here. To what extent is Texas load growth and ERCOT market reform considered in the fundamental analysis here?

So on the load growth, we certainly account for load growth in Texas, because there's a lot of it. We try to anchor our forecasts in credible data wherever possible. So on this one, we, in Texas, use the ERCOT long term load forecast, as our starting point. We have some scenarios that Amit mentioned where we have different load perturbed around that. So yeah, we certainly account for that load growth. And that's for sort of the weather normal peak in total. We, when we're doing our weather-driven modeling, have hourly demand, that varies quite a lot. So for that we have in-house hourly demand models that are sensitive to weather. In terms of market reform, what we try to do with these models is we try to do the best that we can to represent the market as it is today. So for example, when the PCT changed the ORDC in Texas, so brought the price cap down from $9,000 to $5,000 and right shifted the ORDC, that had a big impact on our results. And we reflected that in our model, once we knew about it. But we don't try to sort of get ahead of that by anticipating changes until they're in place, or pretty close to in place. Anything to add on on those ones Amit?

Amit: No, I think just one thing on the Texas load growth - we look at the Texas data, and we also for other fundamental scenarios, like in the Net-Zero scenario that is not shown in the slide deck. We, of course, assume the higher penetration of electric vehicles and the demand overall growing based on other anchor studies that are looking at Net-Zero futures. So that ends up affecting capture rates and every every grid dynamic that you can imagine quite a lot.

There's another question here about any analysis done for the impact on wind capture rates.

So we don't have any material to share right now, but yes, our models do, in fact, help calculate wind capture rates, and we do share them in the various products and Excel reports that we send to customers. So if you're interested, feel free to reach out.

DL: Yeah, yeah. And there are a few questions along these lines. Maybe we could just go to that slide that shows our products. So there are a few questions here about different metrics. So we had a question about ATC prices: Not just capture rates, what are the projections for ERCOT real-time LMPs in 2030? In other words, 75% of what? And that's of course a good question. So the modeling that we do certainly produces forecasts of ATC prices and solar capture rates and wind capture rates. So there's a lot of different results that you can get from a model like this. Our general approach is that we use that data and deliver it to our customers through our products. And so I think it's fair to say that all of those data flow through to the Project Explorer, Project Evaluator, Portfolio Tracker, or at least most of them, and that's sort of the way that we package that information.

So yeah, same thing about wind capture rate. There's a question about what's the solar capture rate in Houston?

Yeah, we have fairly broad coverage of different locations.

Let's see. Do you want to jump to slide 34? Are there any other sensitivities that you include in your modeling?

So I think this one is probably based on - we just spent a bunch of time showing how significant the impact of solar buildout is on solar capture rates. And yes, it is a big deal. So we look at several fundamental scenarios. So first of all, we spend a lot of time on weather modeling and represent those 40, or 43 I think, weather years of variability. And then we have what we call fundamental scenarios. Our standard set includes five fundamental scenarios. So we have a Baseline where we try and use the most credible sources. We have High gas and Low gas, where we stretch the gas price high and low by quite a lot. We have a High Storage, which is basically everything in the baseline scenario, but with a ton of extra storage. And that tends to smooth out that diurnal duck curve that Amit discussed, and then we have a Net-Zero, where we really push the renewables buildout. We have some additional electrification and try and reflect a scenario where we're getting close to nationwide Net-Zero by 2050.

Amit: So I see one question that's trying to ask about overall demand growth and weather.

So I think it's helpful to clarify that yes, in 2030, the weather normal peak demand itself will be much higher than the levels of today, according to ERCOT. And when we try to simulate all the 43 years of weather through it, you will end up seeing a peak that's much higher than anything that happens today. So totally, like the weather of the past will impact the demand of the future, as demand is growing further, will keep pushing it higher and lower on the different sides.

DL: Yeah, I'm not sure if you're looking at the same question as I am right now Amit, but there is one here about “clearly price profiles will be a function of levels of other resources like storage, interchange, and transmission. And as price peaks move outside the solar profile, the rewards for storage, etc, will become higher, and their buildout will increase. How's that captured?” And that's something that we get at with those scenarios. So you certainly do see some trade-offs. So one thing that jumps out in our results, comparing that High Storage scenario, where we have a whole bunch of extra storage, and our Baseline scenario where there's a little bit but not that much, is there tends to be a trade-off in value between different resource types. So the solar, as we've shown, the value really erodes over time in our Baseline scenario. But storage value does pretty well with that additional volatility. In contrast, in the High Storage scenario, the storage value tends to drop when you have that additional storage penetration, and the solar value goes up. And so there's some trade-offs between resource types across those two.

Another one here, “Do variations (pricing, quantity, and products) in ancillary service markets affect solar capture rates?” So Amit mentioned the representation of the operating reserve demand curve. In our model, in all of our models, we represent co-optimized reserves and energy markets. And we're really interested most in the energy prices. But of course, the ancillary service markets affect the energy prices. And the ORDC is kind of an extreme example of that, where you just don't see the volatility in prices, in energy prices, unless you represent the ORDC. So certainly changes in the definition of those products, quantity of those products procured, the shape of the demand curves for those products, will affect energy prices and likely metrics like solar capture rate.

Yes, okay. So there's another question here. “How confident is your team in the robustness of the ERCOT interconnection queue in projecting out PV growth? In my experience, the data in the queue can sometimes be shaky, especially when it comes to withdrawn projects and newly added projects. For instance, withdrawn projects can later be added back into the queue.”

Yes, this is a really difficult thing to manage. So I will say a little bit about how we think about this, though interconnection queues are clearly - I mean, this is making national news, interconnection queues are overloaded, and we're not moving through them as quickly as possible. As a forecast for near term supply additions, they're questionable. We have to look at them, and we do, but we rarely just take them at face value. So there was a slide in there where Amit showed the ERCOT queue over the next few years and where we have our baseline solar buildout in, I believe it was 2026. And that number that we're modeling and 2026 is below where the queue size will be in 2026. So we're sort of haircutting the queue by some amount that's informed by something else. So we look at ERCOT planning studies, the LTS study, we are following industry news. And we do our best to try and have our Baseline scenario reflect what we think is reasonable. And then as I mentioned, we have some sensitivities that we modeled as well.

Amit: I see a question on specific results for High storage scenarios.

So again, as DL mentioned, if you want detailed results, we package those in the different products, but we can mention that if you have a lot more storage on the system, a lot higher than what we assumed in our Baseline scenario, that does tend to increase solar capture rates because the storage is able to time shift the value of solar energy. I’ll just end on that.

DL: Got it. So there's a question here, “Does this analysis indicate which market type between day-ahead and real-time should solar bid into?”

I would say not really. So we do represent day-ahead and real-time markets separately. And the way that we capture that in our modeling is we kind of have some forecast error in day-ahead. And also some unrealized forced outages so unit commitment happens basically based on imperfect information about what will happen in the real world. And then by the time we get to real-time, new information is available so demand is a bit different, wind output is a little bit different, and some units have tripped offline unexpectedly. And that occasionally leads to price spikes in real-time that don't happen day-ahead. But that's kind of offset by some virtual participants in day-ahead, boosting the day-ahead average price on average. So we see day-ahead and real-time prices that broadly align in terms of their average, but don't always align hour to hour. That can have an impact on solar capture rate, but I don't think that it's something that I would base a bidding strategy on.

Okay, I think we're kind of petering out here a little bit. It looks like folks are departing, but I think we'll wrap up. Thank you everyone for attending. Thanks to Amit for putting these materials together and presenting on it today. And do feel free to reach out to info@resurety.com or visit our website if you're interested in any additional information.

So thanks again and have a great day.

Amit: Thank you.