THE 30-METER HEIGHT, HIGH-RESOLUTION WIND MAP FOR SMALL AND DISTRIBUTED PROJECTS: ITS VALUE AND APPROPRIATE USE

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Coordinator: Welcome and thank you for standing by. At this time all participant's lines will be on a listen-only mode for the duration of today's conference. Today's conference is being recorded. If you have any objections you may disconnect at this time.

I would like to turn today's call over to Charles Newcomb. Sir, you may begin.

Charles Newcomb: Thank you very much. I'd like to welcome everyone to this month's installation of the Department of Energy's Wind Powering America Program Webinar Series. Today we're going to be talking about the 30 Meter High - 30 meters off the ground high resolution wind map for small undistributed wind projects that we released about six or eight weeks ago.

And about its appropriate use, what its designed for, where it came from, and how it fits into the spectrum of understanding whether you're in a location where small or distributed wind energy project might be workable for you.

To that end, we're going to have three speakers with us today. The first speaker will be Larry Flowers with the American Wind Energy Association speaking a little bit about the drivers for this type of map - map this far off the ground.

We'll have Jason Fields with the National Renewable Energy Laboratory speaking a little bit about the background of the model, a little bit about the history of wind map development here at the Laboratory.

And then - also speaking a bit about the appropriate uses of the map and where it fits in, again, with the sequence of events that have to happen in order to have a good understanding of a wind resource at a particular location.

And then we'll follow up with Rich Hasselman with GDS Associates and Rich will speak from the site assessor's perspective of once - so you've look at a map and you've figured out that maybe you're in a location where there's wind perhaps or maybe you're not really sure looking at the wind map, what happens or what is the role of the site assessor.

So after the map is done and done its job of getting you interested in wind energy what's the next step and what's really involved in understanding the picture of whether you actually have a workable insight.

So to that end, we have a slightly unusual format today. Normally we take questions at the end and - but today we've got Larry Flowers with us from the American Wind Energy Association who happens to be at another conference and was able to step out for a few moments.

And so Larry needs to run after he presents so I wanted to give you all an opportunity to ask questions of Larry immediately following his presentation. He'll answer those questions and then he'll be lost to us for the remainder of the meeting. But we'll do our best to channel Larry and we can see how we do with that.

To ask a question across the top of your screen or window there is a Q&A label there and if you click on that with your mouse it will launch a little applet that allows you to submit questions. And I'll moderate those questions as your moderator and pass those along to Larry so that you all can hear the answer.

So Larry Flowers is probably not a mystery to many of you. He's currently the Deputy Director of Community and Distributed Wind Energy for the American Wind Energy Association. Larry had a long tenure here at the National Lab and let the Wind Powering America program for the Department of Energy as many of you probably know.

Larry also had a deep history here at the National Renewable Energy Laboratory going back decades and comes into - came into the world as an aluminum guy out of Pennsylvania.

So Larry is one of the - you know, there's people who are a mile wide and an inch thick, Larry is ten miles wide and 100 miles thick. He's incredibly knowledgeable about he industry, knows why it's here, knows how it got here. And it's these kinds of perspectives which are wonderful to see.

So with that, Larry, I'd like to offer you an opportunity for a few words.

Larry Flowers: Thank you, Charles. Wide and thick is something I'm not deeply proud of but I'll go with that.

I just want to give a little bit of a history on this because I was involved international - a decade before I got involved in Wind Powering America. And one of the most important contributions that we made with (unintelligible) to the international program was the development of wind maps.

We had many developing countries that in fact according to their metallurgical data didn't have wind resource. And when we looked into it in some detail we found it was because they didn't maintain anemometers and so

they had anemometers at airports that had worn out the bearings and so their average wind resource over 20 years was about 3 meters per second. And as a result, didn't pursue wind that much.

Well, Dennis Elliott the P&L then, more recently at NREL, and his colleague Marc Schwartz and their team started developing high resolution wind maps for the international marketplace and that became something that had huge policy implications for the international wind opportunity, which was very important back in the 90s.

Wind Power America got going in the 2000s. One of the first things we did was develop cost share wind states - wind maps. And we did that for the entire country. At that time, of course, we were talking about 50 meter maps.

And one of the big outputs of those 50 meter maps was a 20% reports based on 50 meter high resolution wind maps in order to assess state-by-state what the wind resource looked like and what potential it had in contributing to a robust wind future.

And then of course we went from there to 80 and 100 meter maps, which were more realistic to today's wind farm applications. And it was really to the credit of Marc and Dennis that a number of the other now private sector wind mapping, wind forecasting entities have now developed mesoscale based models that Jason will be talking about and develop these high resolution maps.

And as all of you know who, on this call, wind resource is the single most important determinant in the economics of wind.

So these wind maps, high resolution wind maps, have been instrumental in bringing wind, both large and small scale, into the main scene because without them in prospecting and wind analysis at site specific areas would be a very, very difficult for us. In solar, which doesn't have cubit relationship between the resource and the output, much easier to estimate from data that exists.

So this has been a tremendous development and we thank Dennis and Marc, their team as well as the companies who have developed the mesoscale model for this contribution and to the science of wind energy. So that's a little bit of the history.

Now since - I've been doing small wind for probably 25 years now and small wind, of course, has the same cubit relationship as large wind yet is typically installed much lower - you know, elevations where both the wind resource is different from 50 and 100 meters but also we have to deal with issues of obstructions in the path of the wind resource.

And I think Rich will talk a little bit about that where he talks about site-specific analysis.

But these wind baths have become something that are a piece of the tool box that are critical in prospecting and additional siting analysis. And as we move forward the state energy offices as well as some of the federal programs are now moving from their incentives, which are critical to the economics of small wind, are going to be based on actual output as opposed to installed kilowatts.

They found that using installed kilowatts have led to some real problem areas of number of states as an incentive and are now going to be moving and are already in the process of moving to providing incentives based on output.

And when you start getting the output different tools are important. Wind maps have a good interaction opportunity to be used with these interactive analysis tools and now will become a new phase in the quality of installations and the effectiveness of incentives.

So the idea of using a high resolution wind map at the height or close to the height of high and small wind really brings these 30 meter maps into real value.

And I appreciate the Department of Energy and NREL for their investing in these maps as well as in some of the predictive tools that will help small wind remain competitive in the distributed wind marketplace.

I think that's all I have to say, Charles, at this point.

Charles Newcomb: Larry, thank you very much for those comments. And I'm waiting for a question to appear. Usually what happens is people are listening and thinking about questions but takes them a minute to respond. So if folks are comfortable listening to dead air for a few seconds we'll wait for one to come up or we'll move on to Jason Fields.

Larry Flowers: Let me just make one other comment, Charles. I just came out of the small wind session here at Illinois, I'm heading back in there, and the opening presentation was on a wind - small wind (unintelligible) on Illinois and he based his entire presentation on looking at the performance output of wind maps versus anemometers versus actual performance. And there was a great correlation between the three.

And then he compared the wind maps to the solar maps and the cost associated with wind and solar depending on what part of Illinois you're in, whether you're in the Northeastern part where the wind regime is good or in the Southern part of Illinois where the wind regime is weak.

And his whole business model is based on that northern part of Illinois because that's where the wind map shows where the wind resource is. So these wind maps are right now in use and going to 30 meters even makes it more useful for the small wind guys.

Charles Newcomb: Fantastic, okay, well, at this point I still see no questions for you directly, Larry, so I'm going to let you get back on to your panel. We really appreciate your - taking a moment to step out and provide us with your comments. And we'll look forward to catching up with you soon.

Larry Flowers: Thanks, Charles.

Charles Newcomb: Thank you. All right, so next up, we've got Jason Fields. Jason Fields is with us here at the National Renewable Energy Laboratory and Jason started his career out at Black & Veatch where he spent a few years in the private sector doing feasibility studies, wind resource assessments, etc.

And here at the Laboratory he is one of our key folks in doing, again, feasibility studies at specific installations as well as leading projects such as large scale but regional wind map development.

So from that perspective Jason has a nice handle on what's sort of theoretically behind the wind maps and then what their limitations are as well because wind maps, as Larry mentioned, are fantastic for providing

perspective, providing an analytic base for a lot of exclusion studies and capacity studies and other studies.

But they also have their limits. So at some point you actually have to get boots on the ground and make sure that there is a tree there or there's not a tree there or some other obstruction.

And so with that, Jason, if you wouldn't mind leading us down the path of where do these things come from? What are they made out of? And how do we use them?

Jason Fields: Sure, all right. Can you hear me?

Charles Newcomb: We can hear you just great, thanks.

Jason Fields: Great, perfect. All right, so to start off I'll tell you a little bit about myself just as a quick introduction for the audience. Of course, as Charles said, I spent several years as a consulting engineer at Black & Veatch. I was involved in a couple of megawatts - a couple of thousands of megawatts where the projects there for wind resource assessment, project due diligence, etc.

I'm also the US representative for the IEA, International Energy Agency Task 27: Small Wind Research Project. And I'm sitting on the planning committee for the (unintelligible) wind resource and project energy assessment seminar.

So getting into the meat, so today we're going to talk a little bit - obviously give you an overview of the products that are produced, a little bit of the history behind them, dive into the methodology and the technical details of how the products were developed. And then a little bit on the validation and

the recommended use. And then conclusion and some next steps, potential next steps.

So just to make sure we're all on the same page, we have created national and state level wind maps at the 30 meter height. These are really the first kind of comprehensive small wind potential estimates in quite some time. These are based on very high resolution, 200 meter data produced by AWS and they are, of course, available at the Wind Powering America website.

So quick shot of the wind map itself. And a little bit of history on the wind mapping process, so really as Larry said, this - the genesis of this process was started with Dennis Elliott and Marc Schwartz and those folks several decades ago.

And as computational tools improved, as models improved, we're able to go from 25 kilometer spatial resolution in the early days with - by the way, very large uncertainties, all the way through to modern 80-100 meter and 30 meter maps with, you know, talking the same model approach roughly 2 kilometer model resolution all the way down to 200 meter model resolution.

So we've come a long way in terms of the development of these models. Also we've come a long way in terms of the validation of these models, the amount of data that's available now versus 1979 is staggeringly better and higher quality, more of - etc. So we have a lot more confidence in the product.

The point here is that wind mapping is really an iterative, kind of ongoing recursive process and will get better and better as we go. And so we're always looking for stakeholder feedback as to how we can improve.

A little bit more on this, so just a visual representation of the increase in resolution between the 1987 maps, the 2008 maps, and of course, the present 2010 maps.

So you can see we have a much better understanding of the potential resource on the state level. This is primarily, again, due to better models and better high performance computing which allows us to run the models to a finer resolution.

All right, a little bit on the AWS true power process. So we have to understand - to understand the value of the map we have to understand the process, the underlying inputs that go into the model.

So we're taking things like the National Land Coverage Database, terrain information, seasonal information of surface roughness and vegetation. We're also taking sea surface temperatures.

All of these kind of things - and we're taking a lot of observational data in the form of surface met stations, (unintelligible) so upper air measurements and global models, which inform all of these things.

And so when the model looks to compute, you know, large scale pressure gradients and temperature profiles and things of this nature it marries those things with the surface roughness and the terrain for - to understand how the wind is performing in the boundary layer, which is really where most wind turbines operate.

And so by understanding those things and looking at the full physics or mostly full physics we get a large scale representation of what the wind resource look like. And I think it's important to understand that this is a similar technology

as your forecaster uses when he says it's going to be 60 degrees and sunny tomorrow. So same technology, slightly different application.

And the other thing is that by using the mesoscale modeling or numerical weather prediction we're able to get a longer term view of the wind resource.

So if you measure your wind resource for one year that may not necessarily be representative of the full ten or 20 or 30 year lifecycle of your project. So in this way, I think it's important to understand, these models represent a longer term average, 15 years, though when we do this we do one year that's randomly sampled from 15 possible years.

So in that way we save some computation time but we also get a longer term perspective of the 15 years, and that's the mass model that you see in the model of the screen. And that's run at a 2 kilometer resolution.

Those outputs are then downscaled using wind map to the final 200 meter resolution. So this is a lower order math conserving model and that's really where you adjust for localized terrain and surface roughness variations.

And then finally, of course, we got the validation and the wind map products and the database products.

So I think the first thing to say is that the 30 meter maps are based off of the same model and the same technology from the 80 and 100 meter maps. And so those models were validated with 80 meter data and we've got a summary of some of the key statistics on where they were validated, etc.

So there's certainly always room for improvement. And as industry's willing to share data I think we're certainly happy to take a look at that for validation purposes.

So again, over 1600 sites were provided (unintelligible) 80 meters. There's also data from 45 meter towers, 60 meter towers, etc. So we have a pretty wide swath of data, limited duration data, typically two years, sometimes maybe longer.

So it can be kind of challenging and complicated to weave in data sets from different levels, different tempera periods, and different spatial locations.

So by using, again, the modeling process we're able to look at this in a longer term perspective, in a national perspective, and provide a more holistic picture.

So I'm going to talk a little bit about some of the potential model sensitivities and where the model can go wrong essentially. The input data resolution for terrain and surface roughness is not that fine. So, you know, it will not resolve the tree by your front porch but it may know that there is some vegetation in the area.

And again, because this is a, you know, large scale national model there are certain assumptions we have to make and terrain and surface roughness are definitely one of those, kind of baseline inputs that we have to smooth over if you will.

Sheer profile estimates, these come out of the model. They are physically based meaning they operate off of the model derived temperature, pressure, and wind speed - you know, ultimate wind speed profiles.

So there's quite a bit of technology behind the sheer profile that comes out. But again, it could be affected by localized terrain or surface roughness or even localized climatologies that may not be accounted for in the model.

And that generally leads me to my last point, there are definitely regions with minimal surface data, especially, you know, maybe upper air data, 30 meters, 50 meters, etc. or there's areas with complex flow regimes which may not necessarily be captured in the model physics.

And so we want to call some of those out, like in the Northeastern US, these rich sites which are surrounded by very dense trees. We can approximate those trees but in terms of understanding the true turbulent nature of the wind that's very challenging. Interior sites of the Western US and obviously in the Southeast US, I think that's probably one hole for data in general.

And as we've talked internationally, that often times there is just simply not enough data to say that there is a wind resource. We may see the same thing in the Southeast, especially as we go up into higher heights, 80, 100, 120 meters, etc.

So a little bit on the validation results, really no gross differences found between measured and modeled 80 meter data. There are definitely some sites where additional measurements would be helpful. And a national network of measurements at turbine height, whether that's 30 meters or 50 meters or 80 meters, would be very useful and would increase the accuracy of the models significantly.

Of course, we want to talk about the recommended use of the 30 meter maps. We think these are really valuable and that's why we did it, but with some

caveats of course. This is a model and every model has inaccuracies and we want to be very clear about those.

It is valuable as a national and a state level summary of the resource. And it is a good starting point for anyone interested in small wind, installers, homeowners, site assessors, etc.

But we definitely advocate that you find qualified professionals in your area to help guide you through the process, people who understand the technology, understand siting constraints, permitting, and etc. And that's why we put this disclaimer on every map that we've produced so please use our maps as a starting point but also seek expert advice when it's appropriate.

A few sample maps for you, Texas - obviously if you live in the Amarillo area it's always windy there. New York, Wyoming, and of course, some conclusions.

So we developed the 30 meter map through a joint project with the AWS True Power for each of the 50 States. We hope that these will help support developments, help support the wind working groups on the State level, and help policy makers, stakeholders, and in general understand the potential wind in their area. But again, it's all site specific and we encourage everyone to seek expert advice.

Potential next steps for the map, obviously we would love to gather stakeholder feedback on where we can improve the maps, where they may be underperforming, etc. We'd love to validate the map with 30 meter data.

And we may even refine the map uncertainty estimates so we can tell you how far this high level estimate might be off. Of course, we're always open to

other ideas for potential next steps and advancing and iterating on the maps as industry calls for, as stakeholders call for.

Okay, that's it. Really appreciate the time and if you have any questions please feel free to email me or, of course, we'll take questions during the webinar.

Charles Newcomb: Jason, thank you very much. And folks again, to ask questions there's a Q&A label at the top of your screen. You can click on that, it will, again, launch a little window where you can ask questions.

We've got a few questions teed up and for those of you who have asked questions we will get to those - it's traditional for us to answer questions at the end of the session to make sure that all of our presenters have ample time to present and not feel too rushed.

And with that we'll move on to Rich. Rich Hasselman is the Senior Project Manager at GDS and Rich has been in the wind industry for over 14 years and has managed a number of projects in the wind energy space including education, program design and implementation, measurement verification, feasibility studies.

He's a trained site assessor out of MREA and that program, correct me if I'm wrong on that Rich, that's what I remember anyway. And he is the wind energy leader for focus on energy, which is Wisconsin's Systems Benefit Charge Program.

And Rich is a recognized leader in this region and I would suggest that siting projects up in the upper Midwest is rather challenging, much more

challenging than Amarillo or Kansas for that matter because there's a lot of obstructions.

And - from the small wind space or perspective, many of these obstructions are at or near or frustratingly close to hub height. And therefore, siting is absolutely crucial.

One of the things that's not apparent in the 30 meter map is where the wind comes from, which direction. And Rich can and will provide insight into why that's important when you're siting round objects to make sure they're not right upwind of where you want to put a turbine.

So we're thankful that Rich is able to join us today because of his expertise and long history in siting of small wind turbines and Rich represents the interests and perceptives of small wind assessors.

And with that, Rich, we'll let you take the helm.

Rich Hasselman: Thanks, Charles. I appreciate being invited to share some thoughts about the 30 meter wind map today. I do think it's a pretty nifty new resource, small wind hasn't had the same benefit with detailed wind maps being available that are relevant to (unintelligible) hub height.

Big wind has had the opportunity with the 80 meter wind maps for some time and that's really showed some benefit. And I think we're going to see some benefits for small wind with these new 30 meter wind maps.

What I want to talk about today are three things. One is what's the - what's a good use for the wind map? We heard a little bit about that from Jason. A

little bit on some of the key limitations to understand appropriate uses for the map.

And really, what's the role of these maps and the site assessment, decision making process, and where do we need to really potentially look at some other resources to help get a more detailed view of a particular site's wind resource?

So good uses for the wind map, who can really benefit from the 30 meter wind maps? Looking at these, consumers are a clear winner here. The - in the decision making process, consumer may be excited about wind, maybe they've been approached by a dealer, and they need to check - boy, do I possibly have a good wind location?

The other one is the reality check. We often hear from people who are enthused about small wind, they've got the second windiest place in the county.

Nobody ever claims to have the windiest place, always the second windiest, but this is actually a way for them to check that. And going from just their gut lay perspective on the wind resource to saying, well, am I really in a windier spot or not.

So helping address that initial awareness and looking at - to compare across other nearby areas, definitely useful for consumers.

The other is fact checking on dealer claims. Oftentimes dealers will present an estimated output, maybe they've got a wind speed behind it and even though the 30 meter map may or may not be the height being proposed by a particular dealer for a system, you can at least do some initial gut checks to see if this is an exaggerated claim or not.

So from a consumer protection standpoint I actually think this is really valuable. For dealers and manufacturers, looking at the 80 meter wind maps have been useful but really the 30 meter wind maps are really what's going to be more useful for doing targeted marketing or otherwise, prospecting for likely high success projects.

Most dealers and manufacturers want high product turbines in place, nobody likes the callbacks. So helping to validate that initial step in the sales process saying, yes, looks like there's a pretty good wind resource there at the approximate height that small wind is operating at, that's going to be really useful for this group.

Who else can benefit from this? Advocates looking at trying to promote small wind either generally or maybe through policy. You can look at these wind maps and see, well, gosh, who - what constituencies are going to potentially benefit from a given policy?

Also, just generally validating the opportunities for small wind in a state, being able to say, we've got this tool here that shows good potential. This is going to be very useful for advocates.

Also, utilities and renewable energy programs, being able to respond to genera inquiries about the wind resource, helping target regions that may need education or marketing efforts. This is going to be useful for the energy programs.

Potential utilities, everybody's got scare resources. Maybe they need to do some education on interconnection for some of the folks that are going to be more likely to be involved interconnecting small wind systems or code

officials in the area or potentially for working with local planning officials to address the needs of small wind under the assumption that windier areas are likely going to get higher market penetration than elsewhere.

So really helpful in targeting these different needs within the small wind market is going to be - that's going to be very useful.

Getting into some of the limitations, and this is where we get a little bit more into the site assessment issue. The wind maps that we've got have - the 30 meter wind maps have been, you know, dropped from the 200 meter resolution but really generalized to a 2 kilometer resolution.

So in the modeling we're going from a very specific area to much more general. It's also very challenging, even with 200 meter data to capture the specific obstacles at a location. We typically call it ground clutter but the obstacles that affect wind flow.

Additionally, you're going to miss the wind rows consideration, so directional factors aren't on that map. And really looking at the micro setting options if somebody would think about if they were installing a system, that's really not going to be available through the 30 meter wind map.

The level of detail, again, is going to be because of the landscape of their own clutter issues or complex topography. It's going to be difficult to really use these maps for getting accurate production estimates. I think we can get decent production estimates but in terms of being fairly accurate I think using these maps that are presented will be a challenge.

The other thing too is that small wind systems don't just operate at 30 meters. You'll see systems at 80 feet or 25 meters, 120 feet or 140 feet is very common in Wisconsin.

We're now seeing some 160 foot towers being made available for small wind systems and really, you know, with greater elevation you get a better wind resource but being able to extrapolate from the 30 meter specific wind resource estimate to some other height is really something that you need to have a professional involved with.

So the role of these wind maps and site assessments, site assessments - the real goal is - amongst other things, an accurate production estimate for different turbines and tower heights.

A site assessor or dealer might be doing an analysis for a customer and need to show - they may want to show the benefit of going - well, you don't want an 80 foot tower, really 120 or 140 foot's better and here's why and here's the production estimate.

You know, that's really where a lot of the goals of a site assessment. However, these are a good first step. So identifying fatal flaws. Boy, you know, it looks like you're in a valley and the wind resource is pretty bad, maybe not a good idea.

Also spawning the discussions about taller towers, you've got a - you know, 5 meters per second approximately at 30 meters, here's what you might get - you might get a lot more production if you go the 120 - 140 foot tower. So helping - it actually becomes a tool for engaging a customer on that discussion and really serves to support some of that customer education.

Going out on a limb, I think it might be viable if you've got a 30 meter tower proposed, maybe with consistent terrain you could use this wind map for doing some production estimates. But more than likely a more detailed product is going to be needed.

And so companies like AWS True Power, (unintelligible) maps for NREL, Three Tier or Wind Logics, these are all companies that provide more detailed wind mapping products - you're probably going to need to go to those if you're a site assessor looking to do some accurate modeling. Much higher resolution, 200 meters squared is typical.

There's also 50 meters squared and 250, 300 meters squared products. But going to a higher resolution's important once you start getting into the more complex terrain where you've got hills and valleys or, you know, mountains, that kind of thing. You need to be able to isolate in a little bit more.

Typically you may need to combine it with other wind map elevations. So perhaps the 80 meter wind map will help inform the site assessor, other wind map elevations may be available too.

Here in Wisconsin we often use 60 meters for our baseline mapping purposes but we've also found that in doing that the AWS product that we use, which is a 200 meter square resolution, really does a pretty good job of helping a site assessor address the - an accurate prediction of turbine production. So the wind maps really do work quite well for that.

Next I want to share with you why all this matters. These are the things that site assessors who look at wind maps and trees and buildings probably think about a little too much. But here on this illustration we have a turbine there on the left, the issue is what's going on.

You've got wind coming across at some elevation toward the rotor but there's an object there, could be a tree, could be a building, maybe it's some typographic protuberance, some significant hill or some sort. And that is also - that object is influencing the wind speed just above it as well up to some height.

So a site assessor things a lot about, okay, I might have a sense of what the wind speed is at 30 meters from the wind map or maybe I'm using a 60 meter height for the wind map but, boy, all these objects here that I'm looking at on the ground, I don't - I need to make a judgment of how they're going to be impacting that wind speed in the end.

In looking at the modeling for the wind maps, while they do a very good job of presenting wind speeds, they do miss some of those site specific objects that are there on the ground.

And if a 30 meter wind map says you've got 5 meters per second at 30 meters but you stick a barn in-between, you know, a 40 foot - 50 foot barn between the predominant wind and the turbine, you know, that barn probably wasn't captured in the model for the wind speed but it's sure going to have an effect on the wind.

Additionally, there are differences in wind sheer as you go through the different heights. And objects on the ground impact the wind sheer. So some of the modeling that goes on using the 80 meter wind map and going down to create the 30 meter wind map, there are - the trees, tree lines, buildings, things like that actually have an impact on the wind sheer that may not be captured in the modeling.

And so a trained site assessor looks at those factors and work with that object to take the wind map data and actually convert it to a better estimate of the site specific wind speed.

So getting back to where might we see the wind map being workable for production estimates, the image on the left - yes, you know, if your landscape looks like that, flat corn as far out to the horizon as you can see, and there's no huge grain elevator right to your left just off camera, that might be a place where a 30 meter wind map can actually be useful for production estimates.

I think most people don't live in that environment and so if we look at the middle picture there, you're probably not going to use this wind map for doing specific production estimates. You're going to need to get into the more detailed wind map - wind map products and a little more detail, more complex modeling will go into that.

You can see we've got topography changing, we've got trees, we've got barns, and depending on where you might be looking to put that turbine all those things will have an effect on the local wind speeds.

And then of course, we look at the other picture of Ashville, North Caroline where you've got not only buildings, obviously, but you've got significant terrain changes because of the Appalachian Mountains.

And those are the locations that give site assessors a lot of heartburn, and in particular when you think about the 2 kilometer resolution on the wind map an awful lot of things are changing within that 2 kilometer space in an environment like Ashville there.

And so you need to go to the more detailed map again and really you're going to have to go to much more advanced modeling to address some of the different particulars, whether it's buildings or significant elevation changes in the area. Those are the sites that give site assessors a lot of headaches.

But in summary, this wind - the 30 meter wind map is going to be a great resource for the industry. It's going to be a huge benefit to the different stakeholders, customers, dealers, advocates, people who care about small wind. It's going to help tell the story for small wind as far as what the - where the resource is and where it can be targeted.

It's going to fill a key gap. We've missed that, we haven't had that lower elevation wind model generally available. We've known a lot about the 80 meters, they've been very useful, but now we've got something for small wind.

It can be very carefully and in certain situations used to support production estimates but in most cases, like I said, you're going to need to go to get some more professional support to get an accurate estimate.

It's important not to assume that we've got any kind of pinpoint accuracy within a 2 kilometer squared area. But in truth, you know, this I really going to add to site assessor's and dealer's toolboxes, this is going to be great for spawning discussion with customers and helping educate the general public about small wind and its potential.

So I'm enthused. And with that I want to thank you.

Charles Newcomb: Rich, thank you very much and we definitely appreciate your insights. And, you know, just to be clear, I don't think there's any mystery that the

AWS blurred this map out for the 2 kilometer cell because I think you make a very good point that this map is about, A, getting people excited about wind where it makes sense for them to get excited and, B, since they're giving these maps away for free or they allowed us to give them away for free they had to make sure that there was certainly a product that they could still sell.

And I'm sure they appreciate your describing that even briefly that there are products out there from AWS, Wind Logics, and Three Tier that are all about getting a better perspective.

So thank you. So with that, we're going to launch into some of these questions. We've got a handful of them and I'm sure more will be on the way. The first one is a fun one but maybe we don't have a great answer for it.

And the first question is that there is a table out there based on the 80 meter map that ranked the States in terms of their wind energy potential. And that's available on the Wind Powering America site. On the wind map's page there's another link you can follow, the resource potential map.

And it's been really great for talking with policymakers about where they fit. So is Iowa better than Texas or do they have a better resource? Or does South Dakota have a better resource than Iowa? It's a fun way to kind of get your effective rank with regards to the potential and other States.

And Jason, I guess the question for you would be, are you aware of any - have you heard any ruminations as to whether a similar exercise might be conducted at NREL using the 30 meter maps?

Jason Fields: I have not heard - excuse me, I have not heard anything to date but I think since the wind maps were just launched this is exactly the kind of feedback

we're looking for as to what next steps are valuable. So if capacity calculations are valuable then certainly we can escalate that to the Department of Energy as a need.

Charles Newcomb: Excellent. In fact, the host of these questions are going to be for you Jason because the ones for Rich are just rolling in now. And actually there's another person asking about State ranking, exactly, same question.

Another question for you, and I think I can answer this one, are these interactive or are they similar to the other static maps at NREL? And the answer to that would be unfortunately these are static. And if you want the interactive maps then we encourage you to reach out to either AWS or Three Tier and they'll be more than happy to sell you an interactive map.

Okay, there's another person who asked about other than very mountainous regions - and Rich actually might be interesting to have your perspective on this, other than very mountainous regions or sort of ridge top sites or sites that are directly on the water, do you think that small wind has a play in Southeastern United States?

And I'm thinking about both in terms of the sort of small traditional wind turbines but then also if you wouldn't mind providing a comment or so about the (GUIA) and, you know, that class of machines that has just a monstrous rotor.

Rich Hasselman: Yes, the Southeast is always the enigma and I think you indicated, Jason, that the Southeast was where we might have some data gaps as far as some of the modeling or validation information.

But, you know, the 30 meter maps are only at 30 meters and in my view you look at what's the impact of taller towers and look at the impact - and look at the relative economics there.

And we've also got turbines coming out with larger rotors like the (GUIA) or the Endurance 3120 where we've got larger than traditional rotor relative to the generator capacity. And in my view that's what's going to work well and has traditionally been considered a wind resource location.

Charles Newcomb: Very good, thank you so much. And it's true that - you know, from the big wind perspective as we look at the new Class 3 rotors for the Southeast, it's a dramatic change.

It's not just a big rotor but it's also going to the 110 and even looking theoretically up to the 140 meter hybrid towers, that the development potential in the Southeast is - when we think about it today it's markedly different from when we thought about it five or seven years ago.

But unfortunately small wind towers at less than - you know, less than 100 meters are going to benefit in the same way.

You know, there's a - somebody asked a question, they said, is this a silly question? It's not a silly question and the question was, where do you find the 30 meter maps? Let's answer that one real quick because we have - we still have 75 people on the line.

The way you get to it is you go to WindPoweringAmerica.gov - www.WindPoweringAmerica.gov and there's a map off to the bottom left that looks like a US wind map. If you click on that that will launch our wind maps page and there you'll see the 80s, you'll see the old 50 meter maps.

So we've left those legacy maps up because they're part of our legacy. And then the 30 meter maps. So that's where you'd find them.

Another question, as you look at the 50 meter map - and Jason, perhaps you can provide a little color on this, pun intended, you'll notice that we changed the color coding a little bit and we also changed them from wind classes - we developed something called a DOE wind class rating to wind speeds.

And can you share a couple thoughts about why we went from class to speed and maybe the colors, just - it was by committee. But at least can you provide a little - a couple comments on why we abandoned wind classification system?

Jason Fields: Yes, absolutely, so what we found was the - once projects actually started going into the ground - and again, this speaks to the iterative nature of the process as we learn more we can do it better, we found that the wind power classes actually resulted in rather large variances in capacity factor.

So for example, you could have a 40% capacity factor site in something that was a Class 3 or even a 20% capacity factor site that was in a Class 4 regime. So we felt like it really wasn't representative of the true intent for quantifying the resource, which is how much energy can I get out of a particular site.

So for that reason the wind power classes were deemed inaccurate and I should also say, you know, moving to an annual average wind speed is still some what inaccurate because you also have to understand the frequency distribution of the winds at your particular site.

So a 7 meter per second site with different (unintelligible) characteristics or different frequency distributions which average out to 7 meters per second can produce significantly different capacity factors and energy production.

So I think that's another important thing to understand about the maps in general is, again, they're a relative good starting point but if you want to dive deeper and get those frequency distributions that will help you refine your energy estimates. And of course, you can get those from site assessors and AWS, Three Tier, etc. They can really give you that more detailed data.

But to go back to the original question, yes, we quit using the wind power classes because ultimately they did not represent frequency distribution well enough and they did not represent the ultimate energy production you might expect to see out of a site.

Charles Newcomb: I would also add that we also classified things as poor, marginal, fair, good. And those are fairly subjective, especially in a climate where technology is changing quickly and the pace seems to be accelerating.

So what was marginal before - maybe ten years ago, you know, could be considered good today with today's technology and could be considered very good with tomorrow's technology.

So sort of putting a qualification on wind speed seemed like a static perspective in a changing world, and that could be a mistake. I think the other thing we had tried was we had power density maps if you remember for a while.

Our legends also had watts per meter squared in them and that did address what Jason was talking about, it talked about sort of the (unintelligible)

distribution and what's kind of the average power density for a specific location might be over the year. But it was confusing to folks.

And so we wanted to - it's kind of like why are towers white, right? Towers aren't white because - there's a technical reason for it. Towers are white because they're attractive and they can be accepted. And so wind maps are a little bit of that as well as that we're trying to come up with a variable that makes sense to people and people can resonate with.

So another question, what's the level of accuracy the map - Jason, and I think you talked about down sampling and kind of getting to the current resolution that we see in the maps and that there's an underlying resolution in the maps that could be greater. Could you spend just a quick second talking about that again?

Jason Fields: Sure, so I think first of all, the accuracy - the relative accuracy in the maps is going to be greater, really have more data. For example, we have good data in California and Texas, you know, States with a lot of installed wind power capacity and a lot of prospecting, things of this nature.

Again, the uncertainties we would expect to be rather high in areas with little wind power development like the Southeast. So we - and again, this is where I say the potential next steps are really to start to quantify with numbers the relative uncertainty in different areas of the map and different areas of the model.

So for example, quantifying the difference in, you know, how well we know the wind speeds at 80 meters versus what we know at 30 meters, and quantifying the impact of surface roughness being much more significant at 30 meters than at 80 meters or 100 meters.

So that the simple answer is for numerically that's work that we still need to do, I think, but in a relative sense for understanding how the map applies to your situation I would say look at the available data and in your area look at the relative maturity of the industry in your area and that should help you - help guide you on how much to trust the maps in a particular location.

Charles Newcomb: Very good, there's a nice comment, I appreciate it. Somebody put in a comment that says, towers are white because pilots can see them better if they're white. And it's very true, in fact, I remember a project where we had the council in the areas asking if we could paint the towers so that it would blend in.

In fact, they wanted us to paint the entire turbine, blades and all, so that it would blend in with the surrounding environment would be all but invisible. And it was very nice to be able to look back, pull out the FAA reg that says, wind turbines shall be painted so as to be visible to pilots and then not have to go there.

So yes, turbines - thank you for that correction, (John). They are attractive. I think we would all agree and I would maybe correct myself and say, well, okay, so wind turbine blades are usually white as well even when it makes sense to make them black because they're attractive but you're right, (John), thank you.

Let's see, there's another question, so there's some validation sites that you mentioned, Jason. And is that available for the 30 meter maps? Or are there other technical details with regard to that validation that's publicly available? Or is that something that NREL holds reasonably close as part of our agreement with the consultants that gave us the data?

Jason Fields: So the - we have some summary information but certainly we can't release the validation data per say because of confidential agreements with developers, consultants, and other stakeholders. I don't know of the level of documentation regarding that but if you send me an email I can definitely look into that deeper for you.

Charles Newcomb: Good, and actually back on the 50 meter maps, I remember - at least there was some revs going back a few years that when we were first socializing the concept of wind maps for different States around the country we would show little stars to sort of show where the validation points were.

But I think we've definitely gotten away from that and so if you are curious definitely reach out to Jason and we'll see what we can do.

I think at the very least, what it would do is it would give you perhaps greater confidence as Jason was describing how in areas where there's been a lot of wind development and you've had consultants all over that area putting up towers and taking measurements. And then providing that data to NREL for validation purposes.

You might have higher confidence in the map in that area and lower confidence as Jason rightly pointed out for the Southeast.

Which, you know, it's a good thing if you believe about - believe in a half-full glass that there's a lot of opportunity for improvement in the Southeast, especially with regards to this height and map.

All right, so that gets us through our questions. We really appreciate people being on the line and sticking with us through the hour. Looking forward,

oops, somebody's ahead of me, we have a couple upcoming webinars in August. We have renewable energy future study.

We had had social acceptance scheduled for August but given that the future study has come out recently and it's important because it's an exciting study that talks about what's the role of renewables - all renewables going forward into the future. And when we say future we mean, you know, 50 years or so.

So what's it going to look like? Where's the grid going to go? What are some of the constraints that we might see? What's the relative position and role that renewables may play with respect to other generation technologies?

And when a study comes out like that it's exciting, it's important that we get that out - get the word out and get people to understand what that study does for folks from a policy and perspective.

So we've pushed social acceptance back one month and we're sorry for those of you that were looking forward to that in August but please do look forward to that, social acceptance, on September 19.

Again, these webinars are monthly, recurring on the third Wednesday at 3 o'clock Eastern. And these will be posted as well as the presentations be available to be downloaded off of the Wind Powering America website in about a week's time, that's about how long it takes.

And the transcript - and I can't remember if the audio is but I know the transcript is available at that time as well so you can read through and see all of our ums and ahs to your great pleasure.

And again, thank you very much. Special thanks to the US Department of Energy and its continued support of this important program. There's a few Wind Power America or Wind and Water Power deployment contacts up there, Jonathan Bartlett out of the D.C. office, our fearless leader nationally.

It's fantastic to have your support, Jonathan, it's nice to see you online again today. Ian Baring-Gould who I thought he was paddling down (unintelligible) but I think that might be closed to raft so we'll have to figure out where he really was this week. And then there's me as the last in line there.

So thanks very much again, folks. It was a pleasure to have you on the line and thanks very much to our speakers, your time and expertise is much appreciated. And have a safe month until we speak with you next. Thank you.

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