TOOLS AND TECHNIQUES FOR ASSESSING ENERGY YIELD POTENTIAL FOR SMALL WIND TURBINES WEBINAR

September 1, 2011

Coordinator: Welcome and thank you for standing by. At this time all participants are in a listen only mode and will remain on listen only throughout today's conference. This conference is being recorded. If you have any objections you may disconnect at this time.

I would now like to turn the meeting over to Ms. Trudy Forsyth. Go ahead ma'am. You may begin.

Trudy Forsyth: Thank you (Sharon). So my name is Trudy Forsyth and I work at the National Renewable Energy lab in the National Wind Technology Center. I've been leading distributed wind projects here since 1995.

Thank you everyone for joining us today for yet another wonderful ASES Small Wind Division Webinar. These are held bi-monthly. And in fact we have another one scheduled the beginning of November with the Distributed Wind Energy Association November 3rd. It's going to be at the same time.

But today's webinar is focused on Shawn Shaw from the Cadmus Group. He is a senior associate with the Cadmus Group. He has ten years of experience working in the renewable energy field and has worked extensively with distributed wind energy projects and programs in the northeastern US.

In particular, Mr. Shaw has focused on performance monitoring, funding program design and evaluation, site assessment and the development of tools and resources to help improve the accuracy of pre-installation energy yield predictions.

So during today's webinar Mr. Shaw will discuss some of the challenges of estimating the energy output of small wind turbines. These systems typically installed at the residential and commercial scales, do not have the benefit of expensive meteorological studies to make accurate energy yield predictions.

Instead there are various computer models, rules of thumb and assumptions made to calculate annual energy yield. However, these approaches are not always consistent with actual measured performance data.

In addition to discussing these challenges, tools and techniques Mr. Shaw will demonstrate the use of online tools such as the small wind energy evaluation tool, to improve the accuracy of pre-installation performance predictions. So without further ado, Shawn I would say let's get to your presentation.

For the audience, we're going to have several question periods. The first will be after Shawn gets through the site assessment portion of his presentation. And then the second set of questions will be after the demo of what he calls the CWEST tool which he'll explain to us.

And then in the end we'll close questions. Those questions can be typed in through the webinar software and I will attempt to moderate all the questions so that Shawn gets a chance to answer them all.

So just to recap, three question periods, one at the end of site assessments, one at the end of the tool demonstration and one at the end of the presentation. All right, Shawn, tell us what you know.

Shawn Shaw: All right. Well thanks Trudy and thanks to everyone who was able to tune in today. And I hope we have a good discussion going. I'm going to share some

thoughts and some experience with all of you and maybe we'll all get together and move the industry forward a little bit on these performance predictions.

So hopefully everyone can sort of see the slides. I guess if you can't there's no way for you to tell me so. But we'll do the best we can here. Today, a quick breakdown of the agenda, we're going to cover a lot of stuff. And I want to make this as helpful for everyone as I can.

So feel free as Trudy said, to ask any questions you need to, clarify anything you need to, anything along those lines. So I'd like to start with a quick overview of what some of the challenges are for small wind site assessment.

Not knowing who all is out there in the wide world of the audience today I'm sure many of you have dealt with site assessment for distributed wind projects before. Maybe it's sort of new for some of you so hopefully we'll, you know, it won't confuse anybody nor will I bore anybody with a quick overview.

And then a discussion of how a site assessment world, what some of the available tools and resources are for doing these site assessments and then I'd like to share if you don't mind, a couple of tools that we've developed that are available for use or soon to be available for use, you know, to help make site assessments easier and more repeatable and perhaps most importantly, as accurate as possible.

So the two tools that Trudy alluded to one of them, I call it CWEST. That just stands for the Commonwealth Wind Evaluation and Siting Tool. Commonwealth refers to the fact that we built it for the Massachusetts Clean Energy Center.

The basis of the tool can be used anywhere. I'll give an example, you know, use an example from Massachusetts but the same principles of operation and everything apply.

DSAT is a national tool that we are just about to release within the next few weeks, funded by DOE, to help make site assessment easier and more comprehensive as well. So I'll get into those in a little bit. As Trudy mentioned, there will be a few spots during the presentation for questions.

So just to sort of start off and frame things up a little bit, here are 17 small wind systems. These happen to be installed in Massachusetts. And each of these bars represents essentially how close these systems are coming to meeting their predicted energy yield.

So for example, the system on the bottom there is about 30%. That means that if the system was expected to produce 10,000 kilowatt hours it's actually producing 3000 kilowatt hours. So the average for this batch of 17 is about 70% which isn't bad.

Many of you may know that a few years ago in Massachusetts we were nowhere near 70%. We were less than half of that which is to say that our systems were falling far short of their expected performance.

You know, and there's - we can go into a whole other presentation about some of the reasons behind that but it was actually more of an issue with the prediction methods than necessarily the systems themselves.

And that's really when I think some folks in the industry, ourselves included, started getting really interested in looking more closely at how small wind system performance predictions were made and how they could be improved.

There's an army of good and qualified folks working on making turbines better, testing turbines and doing things like that. This presentation is a little bit focused on the other side. And hopefully between better turbines and better predictions we're able to move closer to 100% on graphs like this.

So what is hard about doing a site assessment? I mean surely it's not rocket science, right? You plug in some numbers, you have data, there's wind data on the internet. I think everybody knows that. And so what is it that's the holdup here?

You know, certainly, you know, people aren't investing in 100 megawatt wind farms and having such a variable performance in their output. No one would keep putting them up. Well that's a whole other discussion. But in this case the largest issue we're facing is the limited availability of data.

When you go and you site a 2 megawatt wind turbine at a school somewhere or you site a larger wind farm in a field in Wisconsin somewhere you're looking at a very involved pre-construction feasibility study process that includes detailed wind monitoring.

It includes, you know, paying some consultants to calculate your energy yield and make very detailed financial projections for you. You've probably got some sort of site transitions modeling using CFD and (WASP) and all kinds of fancy software. And that's great.

You know, you can easily blow hundreds of thousands of dollars on such studies. For small wind when you're talking about a wind turbine where the entire project cost may be $50,000 or $60,000 there's really very little overhead to do a lot of due diligence.

Almost never are there resources available to actually measure the wind resource before putting a small turbine up. So you've got to rely on secondary data sources.

You've got to rely on assumptions, rules of thumb, all kinds of things that would put any for profit wind development firm trying to build wind farms, you know, quite ill at ease to use them. So the small wind industry is quite a bit different than the big wind industry in that respect.

So it falls to us to, and I speak as the industry at a whole, to get a hold of the best data and best assumptions we can, and make them widely available to as many folks as we can so that performance predictions can be made as accurately as possible.

So in particular we need three pieces of data. We need to know what the wind resource is. We need to know about the turbine's performance characteristics. And we need to know once we have the wind resource data, how is it and how is the turbine's performance impacted by what's actually at the site.

Excuse me. So first off, the wind resource data availability, just a quick - this is a snapshot of the New England wind map. And it happens to be an area that has a few different colors on it. So the sort of pink and red area here, these are areas of high wind resource.

And that ranges all the way back to the white and lighter green areas where wind resource really isn't that good. This type of wind map I, you know, certainly you can get these from the Wind Powering America Web site. You can get them online.

I think they may be on EnRel's Web site as well. And certainly this was very commonly what you would be looking at to do site assessments and such or preliminary assessments for turbine projects six, seven, eight years ago. There are some more modern variants of these wind maps now.

But these are - this was the - era 2003 was the last time we had freely available fairly high resolution wind maps to work with which gets us back to the cost. Again, if you've got a $50,000 or $60,000 wind project you can't afford to spend thousands of dollars on wind resource data.

So the free data you have available to you I've shown on the left here side just a couple of examples. As I mentioned there's - EnRel validated era 2003 wind maps data for about 37 states.

There are free services available from AWS True Power and Three Tier, the range in grid resolution from 2 kilometers to 5 kilometers. So much broader but yet updated data. So it's a trade-off. You can use higher resolution, older data or you can use lower resolution newer data that's been updated.

It's hard to tell which of those is really better. It probably depends on your - the complexity of your terrain. On the fee based side, AWS True Power and three tier will both sell you wind data for your site. It varies - the resolution varies. Exactly what you get varies.

But you're looking at spending $1000 to $3000 for a decent report on what you get for a site. This is the basis of what you might have heard of as virtual (MET) maps data but that's basically what you're looking at.

You know, if you want good resource data you're probably going to have to spend money on it. The other important thing about wind resource is that a lot

of people think wind resource is just all about your wind speed but it's not. There are a couple of other things that you really need to know as well.

One of them is the probability distribution of the wind speed. In most cases the wind follows what we call a (WIBL) distribution. That's this kind of almost bell shaped curve here. The smoother one is sort of a predicted (WIBL) curve of the wind speeds.

The red graph overlaying it is a graph that we actually measured at a site and so we're sort of comparing them here and saying in this case they happen to be fairly close.

We've seen other cases where they're nowhere near each other and what that does is that impacts for example, if your turbine doesn't turn on until 4 meters per second and your curve is shifted more to the left that means you're going to have more hours during the year where your wind turbine doesn't have enough wind to generate electricity.

So knowing how the wind speed is spread out throughout the year is important. The other thing it's important to know is where your wind comes from. And that is usually in the form of a wind rows.

And what it's basically saying is it's saying that each of these, for example in this wind rows there are 16 different directions.

And it says that let's suppose that each ring is 10%, it's saying that all right, well from the south southwest you're looking at something like 15% of your wind over the course of a year comes from the south southwest. So that's important to know when you're looking at a site.

For example, if you want to put up a turbine but you know that there are - there's a large stand of trees to the southwest of where you want to put the turbine you may want to think hard about that because those trees are going to be right in the area where you get most of your wind for the year.

On the other hand if the trees are in the southeast you may not care very much because almost none of your wind comes from that direction. The other thing here is - to consider, is the actual performance data for small wind turbines.

And again, there are a couple of major things to think about with regards to that and one is the power curve. For those that don't know, a power curve is just like the one I've pictured here where you've got wind speed on the X axis and the power output of the wind turbine system.

This is the output of basically where it connects to the grid. And the graph usually follows a form something like the one shown here. It will peak at somewhere around 25 or 30 miles per hour and then depending on the turbine will either stay level for a while or will start to drop off.

So these power curves are - a few years ago were measured in all kinds of different ways. It was very difficult to find out from manufacturers the particulars of how their power curves were measured, whether or not they followed the applicable standards, etc.

More recently, the Small Wind Certification Council has become a major force in the industry to help standardize power curves and other measurements and basically give us, you know, an equal playing field to compare wind turbines one against the other.

So that is a great thing that we are looking forward to. Unfortunately we don't actually have any certified turbines yet. We have a couple of provisional approvals so we are getting very close. But that's only part of it.

The other issue you have to consider is the turbine's availability and how often it goes down. And this can be a combination of how the (invert) controls the system. It can be how the turbine responds to high winds, how the turbine responds to low winds. There's a lot that goes into that.

And without, you know, without some sort of in field measurements it's difficult to predict ahead of time what a reasonable number for a typical turbine is going to be. So just, you know, in speaking to power curves here are a couple that we've recently measured for turbines here in Massachusetts.

And you can see there are often differences between the actual power curve and the one that we get from a manufacturer's spec sheet or something along those lines.

And even with - in the case of power curves that are measured using the applicable standards, it's important to realize that the standards are based on measuring power curves in sort of ideal conditions - a very open terrain, a very flat terrain. That has the benefit of making the results reproducible.

But it doesn't always - those power curves don't always get realized when the terrain doesn't match how the turbine is tested. So here in the northeast for example, we have a lot of trees, we have very hilly terrain, we have a lot of buildings. It's a very busy environment.

And so we sometimes see power curves that show that effect. And so far nobody is exactly sure how any given turbine is going to react across a wide variety of terrains.

But that's - hopefully that data is going to start becoming more freely flowing as SWCC becomes more widespread and as testing of turbines in general becomes more widespread. So stay tuned. Hopefully more data on that will be hitting the industry before long.

As far as availability and downtime goes there are not a lot of published studies out there describing turbine availability in the field. The operational time fraction is part of the SWCC testing and that tells you some of it.

And it's a great number to go off of but it's going to be a sample size of one turbine at a test site.

You know, if you want to know how a turbine is going to - what kind of availability to expect from a turbine it would be nice to have a data set with 10, 15, 20 turbines in different locations and how much downtime they had over the course of a year, for example.

In our metering we've done it on turbine installs in the field. We've seen typically most turbines tend to be a 90% or above for availability. But we also see turbines that fall much lower. You know, we have some turbines that are in the 30% or 40% range. Again it depends on the turbine.

It depends on the conditions. It depends on the weather that that turbine experiences. A lot can contribute to it. Hence why you need sort of a larger data set before you can make any really intelligent assumptions.

So, you know, you can certainly assume 90% when you're doing calculations of performance. But occasionally you're going to find turbines that fall far short of that. So when you're doing micro-siting, you know, I mentioned this as sort of the other leg of the proverbial pyramid.

You've got the performance of the turbine, you've got the wind resource and then you've got the micro-siting which affects both of the first two. As I mentioned, you know a turbulent environment produces a different power curve than a flat open environment.

Likewise, a turbulent environment has an effect on the wind resource that your turbine sees as compared to, you know, if you have a 5 meter per second nice, green looking site on your wind map and it's in an open field.

And you look at the same site again 5 meters per second at say 30 meters above effective ground level on your wind map and it's in the middle of a forest, don't expect that your 100 foot tall wind turbine is going to see the same wind resource in both of those locations.

So as part of our work for DOE which we're, you know, we're pleased to be partnering with EnRel and Encraft in the UK on. We've pulled together as much wind shear data as we can get our hands on.

And I think we ended up with - I'm probably going to get the number wrong, something like 80 or 90 towers spread around the country which we looked at by terrain type and tried to come up with some estimate of what kind of wind shear you can look for in different types of terrain, so just a general table here.

The other thing we look at when we start making assumptions about things is canopy height and solidity? So this comes into play and I'll explain more about how it comes into play and I'll show you an example in a way.

But essentially the canopy height is if you've got a sparse forest that's basically just how tall the average of the trees are. You know, in this case you've got a bunch of 10 meter trees. It doesn't mean every tree is 10 meters.

But if you were to stand up and look across the top of the forest that's kind of where you'd be looking from. And the solidity is a measure if you were to essentially take a portrait of the terrain, for example take a portrait of the forest standing outside of it.

That's a measure of how solid the obstruction is. So a solid building with all the windows closed would be a solidity of one whereas you see our sparse forest is just a little over 50% solid.

And that's because there's still lots of room for the wind to move between branches, under the canopy, through the canopy, things like that. So for example, this - terrain impacts the wind resource by essentially taking what the wind sees as the ground and moving it up.

So if the wind is blowing across an open field effective ground level is at the ground. If that wind suddenly impinges on a forest of 50 foot trees then that effective ground level is no longer at the ground where you're walking. It's above your head 30 or 40 feet into the canopy.

So what this means is if you're looking at a wind map and it says that 100 feet off the ground you should have 5 meters per second, that may be true in the open field.

But if you go into the forest and you need to shift upward that means that that wind speed you're expecting to see at 100 feet doesn't actually happen until you get to 130 or 140 feet.

So that's sort of like, you know, you're essentially - if you put a turbine in the woods you may - you're effectively shortening your tower by whatever the effective ground level is. So that's an important thing to consider, you know.

In Massachusetts when people first started putting small turbines in 80 feet sounded like an awful lot to everybody. But unfortunately Massachusetts is full of 30 to 100 foot tall trees.

So when people started doing that and started getting horrendous energy yields from their turbines that's when people started to realize that even though 80 feet may sound like a lot and give a lot of zoning boards heartburn it really isn't enough to make wind viable in complex environments.

An urban canopy is very similar to a forested canopy. It's, you know, similar kinds of concepts. It tends to be more solid. It also tends to be in some cases taller.

But what you're looking at here is, you know, for example if you put a wind turbine on top of this 350 foot building but all of the rest of the cityscape around you was 100 feet above grade then prepare to be looking more at 250 feet when you're trying to line up the wind resource on top of that building with a wind map.

So - and of course this all - the other thing about these terrains is as I noted earlier, the wind shear gets higher. So that means that wind speed increases faster above rougher terrain.

So you get more bang for your buck by making your tower taller in rough terrain than you would by making it taller over open terrain.

The other aspect of siting with respect to the terrain and the overall turbulence or the choppiness of the wind is thinking about what impact that has on your turbine, you know. So far I've talked about power curves and I've talked about things like that.

But you also want to think about turbine durability. No matter how good your site is very few turbines are going to pay for themselves in a year or two. They're going to take some time.

And if your turbine falls apart after five years because it's in a really turbulent wind area and is getting frankly beaten by the wind, then you're never going to get a payback no matter how good your power curve is. So it's important to consider that as well when you're siting.

And that's something that is very hard for software tools and things to take into account. You know, you can look at it and say by rule of thumb, you know, you don't want to put a turbine in these kinds of locations because it'll get damaged from the turbulent winds.

But, you know, it takes very good analytical modeling and anybody that tells you they can tell you exactly how turbulent it is right behind that particular building over there is probably lying. So obstructing wind flow is similar to what happens with terrains.

But on the other hand, it may be a little bit different too. Obstructions look a lot like terrain features but they tend to be more localized.

A single tree or a single building or a very sharp hill or a sudden change in topography, these sorts of things tend to cause more sudden changes in wind flow and induce a downwind wake effect that essentially increases turbulence and slows down the wind right behind the obstacle but may not be so pronounced as to move the whole effective ground level.

So a more localized effect if you will is kind of what you get from obstruction. So as an example, we've - oh, you know what? I'm sorry. One of these lines is a little hard to see, the .5H. If you can't see it it's a little bit lower than the - for most of the graph than the 1H, the gray line. Sorry about that.

Anyway, the - so this is a wake effect that we measured in collaboration with some of Encraft's folks in England on a typical two story house in a wind tunnel. So the downwind distance is expressed as a function of H. That's just - H is just how tall the house is.

So for argument's sake we'll say H is 25 feet full scale. The velocity ratio is the different - is the ratio between the measured velocity with the house and the measured velocity if we take the house out. So hopefully that's simple enough.

So what we see here is once we get to about 3H above ground, so if we're 75 feet in the air the wake from the 25 foot house doesn't really have much of an impact especially if you're - well I mean it just really doesn't. You know, you get - whether you're close to the house or whether you're far away.

The wake does grow behind the house but it doesn't get up to the 75 feet here from the 25 foot house. However, if you're looking at a turbine like say a 30 feet guide stream installed near a two story house you can definitely have an effect.

If you're 50 feet downwind of the house on a 30 foot turbine then your wind speed is going to be less than half of what it would be had the house not been there. So that's an important thing to think about.

Now you can minimize that if you move your turbine around so that the house isn't in the prevailing wind direction. You know, I mentioned going back to that wind rows earlier. If you put that house in the portion of the wind rows where you don't get a lot of wind it's not a big deal.

But imagine if 30% or 40% of your wind over the course of the year were coming at you - at the wind turbine over that house, all of a sudden your 5 or 6 meters per second that you were expecting at hub height, could be much, much lower.

Similarly for a new case of deciduous tree, we did the same kind of modeling. And you see that as you get to be three times the height of the obstruction the wake has a small effect.

But again if you're down similar in height or yet even lower than the obstruction, the effect can be very significant especially if you're close to it. I have a video that I'm going to try to show. I don't know that it will actually work.

But it's essentially going to show the deciduous tree in that slide and what the wind looks like as it passes through. This was taken in a wind tunnel at the building research establishment in the UK.

And so what you can see is we're essentially letting loose some smoke so we can see the streamers as the wind impinges on this tree. And you see a lot of the wind is able to pass through this deciduous tree.

But the wake of it is very choppy after the tree for again, you know, three or four heights of the tree downwind. And as you get toward the right side of the screen you can actually see that it starts to stabilize again. The wind becomes smoother. Okay. Like I said, I'm sorry if you guys couldn't see that.

We experimented with it ahead of time and it - I wasn't sure if that was going to work. But we - I, you know, we can provide that video as a link on the Web site or something if we need to. A lot of people talk about wind on buildings. We could probably do a whole other thing on this.

But for argument's sake here are a couple of computer - computational fluid dynamic models. These are fancy computer models that make very pretty graphs and do a lot of math.

But the upshot of it is, is that it tells us if we have wind of a known velocity coming in, in this case a 5 meter per second wind, how fast is the wind going to be at different places around an obstruction? So this is just a rectangular building.

And you see that at the windward corner of the building the wind starts to separate.

And so the building mounted wind folks would like to say well we can put a wind turbine right on the corner of the building and we can stick it up a little bit and it gets into this yellow and orange range which means the wind is actually faster than you would see from the wind map because it's being accelerated as it splits at the corner.

And then as it goes downwind you can see the picture on the right shows what the wind looks like on the leeward side of the building. So the wind's sort of coming across on this slide from the left to the right. And you can see this area right downwind of the building is just a mess.

You see all kinds of turbulent eddies. You see very low overall velocities. You certainly wouldn't want to put a wind turbine in this area. And the building mounted wind guides are right to an extent. You can accelerate the flow on the windward corner of a building a little bit.

But all of a sudden the wind shifts direction and what was the windward edge may now be the leeward edge. So you're back over here on the right in this blue region again and you're not doing so well.

So definitely some caution needs to be taken when thinking about mounting turbines on buildings because the wind direction changes and you may not have what you think you have. So unfortunately there's - there aren't too many inexpensive ways to model how wind flow works on buildings.

I'll get to (DSAT) a little bit later I hope and we've taken a look at it. And we're trying to provide people with some tools to do that.

But right now the state of the industry is either you need to measure and/or you need to use some CFD, computer - computational fluid dynamics models

like this, to predict what your wind resource would actually be over the course of a year.

Trudy Forsyth: So Shawn maybe this is a good place for a pause to...

Shawn Shaw: Sure.

Trudy Forsyth: ...do some questions before you slip into your prediction tools. The first question I have is do the availability and downtime percentages include time below the wind turbine's cut in speed or is it strictly maintenance based?

Shawn Shaw: The availability numbers I gave there are not including the calm, you know, the calm period, where there's no wind. That's periods where there should be enough wind to operate but the turbine for whatever reason is not operating.

Trudy Forsyth: So it sounds like you're saying that you're not including the time before cut in.

Shawn Shaw: That's right. Yeah.

Trudy Forsyth: And then do you want to comment on the maintenance based part of it, the downtime part of it, scheduled/unscheduled? Anything you want to say there?

Shawn Shaw: Yeah. The scheduled maintenance on most wind turbines is fairly minimal. Many of them don't even require you to interrupt operation to do it because it's usually some manner of visual inspection on an annual basis.

Every three to five years some turbines recommend - some turbine manufacturers recommend that you do things like apply lubricant. But overall,

for scheduled maintenance you're usually talking about maybe shutting the turbine down for a day a year.

It's really the unscheduled issues that hurt the availability. And so things, you know, examples of that might be for example, the turbine experience is a high - an overspeed fault. So the wind speed gets very high and the turbine have to shut down and something prevents it from coming back online.

Some types of turbines when they furl occasionally get stuck in furl and aren't able to unfurl and return to normal operation on their own.

Most of the issues I would say it's fair to say, happen on the electronics side, so the fancier and more electronic a turbine is you might experience, you know, failures in the computer.

You might experience breakers tripping if for example, somebody installs a turbine and maybe they don't size the back feed circuit breaker quite large enough the turbine may trip when it - as maximum output.

So those are the kinds of things, you know, a lot of it is you do - if you walk out and you hit a reset button and the turbine goes back to running. More occasionally you actually have to replace a component like a charge controller or an inverter or something like that.

Trudy Forsyth: You know, another reference would be people could look at our site on the www.EnRel.gov site under independent testings where we give a statistic on operational time fraction which is even more precise than the general availability number.

And we have one turbine for example that had a 100% operational time fraction which is very difficult to do. So from our perspective we see very high operational time fractions and very high availability for small turbines.

The next question - does the wake effect of a deciduous tree, you know, the one that you were talking about a couple of slides back. Does that assume that the tree is in the summer or the tree is in the winter when it doesn't have its leaves?

Shawn Shaw: In this case this is a deciduous tree in leaf. We also measure deciduous trees out of leaf. And what we found was perhaps not too surprisingly, that a deciduous tree without leaves actually has a fairly small impact on the downwind relative velocity.

It'll reduce it by a little bit. You know, the curve shape will be similar but it'll return to a velocity ratio of one much sooner.

Trudy Forsyth: Okay.

Shawn Shaw: So, little effect from trees without leaves.

Trudy Forsyth: Yeah. Okay. That'd be an interesting point to debate a little bit further. But I've got other questions so let's keep rolling here. Do you know if AWS True Power or three tier online wind maps account for places where the effective ground levels should be raised above grade?

That's the question. They claim to account for terrain roughness and some degree of ground cover impact. So do you know if they account for those effective ground levels?

Shawn Shaw: Well I can't speak to the more fee based services that they provide. In general the free wind maps and the 2003 era wind maps don't include effective ground level. They simply instruct you to account for it based on what's at your site.

You can get wind shear from the wind maps. Again, I would say that the wind shear you get from the maps themselves is probably a bit low.

But you probably need to apply your own effective ground level to whatever the reference height wind speeds you get from the wind maps are unless you specifically find something in the data saying otherwise.

Trudy Forsyth: Okay. How do you handle the annual variation of the wind resource? You know, at our site we see up to 50% annual variation wind resource from year to year. So how does your tool handle that?

Shawn Shaw: The - I don't know of any way for a tool to handle that. Ours don't really.

When we've done studies for example, for Massachusetts, when we've looked at the fleet of turbines installed there we've adjusted for annual variability and the wind speed by using available NOAA data, National Oceanic Atmospheric Administration.

The - in that case - I mean it depends. If your wind resource is varying that much from year to year the thing to think about is you're putting in a wind turbine as a - hopefully something like a 20 year project. So when you're making performance predictions you're talking about typical year.

It sounds like you may not have a typical year at a site like that but if you take a long term average that's kind of what we're getting at. But obviously there's

going to be a big difference between any calendar year and what the actual output is.

So if you're comparing you've got to make sure you normalize for that before you start making comparisons between predicted and actual output.

Trudy Forsyth: Yeah. That really to me is the most difficult part of building a tool that can accurately predict energy production because the resource varies. Next question - how efficient are residential roof mounted wind turbines?

Shawn Shaw: Efficient's a tricky word for that. I'll say a few general thoughts about residential building mounted wind turbines. And if I haven't answered your question, whoever you are, by all means try to clarify a bit. Residential wind turbines - often they are vertical axis, sometimes they're horizontal axis.

They're usually fairly small, perhaps a few 100 watts up to a kilowatt, maybe as much as 2 kilowatts. The issue that they have isn't even so much in how they operate. It's the wind resource and where they operate. They may be on paper, much more efficient perhaps than a standard vertical axis turbine.

And you see lots of literature on the internet to that effect. But the problem is, is that if you're 5 feet above a roof that's a - and you're a total of 30 feet above the ground on a house, there isn't that much wind there to work with.

You can be twice as efficient as a (Birdie) XL wind turbine for example, but the fact that you're on somebody's roof and the (Birdie) is in the middle of a field on a 120 foot tower that's really where the big difference is going to be.

So it's a question of available wind resource and it's a question of cost effectiveness too I think. You know, you have some costs associated with

mounting something safely to a residential structure. And that may not match well with the kind of output you get given the limited wind resource.

Trudy Forsyth: Okay. And a general comment from (Mick Segrillo) in this case is he says one way of adjusting annual variation in data is to plug in 12 months of data instead of the annual data. And though it's a bit more work it will get you closer to a more reasonable answer.

Shawn Shaw: Yep. Yep. That's a good strategy. The - as long as you can be sure that you can, you know, you have a good wind speed distribution over the month. A lot of tools assume, you know, the (WIBL) distribution I showed earlier.

And usually that holds over a month as well as over a year but just something to be aware of. Certainly if you can get the - do it bi-monthly then, you know, you can possibly get better answers that way.

Trudy Forsyth: Yeah, okay. Well that ends it for the questions at this point. I would say now let's transition to the tool part of your presentation. And then again at the end of that we'll take another set of questions.

Shawn Shaw: Okay.

Trudy Forsyth: Okay.

Shawn Shaw: Thanks Trudy. So, you know, we've covered some of the challenges and issues around doing a site assessment and what you're up against essentially. So now let's get to sort of the arsenal you have available to minimize some of these challenges.

When you're looking at performance prediction tools you really ought to be looking at a tool that does hopefully all three of these things. It should standardize the calculation methods. So, and I say this coming from a perspective of dealing with a lot of funding agencies and their programs.

It's very difficult for, you know, somebody who's giving out rebates for small wind turbines to line up an estimate that somebody's done with the (Birdie) wind (CAD) model for example against another prediction somebody's handed you that's one of the AWS True Power customized reports that you can purchase for a couple thousand dollars.

They look at those and they say I see two different numbers on two different types of tools. What do I do? So using, to the extent possible, at least tools that work the same way, if not the same tools, helps to cut down on some of the variability. And I think in the end that's what we want.

Ideally everybody is going to do their estimates the same way and it's going to be a level playing field. We're not going to necessarily get there but using standardized calculation methods helps. It eliminates at least one source of variability that we have to try to chase down.

The other thing that it should do is it should simplify the assumptions. We don't want to have to run a sophisticated computational fluid dynamics model for every site.

We need to find, you know, a good performance prediction tool should be able to by all means, incorporate the best data available but make it accessible to the user. You know, we don't expect that every small wind installer is going to have a PhD in aeronautical engineering.

We, you know, and nor should they. So we need to provide tools and assumptions and data in a way that is actually useful to people who are in the field every day, putting up and selling these systems.

And finally, a good tool should be not only, you know, should not only give you a number but it should be an educational resource as well.

A new installer should be able to pick up a performance prediction tool and hopefully learn something about doing a site assessment because the tool will ask them for the right information so it's a balancing act.

You want to make sure that your - the tool provides good assumptions in data and doesn't make you spend too long on the site assessment but on running the tool for your site assessments. But on the other hand it should ask enough questions to sort of nudge a novice user toward a more rigorous site assessment method.

Because if a novice sits down and says boy, I did my site assessment and I don't have half the data I need to fill out this tool, that may get them thinking and saying maybe I should have spent more than 15 minutes on site and I should have taken some measurements or I should have, you know, walked all the way around the site or I should have done this or that.

So I think a good performance prediction tool should do these things. Moreover, as far as some particulars about what it should include, you really want to have the ability to include in there at least an annual mean wind speed better as (Mick) pointed out, if you can incorporate monthly in there.

Sometimes you can do that sort of - you can sort of force it to do that by making 12 separate predictions based on putting in the monthly averages. But

either way you should be able to get that. You should also be able to describe what's around the turbine.

A lot of models out there, the simpler ones, will just ask you to put in what the wind resource is and what the turbine is. And they spit out a result and you're sort of expected to take that. You need to be able - the site around the turbine is incredibly important.

A turbine in the field is not the same as a turbine in the woods. And whatever tool you're using has to have some way of recognizing that and letting you as the user include that in your analysis. You also have to be able to include the turbine's power curves obviously.

And you also have to be able to say something about what losses there are because availability is a great example. While some turbine at test sites may have very good availability, you know, not all turbines will all the time. So you want to be able to make an assumption there and say, you know what?

I'm going to assume that at least 5% of the time my turbine's going to be down for something. That's not a crazy assumption. So you put a 95% availability in and you adjust your estimate accordingly. Nobody I've heard of ever gets yelled at for low balling an estimate on their energy yields.

Most of the time people like good surprises more than they like bad ones. So don't be afraid to be a little bit conservative where it makes sense to. You also are going to need a wind rows.

If the tool includes the ability to describe your site to it then it needs to know what the wind is doing in relation to what's around the turbine. That means where is the wind coming from?

And of course the probability distribution I mentioned earlier, this is important because one number, the average, can describe a number of different shapes on that (WIBL) curve. And the actual shape of the curve is what tells you how many hours the wind spins in different wind speed buckets.

So it's important to know how that curve is shaped, how squat it is versus how tall and pointy. You know, that's important. So a quick overview of the Commonwealth Wind Evaluation and Siting Tool - this tool has been around in one incarnation or another, for the last three, 3-1/2 years.

It's been in use in Massachusetts and elsewhere. It's been picked up by others. But essentially it allows the user to grab data from the New England wind maps. That's the 2003 era data that was purchased and is publicly available so that's what we use.

And it lets you describe your site, your turbine, all of those sorts of things that I mention. It lets you talk about de-rating, it lets you talk about all of it well I wouldn't say it all of it. But it lets you talk about many of the features that I just described.

And when you print out your report it gives you wind resource information. It gives you a summary of your project, how much energy it will generate, all of that. I'm trying to think if there's anything else I want to say before I actually show it. I don't think so. All right, I'm going to hopefully...

Trudy Forsyth: Yeah. This time I think maybe you didn't toggle between the different screens in your computer so...

Shawn Shaw: Okay, yeah. Let me - good point. Let me do that. Content. Nothing is currently shared. Okay. Trudy, can you see the CWEST page right now?

Trudy Forsyth: Yes, I can. That's wonderful.

Shawn Shaw: All right. Well that's a step in the right direction. Okay. So this is the splash page for the tool. Basically you start off and you come here and you enter your latitude and longitude and you click on get results.

Now again this is only going to work in Massachusetts right now because that's what it's built for. And it drops in, excuse me, drops you into a spreadsheet file that downloads to your computer. So this is the starting screen.

You can see these yellow boxes are where it has pulled in data directly from the New England wind map. So these are all the raw, unfiltered, just what's in the wind maps pieces of information. All right? So we'll go to step two and this is - again this is it pulled in the wind rows information from the wind map.

And this is the page where we described the site to the tool. So we have wind direction here. So from the north we're saying the terrain is rough. That may be consistent with a forest or heavy vegetation, some scattered buildings, probably one or two buildings and a few trees might be rough.

Most sites we see in New England tend to be rough or very rough for most of them. Just, you know, you can see down at the bottom here we've taken some pains to describe them. But, you know, your smooth sites are water, mud, ice. Moderate sites are things like grasslands, lawns, a little bit of plants or crops.

And then very rough tends to be things like suburban, urban. You've got a lot of buildings. You're far - you have a forest that's not only dense but it has trees of all different heights. It's a little bit intuitive. There's a user guide on the CWEST main page. Is that still up?

There's a user guide here that gives some photos and things like that for general guidance. So anyway what we can do in here is we can say all right, well I'm going to put in a 30 foot tree. In this area you can select vegetation or solid obstruction.

You can say all right, well then over here I'm going to - it's going to be a house. You want to make that very rough. It's a two story house and it's solid. So you can go through here and you can add a few more trees if you want. I'll just add a couple here for argument's sake.

And you generate your wind resource report.

Trudy Forsyth: Can you put in something higher than 30 feet?

Shawn Shaw: Sure. Sure.

Trudy Forsyth: Eighty feet or something?

Shawn Shaw: Sure. Why not? There we go. So this has all been converted to meters. I didn't enter comments in all of them but here are a couple of 24 meter obstructions. This tells you the coordinates and everything. It tells you the average obstacle height.

You have your predicted wind rows and also shows you in the same radial format what your obstruction heights are so you can kind of visually look at it

and say oh good, you know, my wind is coming from the southwest and I don't have much in the way of obstructions there.

That's probably good news for me. So you come down here, it gives you your (WIBL) K value which for those of you that don't know, that just sort of describe the shape of that probability distribution that I mentioned.

Your average site wind shear weighted by how windy it is in each direction and what type of terrain it is in each direction is .37. Oops, sorry. I can get into wind shear later if folks aren't sure about what that means.

But it's essentially the higher it is the faster the wind speed changes with height and generally speaking the rougher the terrain is. So on the bottom here you've got your typical wind map reference sites of 30, 50 and 70 meters. The second column is what's actually on the wind map.

So for this particular site we have an annual average wind speed of 4.7 meters per second at 50 meters, a reference height. After we adjust for the site factors since fortunately our tall trees aren't in a very windy direction they don't make that big of a difference.

And all we end up doing is decreasing our 30 and 50 meter wind speeds a little bit for this particular site. So this is the - this is just a wind resource report. Massachusetts uses this as part of their funding application for applying for feasibility study grants for a community wind project and such.

So it's meant as an early stage what's my general wind resource look like kind of analysis. And if you want to actually test out what a turbine would do you can come here and you can actually describe the turbine. You can say I want to put an Aerostar 6 meter for example, on a 100 foot tower at my site.

And you can add any additional losses you want to. Some people like to just take 10% or 20% off the top to be conservative. That's fine. Whatever floats your boat there. The wind speed de-rate factor - I ought to say a word about this.

In Massachusetts we have found that the New England wind map that we're using overpredicts wind speeds by between 8% and 12% depending on where in the state you are. So CWEST has a 10% de-rate factor that's applied to wind speed included in it for when you make the energy yield prediction.

So your mileage may vary on that front. But and then you have your conversion and equipment losses here. So you see things like voltage drop, blade wear and roughening, standby power draw and availability. So these are just some assumptions that we've put in based on kind of what we've seen.

I don't necessarily have formal studies for all those numbers. But they seem to do pretty well. And in the end you click on this to generate your wind project system summary report. So here's your (WIBL) curve again, some basic information about wind resource at your height.

So what we're saying here is, is that even though your average annual wind speed may be 4.3 meters per second by the time you adjust everything and get the hub height you're much lower, more like 3.4 meters per second.

So, you know, for this Aerostar 6 meter turbine which is a little under 7-1/2 kilowatts at 11 meters per second, excuse me, not a very windy site so you're probably only going to generate 2300 - sorry, 2300 kilowatt hours per year or so. There.

And then we have some other information on well okay, if you made your tower a little taller what would you get and CO2 emissions and such. So that's - that is CWEST.

And the way this works is it treats everything as I described the terrain being treated earlier. So you've got - so everything is adjusting the effective ground level.

And so essentially what we're doing is we're using the wind shear and we're using the adjusted effective ground level and doing an independent calculation of the energy over the year from each of these directions and then adding them all up at the end.

So that's the - that's essentially how this works. Like I said, the user guide online if you're interested, can - actually has all of the calculations in it and a lot more explanation than I can give right here, right now.

So if you're really curious by all means ask questions, contact me offline, check the user guide however you wish.

Trudy Forsyth: We do have quite a few questions so I think this is a good place to pause.

Shawn Shaw: I think so. Yep.

Trudy Forsyth: Let me just start by saying what's the difference between the SWEET tool and the CWEST tool?

Shawn Shaw: Almost nothing. What ended up happening was the SWEET tool, the Small Wind Energy Estimator Tool, morphed into CWEST.

We basically took the SWEET tool and we added, you know, an online Web interface and automated a database to search the wind map data and automatically populated them with what was in SWEET already.

We continue to, you know, study the performance of wind turbines in Massachusetts and the wind resource in Massachusetts so we're always updating things. But in terms of sort of the function of how it works this is the same.

Trudy Forsyth: Yeah. So it is a state specific tool. It's a Massachusetts tool. Is there...

Shawn Shaw: Yep.

Trudy Forsyth: What's the strategy to make it a national tool from your DOE funding perspective?

Shawn Shaw: So from the DOE funding perspective we have a whole separate program. We took what we learned building SWEET and building CWEST and we've turned it into a much more detailed and I would say probably more user friendly version of this which I'm happy to demo in a few minutes after we do some questions.

So it'll - it does a lot more than CWEST does is kind of what it boils down to. It does - it treats terrain in a similar way but it has - it treats obstructions differently by just looking at the wake effect from them based on a bunch of testing and modeling we've done.

It's also got a nationwide validation campaign behind it whereas CWEST has only ever been really validated within Massachusetts. Actually we validated

DSAT in England too come to think of it. So it's a very much a big brother to CWEST I would say but there are some similarities.

Trudy Forsyth: Okay. Let's see. One question is how far away are the obstacles? So if you take your first line in the north direction 3.81% frequency you have a height so you have a vertical height of 30 feet. How far away is it sort of from a horizontal perspective?

Shawn Shaw: In the instructions we ask people to consider a radius of about 100 meters from the base of the tower. In reality it's probably a little bit more tied to the scale of the turbine. Three hundred feet wouldn't be enough for a 2 megawatt turbine but it might be too much for a 1 kilowatt turbine.

So 20 rotor diameters is also a reasonable place to start and in terms of CWEST there is nothing in here that calculates a change based on how far away the obstacle is as long as it's within that radius.

So the rationale behind that is, is that most of the time if you've got something within 20 rotor diameters of the turbine you're going to see the effect - the effective ground level is probably not going to have enough time to change very much before you get to where the turbine is.

It's obviously an assumption. And in DSAT we've refined that. But for CWEST that's the assumption that's being made.

Trudy Forsyth: Okeydoke. How did you determine what turbines were on your list and how were they selected? How did you do that part?

Shawn Shaw: Sure. In this case the turbines that are on the list were the turbines that are eligible for funding under the Mass Clean Energy Center's microwind program.

And that list comes from - they basically copied the New York State Energy Research and Development Authority, the NYSERDA list and sorry, it's a bit convoluted.

But the - in essence what happens is that when NYSERDA adds a wind turbine to their eligible equipment list that's picked up in turn by a bunch of other state agencies including Massachusetts.

And before a turbine is added to NYSERDA's list they put it through a review with an independent consultant that they hire. And that consultant looks for things like evidence of a turbine being - having a year of reliable operational data which the consultant would review.

Or having - for example, if a turbine had been through the SWCC process that would be an acceptable criteria. Or if they can provide IEC equivalent test data or results that would be considered sufficient to get on the list. It's a little bit vague frankly.

But what it boils down to is, is that NYSERDA spends at least some amount of time trying to do due diligence to make sure that the turbines they add to their list can operate reliably for extended periods of time and, you know, have a viable support network behind them in terms of sales and service and support.

Trudy Forsyth: Sure. Okay. For the CWEST tool how is (LUTI) adjusted in the obstacle input? Or are you just assuming that each of these directions which are 16 of

them, that the full direction is blocked, 100% blockage of the obstacle for each direction sector as noted?

Shawn Shaw: Sure. That's a two part answer. The first part of it is, is that yes, we're assuming that whatever the obstruction is you are picking takes up the whole of the sector.

That's another reason, you know, again if you're talking about a circle with a radius of 100 meters it doesn't have to be very wide to take up the whole of 1/16 of that slice. The actual solidity though is either .76 for the vegetation - if you select vegetation that's basically saying that - I'm sorry, .67.

That's basically saying that 2/3, so 2/3 of this height counts. Like I mentioned earlier, when you're adjusting effective ground levels and you're including solidity that's what's happening here.

This vegetation multiplies a factor of .67 times the obstruction height or a vegetation obstruction and says all right, so in the north I have to effectively decrease my tower height by 20 feet because I have a 30 foot tree.

Houses and solid obstructions have a solidity of one so that's - those are the assumptions that CWEST makes.

Trudy Forsyth: Okeydoke. Let's see. Even in Minnesota prairie land a typical site for a farmstead may have a wind break. Are you familiar with what a wind break is?

Shawn Shaw: Yeah.

Trudy Forsyth: Yeah. Wind breaks are just, you know, a whole row of trees or bushes to try and break the wind typically around the farmhouse. So how do you treat the wind break? Si that a moderate site or a rough site? Does it raise the effective ground level? How do you deal with that?

Shawn Shaw: Sure. So in terms of CWEST a wind break would most likely be raising the effective ground level. If the turbine is in the middle, you know, it's sort of surrounded by a wind break then you'd see that showing up as a - say a 30 foot vegetative obstruction in each direction.

Otherwise you'd just put it where it is in terms of location relative to the turbine. So yes, I would say model it in CWEST as a vegetative obstruction at the actual height in whatever directions it occurs.

And it's probably going to be rough because, you know, while the terrain around it is moderate as soon as the wind hits that wind break almost by definition it's going to become more turbulent. The wind shear is going to increase above and behind the wind break.

So I think that's probably an appropriate set of assumptions to use when - on CWEST when you're trying to model a wind break.

Trudy Forsyth: Yeah. Okay. This next one is a little long so here we go. It looks like your wind assessment tool is based on the 2003 GIS layers from AWS True Power. We used those and had many issues with overestimation of the wind and the energy production. That resulted in unhappy customers.

Today we use the 2010 GIS layers from AWS True Power and those are much closer to the measured wind speed. It looks like you were fudging for

underlying data accuracy in the 2003 GIS layers. If the fudge factor is not universal then doesn't that increase the total variability in the wind estimates?

And wouldn't it be better to just get a better set of underlying data?

Shawn Shaw: Yeah. It sure would. Unfortunately I think the folks at AWS and three tier are fond of having meals and houses and all of the things that they need money for. And so they offer their newer and more updated data at a price.

And certainly, you know, if you're an installer who does a lot of work, you make a lot of your money installing small wind turbines, it might make sense for you to invest in memberships and/or in more detailed site reports from AWS.

Unfortunately a lot of folks aren't quite in that boat. And so they, you know, for them we have to do something based on the most freely available data. So that is why we do it this way. Now again CWEST was built for Massachusetts.

So the validation we've done is valid if you will, in Massachusetts. And you're right. We can't assume that the wind maps are 10% high everywhere that you use the 2003 wind map. We don't know. Maybe EnRel does having done the validation. I don't know that.

But from our perspective for what CWEST was built for this is what we have. It's obviously a little bit of a challenge and this is one of the places where it's a little tough to use something that's really one size fits all without knowing your area.

I mean if you have wind projects happening in your state then you need to e thinking about that.

And if you know that the wind - the old wind maps were a certain percentage too optimistic then that's information it would be helpful to share so that other people who don't have access to the newest and most expensive data can at least start to get close.

Now obviously if you're an installer that gives up some of your advantage. You may not want to do that.

But that's where state agencies and clean energy funding agencies and public entities can come into play a little bit by doing more validation of the freely available data and/or working with folks like AWS to purchase large scale subscriptions or otherwise make better data available.

So you're totally right. We are correcting for what we know to be the case in Massachusetts and that may not work absolutely everywhere in the same way.

Trudy Forsyth: Yeah, that's right. It probably won't. Next question - how do I get the Mass Clean Energy software that you're showing? Is there a Web site?

Shawn Shaw: Yeah. I can make that available or I can try to - I guess you're still viewing my screen so I can go back to it.

Trudy Forsyth: Yeah, just put it on the - there you go.

Shawn Shaw: Right there. That'll take you to it. There was also a question earlier about using this outside of Massachusetts and you can do that. I can send whoever is

interested or otherwise make available an unlocked version of the spreadsheet part.

The Web page you see here is really just a fancy interface to populate the spreadsheet piece of it. So if you unlock the spreadsheet you can actually enter your own wind resource information.

So you can still do all the calculations you'll just have to enter your own wind speed, (WIBL) K value and wind rows information. So I'm happy to, you know, make that available if people want to have access to it.

And on our end, you know, if there are other states that wanted to adopt CWEST it's fairly easy for us to take the GIS data and merge it into the back end and do something just like this for other states. So, you know, that's certainly something that's doable.

And in a little bit I'm going to talk about, you know, our other tool that's going to be released shortly nationwide anyway. So...

Trudy Forsyth: Well that's perfect because that gets to the next question. Let's see. Will Shawn be discussing the DOE project to create this nationally for all the states to use? If yes, can he explain when that would be available and what the costs are? So...

Shawn Shaw: Okay.

Trudy Forsyth: ...take that one there would you?

Shawn Shaw: Sure. Is that the last - like should we just actually move into DSAT or are there other questions too?

Trudy Forsyth: There are about seven or eight more questions.

Shawn Shaw: Okay. Then I'll just answer this and come back to DSAT a little later. So let's see, where to start? So the DOE tool is going to be rolled out for nationwide consumption - we're expecting it within the next few weeks. We're targeting a release date about October 1st, so very soon now.

It'll be sometimes in October. I probably shouldn't say October 1st and hang my hat on it. But it'll be sometime in October. Right now we're doing some pretty extensive validation testing.

We actually have people running around in California right now testing the tool out at real small wind turbine sites funded by the California Energy Commission. And we've already done similar work in Massachusetts, Vermont and some of the midwestern states.

So we're doing a lot of testing to see how well it predicts and that's going to tell us a lot. And that gets back to some of the questions earlier about overpredicting in different areas, the accuracy of the wind map and such. That's all going to be - we're looking at all of that as we test the tool out.

So yeah, I would say fairly soon. And as far as the costs of it go we are, you know, DOE is funding the development of the projects to quite a large extent. And therefore we're going to be offering it for free for at least until the end of the year.

After that our plan is probably to offer two separate user types. You can either have a standard access which would give a user perhaps the ability to create one or two sites and predict performance for them.

And a professional user account which would have a nominal fee per year and that would give you the ability to create and model unlimited number of different sites and turbines.

Trudy Forsyth: So I just have to give you a comment on that one Shawn as a person who works for the Department of Energy and the US taxpayers. The longer you could have this tool available for free the better. So...

Shawn Shaw: Indeed.

Trudy Forsyth: ...I will just leave it there. So next question - smooth, medium, rough, very rough, what are the corresponding alphas or roughness. Four choices seems simplistic from this commenters perspective. And then where do you get (WIBL) K and do you de-rate annual energy output for turbulence intensity.

So essentially three questions - what are the...

Shawn Shaw: Yep.

Trudy Forsyth: ...alphas of roughness for your different classifications? And the (WIBL) K input, where do you get that? And de-rate annual energy output or performance for turbulence intensity.

Shawn Shaw: Let’s see. All right, so turbulence intensity I’ll take that one first. That’s a good one. Basically on turbulence intensity we don’t have - there’s no empirical numerical relationship between turbulence intensity and energy yield.

Everybody at least thinks they know that the more turbulent a site is the less the turbine will generate. But if you say to me I've got a 20% turbulence intensity at my site I have and I don't think anybody else has, any idea what that means you should do with your annual energy yield number.

Is that 10% to 20% turbulence intensity mean 20% less energy? Probably not. There's no evidence to say that that's the case.

So it's best to think of it maybe as a design consideration and say well, if my turbulence intensity at my site is 40% I might want to think twice about putting a turbine there because it's going to have a very rough environment.

But I don't think that you need to - I don't even think you can accurately take something off based on turbulence intensity. The - let's see, the other question I guess was...

Trudy Forsyth: Let's see. Your alphas or roughness for the different classifications - smooth, where is it, medium rough, very rough.

Shawn Shaw: Sure. I don't have that right in front of me but I can tell you that they range from I think .11 at - for smooth up to about .48 for very rough. Those values are derived from (MET) tower studies that we did across Massachusetts for - and we took the (MET) towers.

We classified them according to the surrounding terrain. And then we examined the wind shear between typically say 30 and 50 meters on those towers. So that's where the wind shear comes from. I agree, four categories is a little slim.

One of the challenges placed before us in developing our tools for Massachusetts was to make them a little bit light on the techno babble if you will, and try to give people a good qualitative assessment. We could have probably done more categories.

The other issue we faced early on when we first structured SWEET was that I think we had 19 (MET) towers and it was hard to get good sample sizes for much more than four categories. So I agree. And DSAT has many more terrain categories. And so...

Trudy Forsyth: The last one of this group is where do you get the (WIBL) K to input?

Shawn Shaw: The (WIBL) K input is actually a layer within the 2003 wind map. So we pull it directly from the AWS True Power data.

Trudy Forsyth: Okay. Can you override the Massachusetts site wind resource data with a site specific wind row? So if somebody goes into the CWEST can they input wind rows information?

Shawn Shaw: Yep. Yeah, you can override it with your own information.

Trudy Forsyth: Okay. Let's see. And we've talked a little bit about DSAT. What's the acronym for DSAT?

Shawn Shaw: Oh, sorry. That's the Distributed Wind Site Analysis Tool.

Trudy Forsyth: It should almost be a DWSAT.

Shawn Shaw: I know. I've struggled with the acronym. That's been a bit of a challenge. But not the only project challenge there's been but it's been one. That's the best name we've got so far.

Trudy Forsyth: Okay. And let's see. You said that that tool was going to be usable nationwide sometime in October. Is that right?

Shawn Shaw: Yep.

Trudy Forsyth: Okay. And then somebody here is asking for a link to evaluate DSAT. So here we are. We have six minutes left on this webinar and Shawn you've just been a champion through all of these hard questions. But we're obviously not going to get to your DSAT tool.

Shawn Shaw: Yep.

Trudy Forsyth: So I would say would you be willing to do another webinar early in 2012 through our ASES webinar format that strictly addresses DSAT?

Shawn Shaw: I'd be happy to. Sure Trudy.

Trudy Forsyth: Okay. That would be wonderful. So I would like to thank you all for attending this webinar. Our next Small Wind Division webinar, that's the ASES Small Wind Division, will be Thursday, November 3rd at the same time. It's an interdirection to the Distributed Wind Energy Association.

And for many of you that know, the way we work within the ASES Small Wind Division is one month we have meetings followed by the next month when we have webinars. So it's a back and forth type situation.

Also the - this has been taped and so that webinar information will be posted on the www.WindPoweringAmerica.gov site so you can listen to this wonderful dialogue again. And I would say that our next Small Wind Division conference call will be October 6th at the same time.

So thanks everyone for joining. Thank you for the wonderful questions. They really have been just awesome. And thanks so much to Shawn for presenting the results of the CWEST tool that's used in Massachusetts.

And we look forward to hearing about the DSAT tool that the DOE is funding through their Golden Field office. Thanks Shawn.

Shawn Shaw: Thank you.

Trudy Forsyth: All right. Bye-bye everybody. Thanks for joining us.

Coordinator: This concludes today's conference. Thank you for your participation. You may now disconnect.

END