Distributed Wind Industry Update

September 16, 2015

MODERATOR/PATRICK GILMAN:

Webinar series where every other month we bring together a set of speakers on the latest developments in a number of areas important to wind energy technology, deployment policy and other topics. This month we're going to be talking about the state of the distributed wind industry. And just for a primer, what we mean, what DOE means when we talk about distributed wind is not so much technology side, but proximity to end use of turbines that are installed near or at the point of end use for purposes of getting onsite energy demand or operation at the distribution grid, or turbines that are connected on the customer side of the meter directly to the distribution grid or in off-grid remote locations, and that can include when turbines from small, one kilowatt machines all the way up to multi megawatt turbines at industrial facilities.

So today we've got a number of speakers that we're excited to bring you. Of course I'm your moderator, Patrick Gilman. I work in the Wind and Water Power Technologies Office of DOE. Today we'll be hearing from Nik Foster, Energy Analyst at Pacific Northwest National Labs, who will be talking with us about our recent distributed wind market report. We'll also be hearing from Alice Orrell, also an Energy Analyst at Pacific Northwest National Labs. She'll be talking about our distributed wind policy comparison tool and the treatment of distributed wind in DOE's recent wind vision study. And finally we'll be hearing from Ian Baring-Gould from the National Renewable Energy Lab, who will be talking about our e-wind model, which is a really exciting new tool that we've developed to help us look at various deployment scenarios for distributed wind in the context of the broader electricity sector in the future.

At the end of these presentations there will be a question-and-answer period. You'll note that you're in listen only mode, so the way to send your questions to me and to our panelists today is depending on whether the platform you are using, and we're going with (inaudible) today, follow the instructions on the screen. So basically go to the Q&A box, wherever that happens to be in your webinar platform, and type your question in and click Send or Ask depending, and we will address those as they come in.

Just a reminder also that this webinar is going to be recorded, and the webinar recording presentations will be posted on our WINDExchange website at wind.energy.gov/windexchange. It usually takes us about a week to get those up, so stay tuned for those if there are folks you know who would be interested in this topic and weren't able to make the webinar today.

Finally, just a reminder that we do this webinar series every other month, the third Wednesday of every other month at 3:00 p.m. Eastern time. So stay tuned for our next one.

And without further ado, let's get to our speakers. First up we have Nik Foster, who will be talking about highlights from the recently published 2014 Distributed Wind Market Report. Nik is an Energy Analyst at Pacific Northwest National Labs and researches the distributed wind market, energy efficiency standards for appliances, and assessing Smart Grid technologies. Before joining PNNL, Nik worked as a consultant to the World Bank's Energy Sector Management Group and as a Research Analyst at the Center for Transatlantic Relations, a D.C. think tank. Nik has an MA in International Relations and Economics from the Johns Hopkins School of Advanced International Studies, which also happens to be my alma mater. So Nik, take it away.

NIK FOSTER:

Thank you, Patrick. Hi, everybody. I'm an Energy Analyst, as Patrick mentioned. And together with Alice Orrell, the co-author of the 2014 Distributed Wind Market Report.

So adding to what Patrick said, I'd like to start out with a quick definition to get us all on the same page. What is distributed wind? Distributed wind energy systems produce electricity that is consumed on site.

Or to support local loads on a distribution line. So this is in contrast to energy generated at large wind farms via transmission lines to distant end users. Some examples in this graphic here are a five kilowatt turbine at a residence, here marked with a “1”. A 50-kilwatt turbine at a farm, “2”. Or a commercial user, “3”, or a multi megawatt turbine at a university campus, marked with “4”. So various applications.

This is the third year in a row that the U.S. Department of Energy is examining the distributed wind market. We gather data from states and federal agencies, and entities, manufacturers, operations and maintenance companies, as well as installers. We break down distributed wind turbines into three categories: small, mid-sized and large. Small is defined by turbines up to a hundred kilowatts in size. Mid-size has 101 kilowatts to one megawatt. And large above one megawatt.

In 2014 we documented installations in varied applications such as homes, water treatment facilities, a vineyard, a Native American cultural center, high schools, farms, a recycling facility, law firms, and a brewery. And just a quick thank you to all of those who contributed with information and review

Let’s look at how the market has developed since 2003. So between 2003 and the end of 2014, nearly 74,000 wind turbines were deployed at distributed applications, across all 50 states, Puerto Rico and the U.S. Virgin Islands. Totaling 906 megawatts of joulative capacity. So the market is approaching a gigawatt of installed capacity. In 2014, 63.6 megawatts of new distributed wind capacity was added, representing nearly 1,700 units and $170 million of investment across 24 states. This breaks out to 3.7 megawatts of small wind, 2.4 megawatts of mid-sized turbines, and 57.5 megawatts through turbines greater than one megawatt.

On this side we see capacity additions in states for 2014 on the left, and cumulatively for 2003 til 2014 on the right. The darker the shade of blue, the more capacity addition. In 2014 we tracked installations in 24 states. You’ll notice looking at these maps that the capacity is not spread evenly across the states. For example, in the southeast there’s generally less wind than in the states in the middle of the country. State policies also play a role in driving the market for distributed wind. And Alice will discuss the impact of state policies and incentives in her presentation just after me.

Some highlights here. New Mexico, Texas and California were the top states in 2014 in terms of adding distributed wind capacity. Texas, Minnesota and Iowa retained their positions as the top three states for the most distributed wind capacity deployed since 2003. Cumulatively, there are 16 states with more than ten megawatts of distributed wind capacity.

In addition to tracking where distributed wind is being installed, we also track what applications the turbines are being used for. We consider six different applications. Institutional. These are schools, universities, and rural utilities. Government. Cities, municipal facilities such as the water treatment plant I mentioned earlier, military sites. Industrial. Those could be food processing plants, oil and gas operations. Commercial, offices or businesses. Agricultural. Farms, ranches. And residential. Homes, cabins, boats or apartments.

Most of the small wind turbines are installed in residential applications. So while there are many residential projects, because they use small wind turbines, they do not add up to a lot of capacity. On the other hand, there are not a lot of government and institutional projects, but those projects use the mid-size and large turbines so they contribute more to the overall installed capacity.

A few notes on small wind. As you can see in this graph here, small wind turbine sales have decreased over the past few years. Since 2013, sales of small wind turbines declined by 39% on a per-unit basis. In 2014, we documented installations at 1,637 small turbines with a capacity of 3.7 megawatts. Some factors affecting sales include competition from solar (inaudible), and the low cost of other sources of electricity.

Conversely, as you see in the yellow bars here, 2014 also marked the third strongest year of small wind exports since 2003. Domestic manufacturers seem to be focusing more on international markets to make up for slipping sales in the United States.

Here we see the export picture. In 2014, 11.2 megawatts of small wind was exported by seven manufacturers, representing about 80% of small wind sales. The value of these exports stands at $60 million coming from roughly1,000 units sold. Top destinations in 2014 include Italy, the UK and South Korea, all countries with stable renewable energy policies and goals that support wind deployment. While the UK and Italy have been strong export markets in recent years, South Korea and Japan represent new opportunities for U.S. small wind manufacturers. The 2014 export numbers are comparable to past years even though domestic sales of small wind declined in 2013. As a comparison, in 2013 13.6 megawatts were exported, and in 2012, eight megawatts.

A little bit about installed costs here. Because small wind turbines range from less than one kilowatt in size up to 100 kilowatts, and there are substantial differences in their turbine, power and installation costs, it is appropriate to examine costs of small wind turbines in smaller groups. We split up the small wind sector into three size ranges here. These costs are based on both 2013 and 2014 sales reports to increase the sample size. With the turbine size broken out, you can see that the larger turbines have a lower cost per kilowatt than the smaller ones.

At any rate, in 2014, the overall capacity-weighted average installed costs of 2.8 megawatts of all newly-manufactured small wind turbines sold in the U.S., was $6,230.00 per kilowatt, down from $6,948.00 per kilowatt in 2013 based on five megawatts of sales. So we can see there's a slight downward tick here.

Now a little bit more about the mid-size and large market sectors. In the mid-size sector we documented three turbine installations in 2014 adding 2.4 megawatts of capacity. The project included a municipality, a water treatment plant, and an industrial park. One explanation for the limited sales could be that because the federal Investment Tax Credit, or ITC, is only available for taxpaying entities deploying small wind turbine projects. Mid-size turbine manufacturers may be somewhat limited to a more narrow market that often includes municipalities and schools.

Over to large. With 31 new turbine installations and 57.5 megawatts of new capacity, the large scale sector almost tripled last year's capacity additions. The upswing in large scale distributed wind turbine installations is mirrored by the growth of large scale non-distributed wind turbines installed in wind farms, which grew more than six fold between 2013 and 2014 largely because of the extension of the federal Production Tax Credit.

Next I'd like to talk a little about four market drivers for distributed wind, incentives, wind leasing, certifications and soft costs.

We documented 115 awards for a total of $20 million going to 14 states in 2014. This is slightly more than in 2013 when $15.4 million of awards were documented. Some of the important incentives include the federal Investment Tax Credit, the ITC, which provides a 30% credit against the capital costs of a small wind project and is set to expire at the end of 2016.

The U.S. Department of Agriculture's Rural Energy for America Program, or REAP, granted just over $400,000.00 for 15 projects in 2014 compared to $1.2 million in grants for 25 wind projects in 2013.

State-level funding and incentives are varied. We counted state-level incentives in 14 states. Some states, like Alaska, provide grants. Others, like Iowa, have tax credits. One important program run by the New York State Energy Research and Development Authority, or NYSERDA, provided awards for 19 projects in 2014. But it is set to close at the end of 2015. So a very varied landscape on our state side.

Next leasing. Lease arrangements allow customers to host a wind turbine installed and owned by a third party on a customer's property. The customer then makes monthly payments for the energy produced on

site that displaces the customer's electricity consumption that bills from the utility. United Wind is the main player in this space and financed five projects in New York State in 2014. As of May, 2015, 27 projects have been commissioned per United Wind records. And NYSERDA reported receiving 40 applications so far, as of May 2015, for incentives for projects using United Wind leases. So we see an upward tick here.

Next on to certifications. A certification or quality assurance requirement can help prevent unethical marketing or false claims and insure consumer protection and industry credibility. As of June 2015, 13 small wind turbine models are fully certified to American Wind Energy Association Standard 9.1-2009. Four medium wind turbine models have published power performance and acoustic certification, and one small wind turbine model had limited or conditional certification.

More than ten additional wind turbine models have conducted testing or have pending applications.

To be eligible for the federal 30% ITC, the U.S. Internal Revenue Service now requires to meet turbine performance and safety standards. This will likely increase manufacturers' desires to be certified, but certification, while it increases consumer confidence, might also add additional costs to manufacturers.

Lastly, a few words on soft costs. That's another factor that affects the growth of the distributed wind market in the U.S. We define soft costs as non-hardware (inaudible) system costs, such as permitting. In one of the 2014 projects, we learned that permitting costs had increased the overall project costs by 50%, so a reduction in soft costs would impact the economics of distributed wind in the United States.

In summary, where does this leave us? Well, it seems like the market for distributed wind is still in flux. We see that the small wind factor is facing decreasing sales and new certification requirements, which may impact 2015 sales and installations. Exports are important for manufacturers of small wind systems.

The mid-sized sector has witnessed very limited sales. In contrast, the large sector tripled capacity in 2014.

We see that costs of small distributed wind systems have generally decreased this past year. Yet soft costs can increase a project's costs, so we want to keep an eye on the economics of distributed wind in upcoming years.

Looking ahead we can say that it's difficult to make predictions, especially about the future. The mid-size sector might grow slightly. We see two projects already installed in 2015, another two potentially ready before the end of the year. The small sector could remain at a current level or decrease; however, the success of the wind leasing model could reinvigorate the market (inaudible) several stakeholders see it as a potential game changer.

Lastly, several small wind turbine manufacturers are entering new global markets. Their success could lead to more activity abroad for more U.S.-based small wind manufacturers.

And in closing, a few more links and information to the U.S. Department of Energy's wind program, distributed wind analysis, as well as the data tables that contain more information.

Thank you.

MODERATOR/PATRICK GILMAN:

Thank you so much, Nik. So we'll have some good questions for you at the end.

So next up we're going to hear from Alice Orrell. Alice is also an Energy Analyst at Pacific Northwest National Labs. She provides renewable energy assessment of wind power project development and

support for the Department of Defense and distributed wind market research and analysis for (inaudible). She has a Bachelor's in Mechanical Engineering from the University of Vermont, an MBA from the University of Washington, and is a licensed Professional Engineer. She is also active in Society of Women Engineers and Women of Wind Energy.

Alice, go ahead.

ALICE ORRELL:

Thanks, Patrick. So hi. This is Alice, and I'm here to talk about the free online Distributed Wind Policy Comparison Tool and also to discuss how distributed wind is included in the new Department of Energy Wind (inaudible) report.

First up is the Distributed Wind Policy Comparison Tool. The Policy Tool allows stakeholders to identify which incentives and other factors have the most impact on the economics of distributed wind turbine up through 100 kilowatts. To get started you just have to select a state and a turbine scenario. The tool then populates the rest of the variables for you. But you can change any of the baseline values.

In this screenshot I have a pica turbine in a residence application in New York State. The scenario characteristics are up on the top right side, and the economic results metrics are down here in the bottom right corner.

Initially released in 2011, the tool is updated annually by eFormative Options and PNNL. The annual review includes, but is not limited to, updating turbine performance characteristics, turbine pricing, RECP, or Renewable Energy Certificate Pricing, retail electric rates, and state and federal incentives and policies.

Some state incentive programs have ended recently, but New York, Oregon, Nevada, Maryland, Washington, California, Illinois, and a few others still have programs for distributed wind specifically.

And we also consider net metering in the economic calculations. Due to net metering being more widely available now, we assume the system owner of the distributed wind system receives the retail value of all power produced on site. In 34 states that's the baseline assumption, up from 13 states last year.

We also work on improving usability and increasing the effectiveness of the tools. For instance, last year we expanded the tools in include Puerto Rico and the U.S. Virgin Islands.

If you go online to the tool right now, you'll see that we've made these input and assumption updates in time for the webinar, but we haven't yet updated all of the text, such as the What's New laws. But we plan to have all of our updates finished by the end of September. So if you see anything when you go online, let us know if there's anything, if you have any comments or questions. And if you'd like to receive notification when all the updates are complete, you can sign up on eFormative Options webpage.

States and utilities make changes to their incentive programs frequently. This is the screenshot from Desire that lists just the number of different incentives and policies applicable to wind for each state. We've designed the tool to be robust so it can adapt to changing incentives and be able to accurately reflect new incentives. For example, the Northern Indiana Public Service Company, a utility in Indiana, recently increased its (inaudible) tariff rates for its customers. The program is currently fully subscribed, but may reopen for new applications in the future.

I'm going to use the (inaudible) tariff from this utility as a case study to demonstrate how to use the tool.

Okay, so on the Home page I've selected Indiana and the non-tax scenario. So maybe this turbine would be installed at a high school. Institutional application as we call it in the market report. But with the assumptions as is, you can see that the economics, in the bottom right, are not so great.

Now I'm going to click over to the technical tab and bump up the wind speed from Mid-Class 2 to a windy Mid-Class 3, and that's increased the turbine's annual energy production.

And then, on the state tab, you can see that Indiana is set to no net metering policy. Well, we have to set a baseline for each state, this utility does, in fact, offer net metering to its customers. But without net metering, the tool assumes the energy generated by the wind turbine displaces only the wholesale value of electricity that would otherwise be purchased from the utility. So this scenario still doesn't have great economic results.

But, as I said before, the user can change all of these assumptions, so now I've changed the scenario to include (inaudible), and with net metering the tool assumes the energy is valued at the retail rate. This improves the economics, albeit slightly, allowing for a positive but low rate of return now.

But now what happens if we assume the feed-in tariff. A turbine of this size is eligible for a 15 cents per kilowatt hour feed-in tariff. So I hit the feed-in tariff toggle, and that removes the net metering and puts in calculations. You can't have both. You can have feed-in tariff or net metered. And the feed-in tariff rate is set to zero, but I can add a custom value of 15 cents, and with that feed-in tariff rate for this scenario, project economics improve significantly.

So playing these kind of what if scenarios is one way to use the tool.

State policy makers and incentive program managers can also look at the tool to compare their state to other states. This simple graph captures the levelized costs of energy, so the base case scenarios for a few states. According to the U.S. Energy Information Administration, average commercial retail rates range from around seven cents to 17 cents per kilowatt hour in the continental United States, with higher rates in Hawaii, Alaska, Puerto Rico and the U.S. Virgin Islands. And average residential retail electric rates range from nine to 23 cents per kilowatt hour in the continental U.S. So this graph for these base case scenarios shows that these scenarios can fall, do fall, within these ranges of average rates across the country meaning distributed wind can be cost competitive with retail rates.

Now I'm going to switch over and talk about the Wind vision.

Released in March of this year, the Department of Energy's Wind Vision report quantifies the economic, environmental and social benefits wind energy can have in the United States and actions we can take to make these increased levels of wind energy a reality. At the time of the report, distributed wind was not able to be included in the quantitative analysis aspect of the Vision due to modeling limitations, but we're working on that, as Ian will explain next. So the report includes discussion on distributed wind's unique benefits, specific impacts, and what steps we can take to advance the industry.

With respect to benefits and impacts, distributed wind creates local economic development and job opportunities in manufacturing, sales, installation and maintenance of wind turbines. This is particularly true for the small wind sector of distributed wind. Those turbines up to 100 kilowatts in size. As Nik mentioned, U.S. small wind turbine manufacturers dominate the domestic market and support a significant number of turbines and rely largely on domestic supply chain vendors.

Onsite distributed wind also allows farmers, schools, small businesses, other energy users to benefit from reduced utility bills and predictable controlled costs and to hedge against the possibility of rising retail rates. And decentralized generation, such as distributed wind, can benefit the local electrical grid system by lessening or mitigating a utility's need for distribution grid upgrades and can help reduce transmission congestion.

With respect to next steps for distributed wind, the Roadmap section of the report discusses the importance of improving manufacturing competitiveness, improving siting tools, and quantifying the distributed wind market among other things as some of the actions we can take to achieve the wind vision.

So you can read the full Wind Vision report at energy.gov/windvision and check out the policy tools at windpolicytools.org. And thanks, that's what I've got.

MODERATOR/PATRICK GILMAN:

Thank you so much, Alice.

Finally today we're going to hear from Ian Baring-Gould. Ian is a frequent contributor in these webinars. He's been with NREL since 1995, and has worked in applications engineering deployment and assistance in education outreach. He is the Wind Technology Deployment Manager and the Technical Director of NREL's stakeholder engagement activities. As well he assists organizations deploy wind and provides information on the appropriate implementation of wind energy. Ian also manages NREL's distributed wind research investing portfolio and oversees its deployment related to wind work including environmental impacts and manufacturing.

Ian has a Master's degree in Mechanical Engineering from the University of Massachusetts, Renewable Energy Research Lab, and has experience in most renewable energy technologies. Ian is going to talk to us today about the distributed wind deployment model that (inaudible). Go ahead, Ian.

IAN BARING-GOULD:

Thank you, Patrick, and hello everybody. It's good to be here. I'm going to talk about the D-wind model, which is a dispersion model that the Department of Energy has developed to really try and get an understanding of what the future market potential is for distributed wind technology. Alice gave a great presentation on the wind division, and as we all know, for utility scale technologies, we've had the capability to model what the installations going to the future of grid-based wind and offshore wind have been for a long time, and that's been very valuable in kind of understanding what the market potential is. But then also what things we can do to help impact that market by changing – increasing technology, or decreasing costs through technology innovation, addressing soft costs. And then Nik's presentation about the market report is really helpful in understanding what the industry has been doing up to date and where it stands now.

What we've lacked is the ability to model what is the industry, or what is the potential of the industry, under different cases and scenarios going into the future. And so the D-wind model is the tool that the Department of Energy has developed to allow us to really understand and to document that. And then, as has happened in large wind and offshore, be able to really understand in which areas different organizations, whether it's the Department or other branches of government or private sector, can really focus efforts to expand the market in ways that make the most sense and gives us the best bang for the buck.

So I am sorry to say that we're not going to be able to look at specific results of the D-wind model because we're not quite there that. I'm going to give a description of the model to let everybody kind of understand what it can do, and then we'll look at a little bit of the preliminary results but we're not providing any numbers, and it just provides a way to get an understanding of trends to really make sure whether the market is doing what we expect the market to be doing.

So I've already talked about this. The model simulates consumer purchase decisions based on economics and consumer behavior. So unlike a model like the ReEDS model that we use for large wind, this model does all the calculations in taking into account wind resource and load and things of that nature. And then determines basically a payback for a wind turbine, distributed wind turbine, at every business, every home, every industry in the country on a statistical basis. So not actual, but on a statistical basis. And then it says how many of these people are going to buy this technology based on the payback. And so if you do the calculation and you're in some place that has absolutely no wind resource, then your payback is really long, and the chances of you actually selecting to purchase wind is not very likely. Now if you're at a farm in the middle of Kansas with a great wind resource and a relatively high energy cost, then the model says you have a short payback and you're much more likely to say I'm going to choose wind.

So it really looks at consumer behavior and economics. The model uses large populations of consumers as statistical basis. It is not a siting tool. And it really over covers when the customer load, so it's behind the meter. It does look, as you'll see, at residential, consumer and industrial clients. But it is a behind-the-meter, so applications like municipal distributed wind, community wind, those things are not covered. That's not covered under this model.

It doesn't model permitting and zoning barriers directly. We don't have the capability to read every county ordinance and apply that directly, but it certainly has a lot of siting and zoning, the kind of the standard tree heights, population density, and all of those kind of things built into the model.

It does simulate through 2050. Clearly, the farther you get out, the less we believe the results, but it does through 2050. And it really allows us to explore these different market impacts as I kind of introduced. And it allows us to kind of create a strategy, as I mentioned, which areas do different elements of our industry want to focus on, whether it's the Department of Energy, Department of Commerce, industry itself.

Right now the status is we've done a lot of proof testing in the model, and we feel that it really does what we expect it to be doing, and I'll show you examples of that in a second. We've incorporated a bunch of different elements into the tool, rate structures from across the country, updated financial assumptions, payback periods, so we're getting quite close. And I have a little summary at the end that talks about what the next steps are to show you how close we are.

Right now the initial results that I'm going to show are really primarily for model validation and understanding what we're trying to do. We've developed a reference case. We're kind of – I don't' want to quite call it a business as usual, but a reference case, and we're still going through internal and industry vetting with our core group of industry representatives who are providing us data. And right now the kind of open questions in regards to this reference case are these three things that we're talking about: incentives, technology cost reductions, and then the financial assumptions that we're assuming for load and things – oh, sorry, for leasing and things of that nature. This gives you a quick kind of introduction to what we're thinking at this point. Certainly installed costs, we get a lot of that data from the market report and then discussions with industry partners. The load growth and rate assumptions are all AEO reference cases. The rate structure is a complex set of rate structures that we have for almost all of the country, though not all of the country, and that actually looks at different costs and what the power rate structure is for the different classes of consumers and things of that nature gets in there.

Metering we do all current policy that is out there. But basically all of that expires in about 2030. It's either filled, the capacities are filled, or they go away by 2030, and you'll see that in some of the results.

Incentives, based on the 2013 Desire data, the ITC expires in 2016, as is current policy. And then we kind of made an assumption that all the state incentives expire when they're specified or by 2024. And that ends up being one of those assumptions that we're talking to industry about.

No carbon pricing.

Siting, don't have time to go into it now, but a lot of details in regards to siting and tower height and things of that nature.

And then there's finance, so basically modeling what the solar industry is currently using now from a financing perspective, which clearly isn't where we are right now from distributed wind, but we would hope that within the next number of years we'll be getting much closer to that.

Some specific notes down there. None of the utility rate escalations assume anything is going to happen with the new climate plans. And then currently the model isn't functional for Alaska or Hawaii, so over time we expect to develop that capability.

Here's kind of – again, the numbers have been removed to protect the innocent. But you can see the kind of growth projections that the model talks about for the sector. Again, residential, industrial and consumer. Clearly the growth, as we just saw from the market report that Nik presented, from a gigawatt installed perspective, the growth really is in the industrial sector, and that's because we're talking about small numbers, or relatively small numbers of large turbines. And so we get kind of large gigawatts. Certainly the growth in the commercial and then the industrial, or sorry, the residential is there. And ends up being, I don't want to say substantial, but ends up being substantial from a number of turbines perspective, but from a gigawatt capacity, it's not as large.

A more interesting graph that we see here. Again, this is annual deployments, again by the three sectors, residential, industrial, commercial. But clearly this is a more interesting graph that really ends up showing the impacts of these different assumptions that we have. Right now the ITC has pretty little impact because it expires in 2016, and so we don't see that. But we can certainly see that the state incentives capping out in 2014 really flattened off that curve of that first hump that we see there in the annual installation. We certainly see a pullback in 2030, and that's a result of net metering going away, so assuming that we're meeting our net metering tasks.

The kind of second hump and the more expansion primarily in the residential sector is really due to higher costs for power that we can see in the AEO numbers. Certainly in specific markets, the price of electric service goes up substantially in this kind of 2030 range, and that really drives deployment, especially in the residential sector from a number-of-units perspective. And then because we don't – we're pretty conservative in regards to the improvements that we see in the technology, things level off and roll off kind of in the 2040s because we're not projecting huge increases in turbine performance that we'll see a little bit later.

So it kind of gives you an idea of how the model respond to some of these questions that we're still trying to iron out and come to agreement, both internally and then with the industry.

What we certainly see is, mirroring what Nik has already reported, that over time this is annual installations by project size, the large, which is primarily the industrial clients. Not tons of annual sales, but because of their bigger units, they get us more gigawatts. But after this kind of 2030 space, we certainly start to see large numbers of annual installations of smaller turbines. So even though we're not talking about tons of gigawatts, or gigawatt hours of production, the units, the numbers, are quite large when we get it out years.

This is kind of older data, going back to the cumulative installs. And what this shows is for the commercial, the industrial, and the residential sectors, what size turbines the model is kind of telling us that we'll end up using. And so clearly commercial sector is pretty widespread, but it's in the kind of 50 to 100 kilowatt range. Industrial, we're certainly looking at much larger turbines for distributed wind. (Inaudible) financial sector, it's primarily focused on the smaller turbines. So all things that we would expect from the model, which as we're looking at whether the model is doing what we expect it to do is very good information.

Another output of the model that we hope kind of helps industry is really kind of identifying where in the country we have really strong economics to support market development. And so this looks at, again, all of the factors that go into the deployment of wind technology, so load, resource, incentives on a state-by-state basis, and really identifies the places within states where you are more likely to see development. Because we do have different diffusion models, so the more turbines that are installed in a particular area, the more likely it is that the next customer will choose to install a turbine, and that changes over time, so clearly in areas where we already have development we expect to see more development sooner than areas that currently don't have development.

But maps of this nature will certainly help the industry kind of target different market areas that seem to have the financials to support the development. And as we go forward, and once we get the model finalized, we'll be able to do analyses of this nature across the country to help support the market development.

So what's next? As I said, we're working to finalize the reference case and initial sensitivity analyses. And that we expect to get done in the next few weeks from an internal perspective. Review with our key industry partners, again over the next few weeks, and we're on target to publish short summary results of this initial analysis in the October timeframe. And then we're planning on developing a couple of market scenarios, so the reference case is just that, kind of the basic one. And then start playing around with what happens if the ITC is extended, or things of that nature to help get a little bit more information out of the model, doing those state analyses as is appropriate.

Going to publish the model documentation in the December timeframe. Publish the scenarios in the winter. Conduct additional analysis as appropriate, as I mentioned, in the spring. And then Department of Energy is really interested in starting to work with industry to develop a more of a strategy once we get an understanding of which are the key drivers and who has control over those drivers, how do we help implement the change in the industry that needs to take place.

Lastly just want to certainly make it clear the model is developed by DOE, funded by DOE. We're doing the work here, but all the thanks goes to Patrick, Mark Higgins and his colleagues, Jose, to move this forward. Certainly we're also getting a lot of support from the industry, (inaudible) and then Alice and her team from PNNL have been fabulous in providing data. So it's a community effort in regards to development of this tool, and then clearly the data that goes into it.

So with that, turn it over to Patrick for general Q&A.

MODERATOR PATRICK GILMAN:

Thank you so much, Ian. We do have a couple of questions coming in so far. I encourage the audience out there don't be shy. Submit questions through the webinar platform and we'll get to them.

First we have a question for Nik. And this question is in reference to slide nine of your presentation, if you could please describe in more detail what's included in the installed cost of small wind turbines that you guys looked at in the market report?

NIK FOSTER:

Yeah, thanks Patrick, and thank you for that great question.

So as part of our data collection for the market report, we sent out surveys to manufacturers and asked questions about the costs of installed turbines. Or installed projects. So beyond total costs, we asked how

much did the turbine cost, so generator, alternator, blades, tower parts, whatnot. The foundation, installation, the labor, balance of system costs such as interconnecting, permitting, other soft costs. As you can imagine, those numbers vary really depending on the location, the turbine type, etc. And just as a quick example, we documented two different projects, all deploying the same 100 kilowatt turbine. And the costs of the two turbines, this was in Alaska, was almost 500% higher than the manufacturer's reported average installed costs on a per-kilowatt basis because of factors such as construction, mobilization, road improvements, etc.

Another project that was an urban location was about 50% higher than the average cost because of extensive permitting requirements, soft costs. And analyzing these soft costs is also part of a new initiative that the DOE is just starting. So several factors go into installed costs.

MODERATOR/PATRICK GILMAN:

Great. Thank you, Nik.

The next question I think we'll toss your way, Ian. You know one thing that we hear about, and Nik just talked about soft costs and one thing that we hear about from folks in industry and people who are looking to put up distributed wind turbines are that permitting can be particularly difficult for small projects. And our questioner here is expressing some frustration that single turbine projects are often treated as if they are a large multi unit or even commercial-scale facilities. And Ian, I'm wondering if you can share with us some of the insights that you may have gained talking with folks about how they've addressed problems like this?

IAN BARING-GOULD:

Well, certainly from an environmental impact, kind of the new regulations and guidelines that are out in regards to avian impact, certainly do have – I don't want to say exceptions, but specific considerations in regards to distributed wind technologies. And so they are not treated the same as a multi megawatt wind farm. And clearly the thing to do is to talk to the local representatives from Fish and Wildlife or the state-based environmental folks to kind of walk through that with them. Clearly that's additional work, and it's something that needs to happen.

I mean the person asking the question is exactly right that this is a huge issue and really depends on regional where you are, and when you're trying to do it, and how you're trying to do it. DOE is launching a very large multi-year effort to address soft costs, kind of building on the experience that the solar industry has had in the Sunshine Initiative to really target and reduce soft costs of photovoltaics primarily distributed photovoltaics. And DOE, the Wind and Water Program, is just launching an effort to really start understanding that more specifically what are the costs and then how do we work to reduce those costs. So I certainly think that we'll have more information later, or relatively soon, and then actual programs to start tackling this. But at least at this point in time, and even as we go into the future, the issue is you just have to talk to the local folks. But in almost all cases, once the dialogue starts, they're not treated the same, even on a federal regulatory basis, they're not treated the same. You just need to do that education early in the project, which we all know is certainly a huge burden if you're talking about a ten kilowatt or even smaller wind turbine. It adds immensely to the costs.

MODERATOR/PATRICK GILMAN:

Thank you, Ian. Just from my own perspective having worked on the Fish and Wildlife Service's wind energy guidelines, you know, Ian is right in that they do include an acknowledgement that distributed wind projects, or projects with smaller turbines, or (inaudible) larger utility scale machines tend to have lower impact. So that is indeed acknowledged, as Ian says, and encourage you to take a look at that, and, as Ian said, communicate early and often with the folks who are permitting the project.

So another question here, one maybe – I think it's mostly for me, but I'm going to ask for Ian's help on this one again, too. Any updates on when we expect the next Competitive (inaudible) Improvement Project RFP to come out. And for those of you who may not know, the Competitive (inaudible) Improvement Project is a program that DOE funds through NREL that goes out – it's a contract, subcontract opportunity whereby distributed wind technology developers can engage in testing activities, either in support of certification or more general R&D work with NREL at our National Wind Technology Center.

IAN BARING-GOULD:

Yeah, so CIP really historically has focused in four areas: turbine certification for small and larger turbines, medium-scale turbines, based on the IWEA and IEC standards. Component improvements, so addressing specific components of a distributed wind turbine. And then manufacturing. So historically it's been in those four areas. It was announced at the Small Wind Conference that CIP Round Four was in the works and that it would be released soon. And I will stand by the words that were given a few months ago, it will be released soon. There's certainly been issues in regard, as everybody knows, in regards to budget uncertainty and things of that nature. But DOE continues to plan to release the CIP Round Four, and it should be expected in the near future.

MODERATOR/PATRICK GILMAN:

Great. Thank you, Ian.

IAN BARING-GOULD:

Um hmm.

MODERATOR/PATRICK GILMAN:

So, we don't currently have any other questions in the queue. I will say that our speakers and I can hold out for a few more minutes to answer as folks have them. For now I direct your attention to the contact information on the screen. If you have any questions about this webinar series or DOE's broader work in stakeholder engagement and outreach related to wind energy, please don't hesitate to reach out to any one of us there that are listed. Myself, Patrick Gilman at the DOE Wind and Water Power Technologies office. Amber Passmore (sp), who also works on our stakeholder engagement activities. Or our crack NREL team, Ian Baring-Gould, who you just heard from, and Susan Tiegen (sp), who is also at the National Technology Center and does great work on this stuff as well.

Once again I would also direct you to our website. If you're interested in learning more about the Wind Exchange initiatives, please do visit the website at wind.energy.gov/windexchange.

And seeing no more questions, I think we'll bring today's webinar to a close. Oop, here's one. This just came in. For Alice. In comparing LCOEs to state retail rates, what states have the best returns on investments?

ALICE ORRELL:

Oh, let me think for a second. Obviously states that have slightly higher retail rates, they get more easier for the distributed wind system to compete. If I go back to that graph, which is not on the screen, I know, sorry. You can get – it looks like we had Oregon, Maryland, New York, Montana, Washington, South Dakota, North Carolina, Arizona, Hawaii and Vermont as the top ten states for low level cost of energy in that graph. And in the tool, it does have the retail rates for the states, the average retail rates, so when you play with the tool and you get a cost of energy from your scenario, you can compare it directly to what we have in the tool for the states' baseline average cost of electricity.

NIK FOSTER:

I can add a little bit more to that kind of looking into the future based on the D-wind model results. But again, it addresses that question but looks into the future including state incentives. Right now the model is talking about the states that have the best combination of resource load incentive. We're talking about Texas, Ohio, Indiana, Louisiana, again driven by incentives, Michigan, Illinois, Wyoming, Kentucky, Oklahoma, Nebraska are the tops there. So a slightly different list, but a lot are the same.

MODERATOR/PATRICK GILMAN:

Great. Thank you both.

So I'd like to thank all of our panelists today, Nik, Alice and Ian, for great presentations. Thank you all for your questions and for your attention today, and we look forward to seeing you on our next Wind Exchange webinar. Thank you so much.