2009 ANNUAL WIND TECHNOLOGIES MARKET REPORT WEBCAST

August 18, 2010

Coordinator: Welcome and thank you for standing by. At this time all participants will be a listen only mode until the question and answer session of the call. To ask a question at that time please press star 1.

Today's conference is being recorded. If you have any objections you may disconnect at this time.

I would now like to turn the call over to Patrick Gilman, Policy and Environmental Specialist of the (DOUN) program. You may begin.

Patrick Gilman: Hello everyone and welcome to this roll out of the 2009 Wind Technologies Market Report. My name is Patrick Gilman and I have had the pleasure for the last two years of managing US DOE's production of the report.

It's the fourth time that we've gone through the process and originally we did it as an exercise really just to, so that we could better our own understanding of the market, but we've gotten just tremendous feedback from stakeholders that this is really useful as a sort of source of market intelligence for them and feedback really has been fantastic and we're really proud of it.

So welcome and as we're coming into the fifth cycle of the report I just wanted to say that your feedback really is crucial because the market has changed and grown and we want to make this as useful to you as we possibly can so please do, don't hesitate to contact us if there's ways that we can make it more useful.

And with that I'll turn it over to Larry Flowers who will introduce Ryan Wiser. Thanks.

Larry Flowers: Thank you Patrick and welcome everyone from Wind Powering America. It is always a pleasure to introduce Ryan Wiser, Dr. Ryan Wiser from the Lawrence Berkeley Laboratory. Ryan's a great partner to Wind Powering America and the DOE Wind program. He and his team have done great work in the area of policy analysis and market, market characterization.

As Patrick said this is the fourth time we've done this. Our network around the country uses this report to separate facts from fiction one of the Wind Powering America's main missions is to provide factual and actual objective information and this report we think is really, at the top of the heap of all of our publications.

So with that I want to introduce Ryan Wiser, he's a Staff Scientist at Lawrence Berkeley Laboratory and Deputy Group Leader, Electricity, Markets and Policy Group, Energy Analysis Department.

And the way we're going to operate is Ryan's going to go through his slides in approximately an hour and then we'll have about a half an hour of Q&A.

Now I will be moderating that and we'll be doing it online so please send your questions as we go along on the online box, and then at the end of the formal presentation I will ask Ryan as many questions as we can get in in the remaining amount of time.

So with that Ryan Wiser.

Ryan Wiser: Great. Well it's a pleasure to speak with all of you today. As Patrick and Larry mentioned really the purpose of this presentation is to provide a reasonably quick overview of what is now the fourth edition of the DOEs Wind Technologies Market Report.

This is a report that came out a couple of weeks ago now and with a few important exceptions that I will be noting in a moment it's a report that has relatively similar structure and content as in past years and still provides a pretty comprehensive summary of some of the key trends in the U.S. wind sector.

Now the document itself, as noted on the second slide here, covers historical trends with the wind sector but with the particular focus on the latest calendar year, 2009. And our goal in producing the report is to build on the rather solid efforts of the American Wind Energy Association in collecting disseminating wind data and information to external stakeholders, but to then extend that work in several new and unique directions, especially in the areas of wind project, pricing, cost and performance trends.

As you might imagine completing a report of this magnitude is a major effort and so I'd like to certainly acknowledge the very significant contributions of my colleagues from Berkeley Lab, from the National Renewable Energy Lab, from (Exeter) Associates and from the American Wind Energy Association as well as the critical funding support from the DOE's Wind and Water Power Program. So thanks to all of you, you know who you are that have helped produce this report this year.

Now the contents and trends covered in the report are, as I mentioned earlier, pretty similar to past years and they're also pretty broad as summarized on this slide.

In particular we present data on wind project installation and industry related trends. We then focus quite a lot of our attention wind project price costs and performance trends and we conclude with a discussion of policy and market drivers and a summary of the future outlook, at least the near term outlook for the wind industry.

Now I will be covering rather quickly most aspects of the topics covered in the report, which will mean that I have a large number of slides I'll be running through rather quickly. Now I will though skip over certain elements of the policy and market drivers portions of the report if only to save us a little bit of time for Q&A at the end.

In addition I will be placing particular attention on the price costs and performance trends information as that really is the heart of the report and the unique aspect of this report that has not been presented elsewhere.

I should note that there were some important new additions to this years report; additions that as one might imagine took a considerable amount of time to create. Specifically, and we will be going through many of these if not all of them in the presentation that follows, but we do now in this years report present turbine and component level wind equipment imports into the U.S. and therefore the import share as well relative to the amount of wind turbine equipment that is being domestically manufactured.

Now we also present trends in turbine hub height and rotor diameter for the first time. We present an expanded discussion of the offshore wind sector then presented in previous reports. We provide some data on wind power curtailment, especially in Texas but also in the Midwest.

And finally throughout the report you'll find references to the Recovery Act, which of course has had very significant impacts on the U.S. wind sector. So those are some of the new elements of the report that I'll be summarizing in the slides that follow.

So again my aim today is to go through a large number of slides, 54 I think to be exact, in order to highlight some of the key findings of the report. We'll also be hopefully giving a good amount of time for Q&A at the end of the call.

The slides that I'm going to be discussing today are going to be presented I suppose within the context of four basic themes that emerged from this years report.

First, notwithstanding the rather difficult climate, the economic climate in recent years that the U.S. wind industry has grown and matured at a very rapid pace thereby readying itself for the possibility of even greater growth in the years ahead.

Secondly that that growth has been the result of course of a variety of drivers including policy drivers but also quite prominently including the fact that wind energy has been economically competitive in wholesale tower markets for much of the last decade or so.

A third recent trend in the cost and performance of wind projects has led to some escalation in wind project pricing and as that escalation continued through the year 2009, and finally despite the fact that there are, is now good reason to believe that some of the wind power costs and pricing increases that we've seen in recent years have begun to moderate as wind turbine prices has declined.

The corresponding drop in wholesale spot market prices though have even been greater and that places at some risk the continued growth of the wind sector here in the near to medium term.

So for most of you on the call, it's probably the case that many of those themes are somewhat self evident but really one of the primary purposes of that annual report is to provide good evidence of those kinds of trends. And again I'll be running through a large number of slides within the context as we go through this presentation.

So starting with the first of those basic themes, and specifically with installation related trends it's quite obvious of course that the wind industry in the U.S. has grown and matured at a rather rapid pace over the last decade or so.

And so all I really want to do at this point is reinforce that point by quickly running through a number of slides included in the annual report many of which present data again that many of you may have already seen at least to some extent.

So the year 2009 was, as we all now know, 2009 is well past us as the largest on record in terms of U.S. wind capacity additions. It shattered the previous record set in 2008, roughly 10 gigawatts of wind capacity installed in 2009 equating to approximately $21 billion of investment in wind capacity additions.

Maybe more impressively wind power represented 39% of all of the electric generation capacity, added to the U.S. grid in 2009, that's roughly the same percentage contribution that we also saw in 2008 and 2007 but well above the

figures that we had seen in previous years, 18% of the capacity, net generation capacity added in the U.S. in 2006 came from wind, 12% in 2005 and less than 4% from 2000 through 2004.

So that made wind in 2009 and now for the fifth straight year the second largest type of electric generation capacity added to the U.S. grid behind natural gas but well ahead of coal. So wind clearly for a number of years now has represented a major source of new electric generation capacity in the U.S.

Now as a result of that significant growth the U.S. has retained, at least for now, its leadership on a global basis in terms of cumulative installed wind capacity.

But for the first time over the last five years the U.S. seated its leadership in terms of annual capacity additions with China now taking in the lead in that category a position that seems unlikely that China will lose at least in the near to medium term, so the U.S. is now the second largest market globally in terms of annual capacity a difference.

Now while the U.S. clearly is still a leader or among the leaders on a global scale in terms of capacity additioned and cumulative capacity and by no means are we at the limits of what's possible in terms of growth in the wind sector in the U.S. In fact the wind installed in the U.S. by the end of the year 2009 represented just about two and a half percent of this nation's electricity supply.

Well that percentage is as high as 20% in Denmark, 14% in Portugal and Spain, more than 11% in Ireland and more than 8% in Germany. So there are a number of countries certainly that have done better than the U.S. in terms of winds overall contribution to their electricity supply mix.

Focusing on the location of wind projects in the U.S. we do see pretty broad geographic spread in development activity with the exception of the Southeastern portion of the U.S.

And while Texas clearly continued to lead the way and continued to lead the way by a wide margin in terms of annual additions in the year 2009, as shown in this table, we do now though as of the end of 2009 have 14 states each of which have more than 1,000 megawatts of installed wind capacity.

And quite impressively in the right most column of the table on this slide you can see that four states, Iowa, South Dakota, North Dakota and Minnesota all now have estimated in state wind generation that exceeds 10% of total in state electricity generation in those four individual states. So we're beginning to see significant percentage contributions of wind in certain states and certain regions of the country.

Now that's also of course true when you look at the contribution of wind to the supply mix of individual electric utilities. So if you moved from state to individual utilities as shown on this particular slide you can see that an increasing number of utilities are achieving wind penetration levels, that is wind generation as a proportion of their overall electricity load or retail sales that are pretty high, in fact nine utilities are over 10% wind energy on this particular metric.

Of course we're not likely to stop there. There is an absolutely enormous amount of additional wind capacity in development in the U.S. In this years report we reviewed 33 transmission interconnection queues across the nation, transmission interconnection queues represent wind projects and other kinds

of electric generation projects that have applied for transmission interconnection.

It's important to note that many of the projects in these queues are somewhat speculative in nature and therefore one should not assume that all of those individual projects will ultimately be developed.

But nonetheless, we find 300 gigawatts of wind that were in the transmission interconnection queues of the 33 queues that we reviewed at the end of 2009 and that represents nearly three times as much proposed wind capacity in these queues as the second largest resource, in this case natural gas.

In terms of the locations of that planned wind capacity, most of it as you can see on this slide resides in the Midwest, the mountain region, in ERCOT, (PJM, SPP) and in the Northwestern portion of the U.S. with smaller contributions coming from California, New York, (ISO) New England and the Southeastern portion of the country.

Now today, as I'm sure all of you know, the wind power capacity added in the U.S. has all been on land but there is also growing interest in off shore wind especially in the Northeastern portion of the U.S. and also in the Great Lakes region.

There are at least by our count 13 off shore wind projects identified in this particular slide as being somewhat more advanced in the permitting and development process, so one might note that there's always a little bit of gray area when one is trying to identify projects that are more advanced in that process than others, but we've tallied up 13 such projects here.

Also quite impressively or importantly over the last couple of years we now have three potential off shore wind projects that have either signed or proposed tower sales agreements with local electric utilities, the details of which are provided or some of the details of which are provided in this particular slide.

Moving from project installation trends to broader industry trends we also see evidence of a changing and maturing wind sector in this area as well. GE of course maintained its position as the leading supplier of wind turbines in the U.S. market in the year 2009, the right most bar in this particular graphic, but you can also see here over time that there is a grow, there are a growing number of suppliers competing from market share in the U.S.

The leading suppliers of GE, (Vestus), (Siemen), some of the other leading suppliers have actually seen their percentage market share drop over time and a large number of new entrants enter the U.S. market.

Despite the fact that the percentage share, by a drop for those suppliers though the aggregate number of megawatts of turbine sales or turbine installations in the U.S. by most of the manufacturers active in the U.S. market, in fact increased between the year 2008 and 2009.

And in addition in 2009 we saw it first in the form of the first wind turbine vendor operating out of China, Gold Wind, installing wind turbines on U.S. soil and of course a large number of other Chinese and also South Korean turbine manufacturers also expressed interest in growing their businesses in the U.S. in the year 2009 and now in 2010 as well.

Now as we all know the growing demand for wind in the U.S. over the last several years has also led to a pretty significant expansion of domestic

manufacturing and assembly of not just wind turbines but also the components inherent in wind turbines as well.

Some of the new manufacturing facilities that were opened or announced in the year 2009 are shown on this map, not going to go through those details at any level of detail, but as a result of that activity seven of the ten wind turbine vendors with the largest share of the U.S. market in 2009 already have one or more manufacturing facilities operating in the U.S.

And two of the three remaining top ten turbine vendors have announced plans to open facilities in the future and so certainly growth in domestic manufacturing.

At the same time though, and I'll discuss this in more length a little bit later, though turbine installations increased in 2009 turbine orders actually decreased in 2009 and has continued at a rather anemic pace here in 2010 and as a result the American Wind Energy Association has reported a slight loss in turbine manufacturing jobs in 2009 relative to 2008.

And it would certainly be a mistake to look at the 2009 developments as being universally a positive, certainly there are some challenges that currently exist in the wind turbine manufacturing business here in the U.S. as a result of the economic crisis and other drivers that I'll discuss in a little bit.

Despite that somewhat challenging environment for turbine manufacturers in 2009 though and trending towards the first half of 2010 as well, one hopeful sign from the standpoint of U.S. manufacturing is that a growing proportion of the equipment used in the U.S. wind projects has been and is being sourced domestically and there's been a corresponding decline in the share of imports used in the U.S. wind projects.

Now this is a new section of this years report and we're certainly open to suggestions for how to improve it in the years ahead. It was a major effort this year but in that new section we clearly indicate that the U.S. still is by far the largest global importer of wind turbines and wind turbine equipment.

Roughly $5 billion per year of wind turbines and component imports have been identified in the report in the year 2009 alone.

Now as a portion of total turbine cost though we see that the total import share has declined over time. So even though the aggregate dollar value of imports has grown the aggregate cost of U.S. wind projects has also grown in large measure because we've installed more and more projects.

And as a result the share of the wind equipment, wind turbine equipment being used in the U.S. wind projects has fallen from roughly 80% in the year 2006 to just about 40% in 2009. So in 2009 what those data suggest is that roughly 60% of the cost of wind turbine equipment used in the U.S. wind project installations were sourced domestically, up rather considerably from previous years.

I should acknowledge that there are different ways of analyzing and presenting these data. A number of caveats that I won't belabor right now, but underlying conclusion here is pretty clear, a growing share of the U.S. wind market is clearly being served with equipment that is being manufactured here in the U.S. both by domestic and by foreign companies.

Turning to some other industry related trends, perhaps not surprisingly wind turbines did continue their increase in average size in 2009 to 1.74 megawatts

being the average size of the wind turbine, more than two times larger than turbines installed as recently as 1998 and 1999.

Also for the first time in this years report we've also tracked average hub height and rotor diameters of wind turbines being installed in the U.S. This was a major effort to collect these data but here too you can see a rather substantial increase in the average size of turbines over time.

Since 1998 and 1999 for example the average hub height of wind turbines has increased by about 39% while average rotor diameters have scaled even more rapidly by about 69% such that in 2009 turbines typically have been installed at hub heights of 80 meters and with average rotor diameters that are actually a little higher than 80 meters, so pretty significant upscaling there.

Maybe not surprisingly we've also seen a similar though somewhat more erratic trend in installed wind project sizes, this graphic shows the average size of wind projects installed in the U.S. over time, and again you can see a long term overall increase in average project sizes so there's some erratic nature to that trend from one year to the next.

Moving from sort of manufacturer turbine and project oriented trends to other aspects of the wind supply chain, developers, financiers, owners and purchasers in particular, we did see some additional consolidation and investment activity among wind project developers in the U.S. in 2009.

We've identified six major developer acquisition or investment deals in 2009 totaling 18 gigawatts of wind development pipeline, that's a pretty comparable figure to 2008 and is down somewhat from the heyday of wind developer consolidation activities of 2006 and 2007 as you can see here.

Now on the project finance front, we move to that one, on the project finance front maybe the most important news from 2009 was that the Section 1603 Treasury Grant Program went into full swing.

That program allows wind project owners the ability to choose a 30% up front cash grant in lieu of either the production tax credit or the investment tax credit, and that single program as shown here was particularly important in reducing the impact that the financial crisis otherwise might have had on the wind sector, and it did so by limiting the wind industries dependence on scarce tax equity investors.

And in fact we find that about 60% of the wind power capacity that came online in 2009 elected to use the 30% up front cash grant, that is chose that incentive over the production tax credit and over the investment tax credit.

And indeed we also estimate that as much as 2,400 megawatts of the 10,000 megawatts of wind capacity that came online in 2009 may not have come online were it not for the Treasury Grant Program, so certainly a very significant program for the wind sector in 2009 as well as here in 2010 and going forward.

As for project ownership we see on this slide that local electric utilities, both investor owned and publicly owned have also gained or have gained increasing interests in owning wind assets in recent years. In fact as you can see on the pie chart on the right here in 2009 roughly 16% of the new wind capacity that was added in the U.S. was owned by a local electric utility.

So you can also see the continued dominance of private IPP ownership, about 83% of the capacity added in 2009 is owned by an independent power

producer of some form, a smaller fraction 180 megawatts of community wind as defined in the report itself.

Of course utilities also are major players not just in owning wind projects but also in being major purchasers of wind power under long-term contracts. As you can see again in the pie chart on the right here of the capacity added in 2009 30% or 36% is under a long-term contract with an investor owned utility, an additional 22% under a long-term contract with a publicly owned utility.

And somewhat surprisingly, at least from my perspective, a pretty substantial fraction of the capacity at the end of 2009 or that was built in 2009 was being sold on a quasi merchant basis, that is projects without long-term contracts in place.

And that's a trend that seems very likely to reverse itself in the relatively near future given the much lower natural gas prices and wholesale market prices that we're now experiencing, trends that I'll talk about in more detail in a few moments. Those trends will not likely support the continuation in a significant way of the merchant market at least in the near term.

Okay so I mentioned earlier that maybe the most important contribution of the annual wind report comes in its collection and summary of information on project level wind power pricing costs and performance trends, and that's one of the reasons that I went through those previous slides rather quickly.

A lot of those slides and the data in them you've seen before perhaps, but it's really the price costs and performance trends that represent the heart of the DOE annual report at least from my perspective.

And so it's really to those trends that I'd now like to turn for not the entirety of the remaining of the, remaining part of this presentation but certainly the most of this, the remaining portion of the presentation will be focused on these particular trends.

In particular using a variety of sources, the sources are identified in the appendix of the reports itself for folks that want to dig into the details in a little bit more depth, but with those data sources we've been able to piece together pretty good samples of data for project level power sales prices, wind project level installed costs and wind turbine level capital costs, project level performance as proxied by capacity factors and project level O&M costs.

Now you can see the size of the sample in each of those categories here. You can see that our sample of project level capital costs and project level performance are the most substantial. We have fewer projects in megawatts or gigawatts of capacity in our power sales price sample and in our O&M cost sample.

So what do we find when we look at some of those data? Well starting with tower sales prices, again our sample consists of 180 wind projects built from 1998 through the year 2009 totaling 12.8 gigawatts of wind capacity. And I want to be clear that the prices I'm going to be presenting reflect the bundled price of both electricity and renewable energy certificates as sold by a project owner under a longer term power purchase or power sales agreement.

Our data set explicitly excludes the prices that are received by both merchant wind projects and by projects that sells their renewable energy certificates separate from their electricity. We wanted to restrict ourselves to projects that had certain characteristics and therefore reduce the spread in the ultimate data.

I should also note that these prices of course reflect the receipt of any state or federal incentives that might be received by the project. So all of these projects, most of these projects at least received the production tax credit or something equivalent to the production tax credit, and that lowers the prices that a purchaser faces for wind projects, and again the prices that I will be presenting include those incentives.

So the first thing that we see is that on a cumulative and average basis wind power prices have in fact fallen on average over the 1999 through 2009 time frame.

So what this graphic shows is that if you look at this bar in the left hand side of this graphic what this is telling us is that wind projects in our sample built in the years 1998 and 1999 of which there are only seven projects, 450 megawatts, sold their power in 1999 at roughly six and a half cents, $65 per megawatt hour, six and a half cents per kilowatt hour.

Projects installed over the entire timeframe though, from 1998 all the way through to 2009 sold their power in the year 2009 for an average price of roughly $45 per megawatt hour, four and a half cents per kilowatt hour. So an overall reduction from $65 to $45 per megawatt hour but also a trend that you can see has been on the rise over the last five years or so.

So wind pricing at least on the sort of cumulative fleet-wide basis has dropped, so you can also see again the beginnings of a price increase on the right hand side of this particular graphic.

In addition you can compare those cumulative average wind power prices presented here as the red dot, so the red dots shown on this graphic are precisely the same data as the bars shown on this earlier graphic.

The average, fleet-wide average wind power prices, but on this graphic we compare those wind prices with the price of wholesale electricity supply purchased on the short term spot market, and that's represented by this wide blue shaded area in this graphic.

And the fact that there's a large shaded area reflects the critical fact that wholesale power prices vary by region. So the upper end of that blue range might represent for example New England prices or New York wholesale prices, whereas the low end of the range might reflect wholesale prices in the upper Midwest for example where wholesale prices have generally been quite a bit lower than in the Northeastern part of the U.S.

Importantly what you see from this graphic is that wind from the year 2003 through the year 2008 was extraordinarily competitive with wholesale market prices. The average price of wind based by a utility purchaser was below or at the minimum at the very low end of the wholesale price range.

You can also see though that in 2009 that trend reversed itself and it reversed itself partly because wind power prices continued their upward rise but more importantly natural gas price reduction resulted in a steep drop in wholesale electricity prices such that in the year 2009 wind projects on average were priced closer to the higher end of the wholesale price range.

Now digging into the data just a little bit more it's sometimes helpful to bin or group the projects by their commercial operations date rather than presenting data on a cumulative and average basis, which is what I focused on in the previous two slides.

Similarly it's sometimes also helpful to break projects down by region with the regions defined in the way presented on this particular map. So this next slide for example shows nationwide average wind power prices in the year 2009, so this represents the price that projects are selling or did sell their power for and (unintelligible) in the year 2009.

And what this graphic shows is that wind projects in our sample that were installed in the year 2009, so this is the right most bar of this particular graphic, wind projects in our sample that were installed in 2009 sold their electricity and (unintelligible) in the year 2009 for on average just over six cents per kilowatt hour.

Now you can see though that there is a rather widespread in the data each of these yellow markers represents a different individual wind project, so big spread across projects but about $61 per megawatt hour, six cents per kilowatt hour average price for wind projects installed in 2009.

If you go back in time though you can see that in the 2002 through 2005 timeframe projects installed in that timeframe in the year 2009 were selling their power for on average a little over $30 per megawatt hour. So you've seen roughly a doubling in wind power prices over this timeframe.

Now there are of course some regional variations in pricing as well, this graphic for example shows 2009 wind power pricing for just those projects built in the 2006 through 2009 timeframe. And even with that somewhat expanded timeframe there are precious few projects in our sample in a couple of cases, so I don't want to place undue emphasis on the overall average values here because in some cases those averages are based on very few projects.

But nonetheless we find that Texas, heartland and mountain regions have generally experienced somewhat lower prices while the East and California have generally experienced somewhat higher prices in recent years.

Despite those regional variations in wind pricing though as well as the regional differences that exist in wholesale spot market prices it is clear that the struggle for wind to compete, at least based on short term wholesale spot markets really spans all regions of the U.S.

So in this graphic we show the range of 2009 wholesale prices by region, that's the blue bar shown in this particular graphic, their floating bar. And we compare those regional wholesale spot market prices with the price of wind power in the year 2009 for wind projects that were installed in the 2006 through 2009 timeframe and we again see in all regions that in 2009 average wind power prices exceeded average wholesale prices and that really for the first time over the last five years.

Now to be clear I don't want to overstate my case here, comparing the price of wind, especially the price of wind that is sold under a long term contract with the cost or price of a flat block of wholesale power sold in short term markets and over a single year is not really a great point of departure in terms of assessing truly the economics of wind relative to other generation sources. So I don't want to place undue emphasis on that comparison.

However I would note that it is just that comparison that is causing some concern in the wind sector about the near term growth prospects for wind in the U.S. market and so it is a comparison that should be of some concern even if technically it is not a particularly incisive one.

Now of course wind power prices themselves are impacted by a variety of other cost and performance drivers including installed wind project costs, wind project performance and O&M expenditures, and so I'd now like to turn to the trends in those factors that are presented in the annual report starting with project level total installed costs.

At LBL we've been able to collect installed cost data for over 40% of all of the U.S. wind projects installed in the U.S. since the 1980s. And what we see here is a rather dramatic reduction in installed wind project costs from the 1980s through roughly the year 2000 then costs were somewhat flat for a period of time and then those costs have trended upwards and trended upwards rather rapidly over the last five years.

In fact what we find is that projects in our sample built in 2009 had costs that average roughly $2,100 per kilowatt, which is about $800 per kilowatt higher than the average installed cost over the 2001 through 2005 timeframe.

Now I should note though that turbine prices are now somewhat softer and as a result we would anticipate that the cost increases that we've seen over the last five or six years will moderate and maybe even reverse in the years ahead as lower turbine prices begin to work their way through into overall installed project costs.

Now looking into our installed project cost data in a bit more detail we find, maybe not surprisingly, some evidence of economies of scale in wind project installation here for example you can see that projects in our sample that are under five megawatts in size have had average installed costs that are pretty substantially higher than larger projects in our sample.

In addition we also see some regional differences in average costs but you can also see quite a lot of consistency across regions in this particular slide, but nonetheless we see some evidence of higher costs experienced in New England and California, perhaps not surprisingly, a little bit higher in the East as well whereas Texas the mountain region and the heartland have experienced the lower, lowest costs on average over the last several years.

Turning from project cost to project level performance we've also assembled a rather robust database on the capacity factors of wind projects in the U.S. and what this graphic presents is fleet wide average capacity factors over time. So what does that mean?

Well that means that for example this left most bar is telling us that wind projects that were installed prior to the year 1999, and we have in our sample 11 such projects totaling 700 megawatts of capacity, those projects had an average capacity factor in the year 1999 of roughly 24%.

You can see though as you proceed to the right of this figure, and specifically the year 2008, that projects in our sample that were installed before the year 2008 had an average capacity factor in the year 2008 of 34%. So a very substantial increase in performance from capacity factors of the wind project fleet from 1999 through the year 2008.

At the same time though you can see a pretty significant drop from 2008 to 2009, it dropped from 34% down to roughly 30%. And there are really two principal reasons for that decline as far as we can tell; the first is that 2009 in part due to El Nino conditions was a particularly bad wind resource year for the U.S.

At the same time 2008 is widely known to be a relatively good wind resource year and so some of this drop in capacity factor is simply the reflection of the fact that 2008 was a good year 2009 was a bad year, the long run average of course is the long run average and so nothing to be terribly concerned with.

The second perhaps more important factor though and one to be somewhat concerned with is that of curtailment. Now curtailment represents wind generation that is possible, that is the wind is there, the turbines are there, they're ready to produce power but because of transmission constraints or because of extremely low even negative wholesale electricity prices that the wind projects choose not to generate and deliver electricity.

And what this graphic shows is that in Texas, and in ERCOT in particular, a full 17% of all of the potential wind generation that could otherwise have occurred in the year 2009 in ERCOT did not occur due primarily to transmission limitations, that is there is simply an inability to deliver 17% of the potential wind generation in Texas to the load centers of that state.

That 17% figure is dramatically increased from 8% curtailment in the year 2008 in Texas and just 1% in the year 2007. And that curtailment is so substantial that if that curtailment in Texas had not occurred the nationwide fleet average capacity factor for wind projects in 2009 would rather than being 30% as shown on this earlier graphic, would have been 32% or so roughly equivalent to the year 2007 and much closer to the figure that we found in the year 2008.

So curtailment in Texas in particular is a very, very big story in the year 2009.

Now again digging into the capacity factor trends in a little bit more detail, we again not surprisingly do see some regional differentiation as well, you could

see on this graphic that Hawaii, the mountain region and the heartland regions have the highest capacity factors on average for projects in our sample that were built from 2004 through 2008, again we're focused here on 2009 capacity factors.

You can see that Texas and the East Coast have the lowest capacity factors, Texas again this is not a story of a low quality wind resource, we all know that Texas has extraordinarily high quality wind resource, but because of curtailment Texas in fact was the lowest performing region in terms of average capacity factors in the year 2009.

Finally O&M expenditures of course also impact wind energy pricing. Unfortunately though out project level O&M sample, cost sample is growing. It does remain rather limited and so I don't want to place undue emphasis on the resulting data that are presented in this graphic and the next couple, and indeed I think to save time I won't even really walk you through the figures in any detail.

But suffices to say for now in the interest of time that despite the fact that we have relatively limited sample for O&M costs we do find, maybe not surprisingly, some evidence that O&M costs increased with projects age, that they decreased with project size and also that the most recent fleet of wind projects have early year O&M costs that are pretty consistent with and maybe even a little bit lower than wind turbines installed earlier in time.

But again our sample here is rather limited so hopefully we will begin to collect more and more data or will collect more and more data as the years go by and we'll be able to develop more robust findings on O&M costs.

So at this point I've presented a pretty considerable amount of data that confirms the growing maturity and strength of the U.S. wind sector really all across the value chain from wind turbine and component manufacturing all the way through to wind developers, owners and purchasers.

At the same time though I've also shown that the economic picture for wind has become somewhat more challenging, at least in the near term, in large measure due to the drop in natural gas prices, but also because wind project costs and performance trends over the last five years have not been universally positive.

But then to conclude, what all of those trends mean for the remainder of 2010 and beyond, what's the future outlook for the sector.

Well the first thing to note I think in this regard is that federal and state policy is in fact now more favorable towards wind energy than really at any time in the past decade. Now let me not just end there, it's clear that there are still a number of policy asks that are quite high on the agenda for wind industry stakeholders.

Nonetheless the establishment of a federal policy and specifically the extension of the PTC now through 2012 is a longer, longest term extension of the PTC than we've seen for quite some time and a variety of the provisions of the Recovery Act are also quite positive in terms of the wind sectors growth.

In addition to that we have a growing number of state renewable portfolio standards that are also impacting the amount of wind deployment but also the location of that deployment across the nation.

And so the combination of those factors, federal policy that at a minimum is relatively clear through the year 2012 with the extension of the PTC through that period, in concert with the growing number of states that have RPF programs and increasingly stringent RPF programs, that these trends would seemingly lead us to believe that the wind industry is well positioned at least from a policy perspective through at least the year 2012.

Despite that surface impression though let me not try to mislead you though, 2010 has already been and it is expected to continue to be a relatively slow year in terms of wind capacity additions. And that's a reflection of certainly the weak economy and a wind financing sector that has not completely recovered.

It's also a reflection of the low natural gas and wholesale electricity prices that I described earlier, and the more challenging economic environment that wind projects now face as a result of those lower prices, and frankly it's also the fact that in the year 2009 there were a variety of factors that allowed 2009 to be a particularly strong year, one of which was the number of projects previously slated to be completed in 2008 ended up sort of shifting over to be 2009 projects when the production tax credit didn't expire at the end of 2008.

In addition there were some policy drivers that motivated projects to be completed in the year 2009 including the expiration of some bonus depreciation rules at the end of that year. Well in 2010 wind project owners there's no inherent policy need or incentive to complete a project in the year 2010.

And so as a result of all of those factors, the weak economy, low natural gas and wholesale electricity prices, and the fact that there's no inherent policy driver to complete a project in the year 2010 a variety of forecasting entities

have forecasted 2010 wind capacity additions from anywhere from 5,500 megawatts to 8,000 megawatts and that represents a 20 to 45% reduction in capacity additions compared to the 2009 figure of ten gigawatts.

Now most of those forecasts do predict some resurgence in 2011 and 2012 as the financing for wind projects hopefully becomes somewhat more steady, and as the Recovery Act continues to have some of its effects, but of course that resurgence is by no means assured and what happens after 2012 when many of the existing federal policy incentives are slated to expire really remains anyone's guess.

And that of course whether we meet, beat or fail to achieve any of those forecasts and additions is going to be determined by a balance among a variety of trends that are pushing and imposing directions, trends that perhaps argue for somewhat weaker growth include the fact that the Treasury Grant Program, the 1603 program expires or at least eligibility expires at the end of 2010.

But it's also fair to say I think that the tax equity market perhaps is not fully recovered from its pre-crisis days. And so there are questions as to whether the extension of the Treasury Grant Program might be necessary or at least useful for the wind sector.

Low natural gas and wholesale power prices and also price expectations have also declined for natural gas and wholesale prices, softer demand from state RPS markets, at least in the near term. The truth is that we've added wind capacity in the U.S. at a much faster rate over the last several years than state RPS requirements demand.

And so as expected or certainly no surprise that those state RPS policies are not likely to individually drive as much capacity expansion in the years ahead, we're simply outstripping demand from those programs in at least some regions of the country.

Inadequate transmission infrastructure beginning to constrain new builds, the curtailment data that I presented earlier for Texas a clear indication of that kind of trend, and finally especially in the Southwestern U.S. increased competition from other renewable sources and solar in particular.

All that said there are also you know, good reasons to believe that stronger may be possible in the years ahead. I mentioned earlier that we have now stronger federal and state policy support that really at any time in the past decade there's certainly the possibility of further federal policy support through extension of the Recovery Act program, the Treasury grant effort for example and/or through potential federal policy in the form of renewables portfolio standards, climate policies or transmission policy.

And then finally falling wind turbine prices, we haven't seen it yet in our data but presumably in the years ahead we will begin to witness lower wind turbine prices in our backward looking view of wind project installation costs and turbine prices and that should improve the comparative economics of wind on a going forward basis.

Amidst that uncertainty though, and there certainly are trends that are pushing both in positive and in somewhat negative directions, the good news is that the sector does remain on a trajectory that may allow us to reach or meet 20% of the nations electricity supply from wind electricity.

I apologize for the background noise, we seem to be having some kind of exercise here at LBL that I'm obviously not participating in.

In any case the rate of growth that we've seen over the last four years and the expectations even on the low end for wind capacity additions through the year 2012 would suggest that we will stay or even exceed the path that the U.S. DOE identified as a potential pathway to reach 20% of the nations electricity with wind energy by the year 2030.

Of course to do so and ultimately to hit that 16 gigawatt per year of wind additions that are shown in this graphic as the blue bars as being necessary beyond around 2017 or so will be a significant challenge. It would certainly require proactive policy, certainly require substantial transmission expansion proactively addressing wind energies integration challenges and perhaps also facilitating rapid wind project sighting and permitting.

So with that let me conclude the presentation and open the floor for questions. Again this report is out, it's already online, it can be found at the link that is shown on this final slide. I've also provided here the contact information for both myself and my co-author Mark Bolinger.

In addition to that I should perhaps also note that this Webinar I think will be posted on the Wind Powering America Web site late next week I understand or maybe a little after that, so check back to that if any of your colleagues would like to look at the Webinar.

And finally let me also note that this year for the first time we have provided an Excel file that includes at least some of the data that underlies the graphics that I've gone through in this presentation. And so for those of you who really

want to get down to the last decimal point you can find that Excel file on the Berkeley Lab Web site where it resides.

And with that let me turn it back over I think to Larry Flowers who is going to help moderate any questions that all of you might have. Thank you.

Larry Flowers: Thank you Ryan. Excellent information and well presented and congratulations to your team for such a quality report.

We do have some questions for those folks on the line who have questions please type them in and we will address them as you do that.

There is an early question Ryan about your Slide 38. Can you go back to that quickly or not?

Ryan Wiser: I can yes.

Larry Flowers: And the question was are these wholesale prices on peak, off peak or 24/7?

Ryan Wiser: Yep. Excellent question, I should have clarified that when I went through it, these are 24/7 flat block of power prices and so that obviously is not an ideal comparison to wind.

Wind in general, and this varies by project and it varies by region, but wind in general is a somewhat off peak resource and so analysis that we've done at LBL at least, and that's focused primarily on the Western portion of the U.S., is that wind, the best point of comparison is probably something like 95% of a, of the price of a flat block of 24/7 wholesale power.

But for the sake of this particular slide as well as the earlier one where I showed the larger blue area, this reflects a flat block of wholesale power.

Larry Flowers: Okay thank you. There was a question about the lag time between the 2009 installed costs versus when those turbines where purchased, is that, how does impact it?

Ryan Wiser: Yes. So this is a really important point, you know, we're looking at the costs of projects installed in the previous years and those projects installed in the year 2009 may well have purchased their turbines in the years 2007 and 2008 at the peak of the wind turbine pricing environment.

And so what we can expect is kind of a lag, so even though projects may be going in today in many cases at lower average costs than what we've seen in the past.

And similarly with wind power prices that are lower than what we're showing with our backward look because we're looking backwards and because we're looking at costs and prices that are in large measure a reflection of turbines that might have been purchased in 2008 as well as tower sales contracts that might have been negotiated in the year 2008 or so naturally we have a bit of a lag.

I'm not going to forecast what's going to happen in the coming years, some of that lag will continue into 2010 as well and so I do not yet know whether our 2010 project sample will show lower average costs than 2009 or higher average costs. What I do know is that wind turbine prices have softened to some degree.

Larry Flowers: Thank you. There was a question you had shown that the drop off in capacity factor in 2009 and explained it away by two aspects, curtailment and an El Nino bad wind year. There's discussion in the marketplace that people are tending to start now building wind projects near available transmission, not necessarily where the best wind resource is, is that also a factor?

Ryan Wiser: Yes. That's a great question. So that's this particular slide here I'm trying to click in on it. That is not really a factor in this particular slide because all we're showing in this slide is the fleet-wide average capacity factor over time and so the difference between 2008 and 2009 is really focusing on the entire fleet of projects.

However we do also see some moderation of the capacity factor increase if you present the slide and, or the data behind the slide in a different way you can also see some moderation of the capacity factor increase over projects that have been built most recently.

And there are two things going on there, LBL is currently doing pretty detailed analysis on some of these things and so within a couple of months we should have much better understanding of these issues.

However, what we're finding is that wind projects are increasingly being cited in much lower quality wind resource areas than they have in the past and clearly that's not because we're running out of high quality wind resource areas, this nation has an enormous wind resource space.

However one very plausible explanation is that we are running out of the highest wind resource classes located in the area just in transmission lines.

Larry Flowers: Thank you. And a follow-up on the capacity factor question, are you reporting net capacity factors for the wind farm or gross capacity factors?

Ryan Wiser: These are net capacity factors.

Larry Flowers: Okay thank you. There was a question regarding small wind and while you didn't present any small wind information I know your team tracks that somewhat. And the question was why is the small wind keeping pace with large wind as far as growth? Do you have any observations on that?

Ryan Wiser: Yes well I guess the first thing that I might note is that I'm not sure that that is a completely accurate statement from the get go. I mean yes, the small wind market, now the small wind market can be defined in a lot of different ways, for the purpose of our report we define it as involving turbines that are under 100 kilowatts in size.

So these are mostly you know, residential, farm, maybe small industry kinds of installations, and indeed we've seen that there has been a rather substantial growth in the annual capacity additions of turbines of that size range. In 2005 for example we have data that show about 3.3 megawatts of small wind turbines installed in the U.S., in the year 2009 we have 20.3 megawatts installed in the U.S.

So dramatic growth in terms of the number of turbines that are being installed as well as the megawatts of those turbines and so in terms of the actual growth rate I'd say that the growth rate of small wind is equivalent to maybe even greater than that for large wind, but you're starting at a much, much lower base in terms of megawatt impact. It's simply a much smaller market overall than for large wind.

I think just one other final note on that point is that one of the largest policy drivers for small wind has just been inactive. The 30% investment tax credit now without a dollar cap was just established by the Recovery Act in February 2009 and so most expectations are for a small wind sector that will continue to grow, albeit from a smaller base and so it's not likely to approach certainly the gigawatt scale additions that we see in the large wind sector.

Larry Flowers: So, and this is in addition to that, (unintelligible) Management Association has an excellent report on 2009 small wind and it breaks those numbers down in quite good detail if you're interested in following that, there is a question about whether these prices including (Rex) and Ryan I think clearly said that they do, so that question was answered during your presentation.

There's a question regarding your future reports and will they continue to track this curtailment problem?

Ryan Wiser: They will to the extent that data are available. This is the first year that we really tried to track the curtailment issue and we were able to find a bit of data from both Texas and from the (MISO), the Midwestern area, however we were not able to obtain curtailment data from other locations and so we can only obviously deliver what is provided to us or what we are able to get our hands on. Certainly we're going to continue to try to get those kind of data.

I should note that it's a bit of a challenge because of course it's always hard to know what would have happened absent their curtailment, you know, how much wind generation was there there that had been curtailed and so ultimately this does represent an estimation process, it's not real data it's an estimate of the amount of curtailment and some areas are more willing to make those estimates than others.

So I don't anticipate that we'll be able to have comprehensive nationwide curtailment data and I don't believe that we will ever have data sources that would allow such a thing but hopefully we will be able to track it at least in some of the key areas of the country.

Larry Flowers: Well thank you Ryan. Another question came up in your looking at the data did you find any projects where we, they actually had wind and natural gas co-located?

Ryan Wiser: Nope. I'm not aware of any, I think this is true, I'm not aware of any facility where a wind, a natural gas generator have been explicitly co-located to either manage variability or to manage transmission flows.

It just doesn't make much sense really to manage an electricity system on that basis. It is an overall electricity system, we certainly need to manage the variability of wind but there's no particular reason that the plants need to be co-located to do such a thing.

So I'm not aware of any location in the U.S. where there's been co-location in that way.

Larry Flowers: Okay. Another question regarding some of the (unintelligible) stipulations. Did the Buy American Provision help increase the market share for U.S. and Canadian manufacturing?

Ryan Wiser: That's a good question. You know I think the answer to that is largely no, I'm not totally certain about this but the Treasury Grant Program is not subject to the Buy American Provision and that's really the principal driver within the Recovery Act for wind. And so that program does not contain Buy American

Provisions and therefore I don't believe that that particular provision has helped particularly increase the market share.

I would note that there is also a manufacturing tax credit that was established as part of the Recovery Act and wind has gained a good chunk of funds from that and those tax credits as projects or as manufacturing facilities come online and access those tax credits I think we will continue to see, at least for some period of time, an increased domestic share in this case in part a result of a different Recovery Act provision this manufacturing tax credit.

Larry Flowers: There was a question regarding the comparison of the 30% up front cash grant versus the PTC and how that 30% cash grant is, relates to the PTC, is it, is the PTC discounted on a ten year basis and that's an equivalency or how is that, how do they compare?

Ryan Wiser: Yes. So obviously how they compare is ultimately up to the investor in the projects to determine, right? If you're invested in the project you've got to assess the relative economic value of the production tax credit versus taking the 30% up front tax or cash grant as well as other non-monetary benefits that might exist for one incentive over the other.

Now for projects that have particularly high capacity factors or particularly low installed project costs those projects may tend to go for the production tax credits because the ultimate value of the production tax credit will be higher in economic terms than the 30% cash grant for projects that have low capital costs and high levels of performance.

At the same or the opposite of this is true for projects that have higher costs or relatively lower capacity factors. Those projects will almost certainly select the cash grant. And so the economic comparison is really project specific,

depends critically on the capital cost of the project and the expected performance of that project, but then of course is also impacted by non-monetary factors as well.

Larry Flowers: Well Ryan there's been a couple questions regarding the run up of costs and I know that you've done some work on this as far as analysis of drivers for why prices have gone up by a factor of 100%. Can you illuminate that?

Ryan Wiser: Yes. We have done a little bit of work on this and we're still working on a project that will hopefully go live here in a couple months time as well on that topic.

What we've tried to do is analyze a variety of the possible drivers, materials and energy, commodity price increases, exchange rate movements, the profit margins of wind turbine manufacturers and also wind turbine upscaling, the fact that we just have larger rotors and larger hub heights of wind projects.

And we don't find that any one of those is a dominant influence. Certainly the fact that copper and steel and concrete have gotten more expensive over time is a significant factor. Certainly the fact that the U.S. dollar has overall weakened relative to the euro that has been a factor in the cost increases as well.

Certainly wind turbine manufacturers, at least through 2008 maybe not through 2010, the fact that turbine manufacturers have improved their gross margins, they've become more profitable over time has also been a factor.

The most significant factor that we find though is turbine upscaling, that is the fact that we simply have larger rotors on larger hub heights for turbines. And

the fact that capital costs have increased as a result of that upscaling should not be viewed in a negative light, right.

You know obviously if you're a wind project developer or owner you would be happy to pay more up front if that up front payment is returned through better project performance over time. And so what we've found at least preliminarily is that something like $250 per kilowatt of the increase in wind project costs over the last five years is a result of the upscaling of the turbines themselves and upscaling that again returns in the form of greater energy production more than is lost in terms of the up front capital cost.

So just a little bit of caution, yes there's lots of drivers for capital costs, yes the fact that capital costs have gone up should be a little bit of a concern however some of that capital cost increase is simply due to turbine manufacturers trying to optimize their turbines performance.

Larry Flowers: Thank you. A question about the competition from other renewables, is this a regional, a state or a national sort of concern for the wind industry?

Ryan Wiser: You know I think it's probably more regional than otherwise. There are certainly still many regions of the country where wind, among the various renewable technologies is quite clearly and with very few exceptions the lowest cost provider.

However in the Southwestern U.S. certainly you know, Arizona, New Mexico, Southern California and some other locations in those areas large scale solar plants are getting pretty darn close to the delivered price of wind.

Especially when you consider the fact that those technologies, sometimes if they're (CSB) come with storage this provides value to the electricity system,

or for solar has a temporal output profile it's a little bit more consistent with the, with electricity demand especially in air conditioning demand focused regions.

And so I think especially this is a Southwestern U.S. issue as the cost of solar goes down the competition between wind and solar may well expand into other regions of the country as well, but it is something, you know for the wind sector to look out for.

Certainly in California it seems now that the bulk of the competition for contracts with the states investor owned utilities is between in state solar generation and out of state wind generation and most of the contracts are with one of those two kinds of projects and so competition certainly is happening within RPS driven markets.

Larry Flowers: Well fortunately that was the last question that was written in and also coincides with when my computer died. I will ask my last question that I have picked up from the marketplace in several places Ryan is what's your observation on the Chinese import situation as far as impact on prices?

Ryan Wiser: You know I think we're probably still a couple of years away from Chinese imports having a substantial impact on pricing in the U.S. The truth is right now that most of the Chinese turbine manufacturers are not yet ready to do full scale exports or imports, whatever, exports from China, imports to the U.S.

They're readying themselves, certainly they will be there but the product, the certification the domestic manufacturing just isn't quite there yet for a massive influx, certainly not within the next year or so.

That said, you know wind projects in China cost oh, let's say $1,200 per kilowatt to install. In the U.S. we're at $2,100 per kilowatt. Turbines in China cost maybe $800 per kilowatt, maybe a bit higher than that in some instances, in the U.S. we're closer to $1,500 per kilowatt.

So the pricing competition that is coming from China is going to be significant and I would anticipate that the impacts also will be significant. But I don't think we're quite there yet, we're still a couple of years away I think from more significant imports of certified high quality turbines from the Chinese market.

Larry Flowers: Well Ryan thank you so much. Excellent presentation. This presentation both audio and visual will be on the Wind Powering America Web site within seven to ten days.

We thank you. We had about 170 folks participating, this is always an important document. We'll be printing it as well on hard copy for those of you who might want that as a distribution.

So thank you Ryan, thank you everyone for joining us and good day.

Ryan Wiser: Thanks all.

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