Wind Turbines and Property Prices
March 19, 2014

Coordinator: Welcome and thank you for standing by. At this time, all participants are in a listen-only mode. Today's call is being recorded. If you have any objections, you may disconnect at this time. Now I'd like to turn the meeting over to Mr. Ian Baring-Gould.

Ian Baring-Gould: Thank you very much and hello everybody to this month's installment of the Stakeholder Engagement and Outreach Webinar series. And it's one I'm very excited to be presenting or offering the opportunity to present on wind turbines and property prices. Certainly a key issue the safety industry in London has been fairly contentious at times but at this session we'll have a great opportunity to hear from two of the experts in regards to this issue that'll present on the—all the way the work has been going on in this area that they will of course not put the issue to bed but put some great documents out there in the peer reviewed phase we can use to articulate how the people's property values are actually impacted by wind technology.

So we have two speakers today—Carol Atkinson-Palombo. Sorry about that. And then Ben Hoen—both known experts in the area. And so we're very excited (unintelligible) to have them. As always, the process ask questions—we don't have verbal asking. But go up to the Q&A bar at the top of your screen and there you can type in a question either to one of the speakers directly or to us more generally.

And at the end of the presentation, we're going to—we'll do Q&A at that point in time. So without further ado, I'd like to introduce our two speakers. Carol is—has focused research on specializing in sustainability where she really defines the forward-looking perspective that focuses on creating capacity of

people to adapt to changing environments specifically around build environments. Her scholarly goal is really to use geographic areas, methodologies and tools to address complex problems and require social action.

Carol comes to us with a PhD of Geography from Arizona State, a Master's in International Economics and Policies from NYU. And then a number of decades of work experience at—looking at this really intersection of international economic development and finance. She's also an (unintelligible) fellow with the National Science Foundation in Urban Ecology.

Since 2007, Carol has been at the University of Connecticut where she teaches a variety of undergraduate and graduate course organized around these kind of general themes of sustainable cities. And then the methodologies, she used GIS (unintelligible) spatial analysis, economics and statistical modeling to look at the impacts of development within these communities. So it's great to have Carol with us to talk about her work.

And then co-presenting with her is Ben Hoen. Ben is not a new person to the wind space. He's a staff research associate for electricity markets in group policy at Lawrence Livermore National Laboratories—one of the (unintelligible) laboratory spaces where he does research on a whole bunch of research and analysis and a whole bunch of topics around the renewable energy field looking at policy, economics, benefits certainly around the acceptance of deployment of wind technologies on land values, economic impacts of—on communities, economic and employment both within the wind and the PV space.

He's also done a fair amount of work on noise and noise mitigation options and trying to understand what different levels of noise does to impact

communities. His work has been published in the Journal of Real Estate Research, Contemporary Economics and Policy in Energy Economics. He comes to us with a Bachelor's degree in Finance and General Business from the University of Maryland. And then a Master's of Science and Environmental Policy from Farg. So I don't remember which one of you are starting the presentation, but I know you're going to tag-team back and forth a number of times.

So Carol and Ben, please fill us in.

Carol Atkinson-Palombo: Great.

Ben Hoen: Thank you, Ian.

Carol Atkinson-Palombo: Thank you.

Ian Baring-Gould: So we got your presentation—should be up and you guys should have control to move it forwards.

Carol Atkinson-Palombo: Perfect. Thank you. So good afternoon everyone. Today we're going to focus on two studies. I'm going to first give some background information just to contextualize these studies. I'm going to then hand over to Ben. He's going to talk about the general methodology that was used in the two reports and explain the study that he did in the US. And then I'm going to come back and provide an overview of the study that we conducted in Massachusetts and finish up with some overarching conclusions that we can draw from the two studies.

And then, as Ian mentioned, we're going to move into the Q&A session. So first of all, I'm going to give a very brief overview on the theory of land

economics that informs research design. So essentially, the price of a specific property is composed of a combination of its various attributes including age and condition of the house, square footage, acreage, and so on. The most important determinant is the property's location or geographic setting. House prices are shaped by supply and demand.

And these conditions can be dynamic and vary over time, as we know, but also across locations. So the net result is that house prices can exhibit a large amount of variations across space and time. So just to illustrate this point, I'm going to show a couple of graphs. This first one shows an index of house prices for ten cities across the United States from 1989 to 2013 which spans the period over which our studies were conducted.

So we can see that from 1989 until about 1996, house prices were fairly flat. And this is for the index of ten cities as a whole. And after that, house prices grow sharply up until about the 2007 housing market crisis. So by about 2003, the average house price in these ten cities had doubled -- so going from 100 to 200. And by 200—2007, they had risen almost threefold. So that's a tremendous amount of variation over 30 periods.

So while the prices have come down since then, there's still approximately double the level they were at in 1996. So this next graph shows the same data but this time alongside information for the New York and Boston markets with New York shown in purple and Boston in green. We can see the prices in Boston rose less than in New York and peaked a little earlier. So the main point here is that house prices can vary fairly widely across space and tine and these factors need to be taken into account when designing a research study that quantifies the effect that a particular event has on property values.

So in the academic literature, specific events such as the construction of a wind facility are described as a treatment. Well-established methods have been developed to quantify the effect of the particular treatment on house prices. The general method that is used is called hedonic modeling. So basically, house prices can be thought of as being the sum of the series of component parts. In this general formula presented here on this slide, P -- the price of a home -- is a function of five different components -- L, N, A, E, and T where L refers to lot-specific variables, N to neighborhood variables.

This is to take into account the fact that house prices vary by location. A to amenity and dis-amenity variables to account for the effects of being close to specific facilities within a neighborhood, E to wind turbine variables, and T to time-dependent variables and this is to account for the fact that as we saw, prices can vary a lot over time. So in very simple terms, these hedonic models can tell us what the value of what we call a variable of interest before and after a treatment.

So we isolate the variable of interest which in our case is the distance to a turbine, and C, whether or not the value changed before and after a turbine was built so we can then net out the difference and figure out what the effect is of a turbine. The models are able to do this by including variables that describe the specifics of each individual transaction that functions as controlling variables. And I just want to mention here the concept—to just sort of remind everyone of the concept of statistical significance.

When we conduct statistical tests, we need to have some degree of confidence that an outcome did not just occur by random chance. So people tend to use statistical significant—significance levels of 5%. And when we say that, it means that we're 95% sure that this difference did not occur by chance. And

this is usually one of the minimum levels of confidence that we use to be sure of the sort of—the relevance of a statistical test.

I'll now move on to discuss some academic literature that has focused on the evaluation of environmental amenities and dis-amenities. There's quite a large body of literature that has examined how proximity to and views of environmental amenities and dis-amenities can impact property value. So it's a very well-established field of research. So here is a table setting out just a sample of studies. And in the interest of time, I'm just going to point out some of the findings.

So first of all, (unintelligible) in 2008, found that being within two miles of a tower plant generated a discount in property values of up to eleven%—sorry, between three and five percent. Sorry, three and five percent on the fourth column over. Similarly, two studies have shown that landfills can create a discount of up to five percent in property values. And finally, even road noise, which is a very common feature of many urban settings, can generate a discount in property values of up to eleven percent.

And those percentage changes are the impacts shown there in the fourth column. So the bottom line of this table is not the research into the relationship between dis-amenities and property values shows clear evidence of negative effects on property values. So the presence of any of these on the landscape needs to be taken into consideration. But one thing I want to point out is the size. So if we look at this Superfund site study that was conducted by (Keel) and (Sable) in Massachusetts, we can say that within a mile of a Superfund site, the average impact on property values was 15%.

So that's a good baseline from which to evaluate the impacts that we may find for other amenities or dis-amenities. So next, I'm going to address the

literature that's specific to the relationship between wind turbines and property prices. The existing research suggests that there are three potential stigmas that could be associated with wind turbines. The first one is an area stigma.

And this centers upon concern that an area will appear more developed. Second, there's a scenic vista stigma based on concerns that wind turbines could spoil views. And thirdly, there's a nuisance stigma, and this is related primarily to noise and shadow flicker. Our studies shown focus on this last type of stigma.

One thing that we would like to point out though is that we did not undertake any noise or shadow flicker studies. But instead, we used distance to turbines as a proxy for the nuisance effect. So here are some of the studies that have been undertaken. So in the interest of time, I'm not going to go into a lot of details about the existing studies. But they are discussed at length in the written reports.

To summarize, the academic and peer reviewed literature on the association between property values and wind turbines in the US is relatively young dating back to just 2006 and quite space. But one thing that we'd like to point out is that the academic literature tends to focus on hedonic modeling techniques applies to large data sets rather than appraisals of individual homes. The reason why this is done is because academic studies prioritize empirical analyses that allow the testing of statistical significance and other measures that can ensure that the findings are robust and trustworthy.

The tradeoff is that hedonic analyses will calculate the average affect that a treatment has on a large number of transactions rather than the specific effect on an individual property. So this next slide shows a sample of reports outside the US that tend to use the same technique. A notable exception is the Lansing

Paper in 2012 that is a case study of appraisals. So just to summarize the findings of these literature, there's a sort of overwhelming consensus that amongst the studies that there's no effect of turbines on property values.

So two notable exceptions include the (unintelligible) 2012 study that again I mentioned that one was a case study of appraisals. And there's also a recent study in Germany that offers evidence to the country. So despite this academic literature, there are claims at the—at large impacts. And I just—we just wanted to show a couple of these pieces of work because some of those claims of the impacts relate to development in Massachusetts.

And you can see that in the order of 15 to 30%—and this is the 2012 appraisal report shown here on the left—and in 2013 the article on the right indicated that property values plummeted by 15 to 40% in association with wind turbine construction. And remember, when we had looked at the impacts of the Superfund site, the maximum effects were 15%. So it's sort of in the order of two to approaching three times the expense of a Superfund site.

So that's it on the background. What I'm going to do is now hand you over to (Ben) who will talk about the methodology and then describe the US study. Thank you.

Ben Hoen: Great, Carol. Thank you so much. I will try to pick it up where you have so adequately and expertly described things. So I am going to overview the specific methodologies for both studies since there's a lot of similarities. One thing to note is that the data that were collected for both studies, spans a wide time period. As Carol mentioned early on, prices can change over time and space.

And so if we are to accurately measure a impact to turbines as a treatment in the post-construction period, we must first understand and account for any difference in home values that might exist prior to the wind facility's announcement for that same group of homes -- those homes quite near where turbines eventually are located. So both studies collect data over these various time periods and bend the transaction into one of these four periods.

Because we're interested in not only the post-construction period, but the post-announcement pre-construction period where we think there might be a unique impact. And so our results will look at both of those post-construction and post-announcement, pre-construction periods. Let's see if I can do this right. Okay, for those of you that are interested in the actual specification that both models use, here it is.

I don't need to go into any more detail than Carol did and only to describe that this specification is quite commonly used for the same type of research question. So one thing to note—and this is slightly different from others, but not in any way new—is that we apply a difference in different specifications in both the cases in both reports. So let's think about what that is.

Let's say we were to focus on homes within a half mile of where turbines were and we wanted to measure that treatment effect. Well, one thing we could do is compare the home prices on average near the turbine to those that were further away from the turbines. That's the first difference in the different specification.

And of course, we're controlling for a variety of different home and site and environmental and market conditions as well. But after controlling for those things, we look at whether there's a difference between homes that are close to turbines and those that are further away. That's the first difference. And then

separately, we need to account for that difference that existed prior to the wind facility's announcement.

And that's the second difference. So with those combined, you can net out a price difference that occurred in the post construction period after accounting for differences that might have existed prior to the wind facility's construction. So, as I mentioned, there are a lot of similarities to the report—they're not identical. They both use hypertonic pricing model and employ the difference in different specification.

They focus on transactions very close to the turbines within a half mile—or between a half and one mile. They investigate these post-announcement, pre-construction impacts as well as post-construction impacts. And they both—both reports also employ a suite of robustness models. And this sort of approach will allow for the fact that a certain set of assumption on views for any model can be challenged.

And so it's quite useful academically to relax some of those assumptions or change them and estimate a different model slightly and see whether the results are robust for that change. If they are robust, then they can have greater confidence in the overall set of results. Now the US core project also includes a spatial air model which is one way of dealing with one aspect of the spatial relationship that prices have. There's another way to do it which is how the Massachusetts project approached the work.

As Carol mentioned, it's important to quantify a variety of amenities and dis-amenities. In the US project, we did that somewhat broadly by including a micro-spatial location variable. But in the Massachusetts product, we not only include a micro-spatial variable, but also measured distinctly eight other amenity and dis-amenity variables not only to control for those, but also to

explore whether there were evident price differences for those various amenities and dis-amenities in the same sample space that we are measuring the impacts from turbines.

Now, both reports have similar but not identical research questions. And the basic ones are turbines located in areas that are already diminished in price? Is there a pre-announcement effect basically? Are there post-announcement pre-construction effects and are there post-construction effects? Both reports (unintelligible).

And as I mentioned are these results robust across a variety of specifications? US report as I mentioned also looks at whether the spatial model impacts results. And then the Massachusetts report looks at those amenities—amenity variables as well it looks at whether there's evidence that less home transactions occur near operating turbines. Some of the folks on the call might recognize that there's a claim that per home, near wind facilities simply do not sell.

So how can you actually gain statistical confidence in them? And so we can actually look at that in a statistical way and determine whether that claim is accurate. And that's what the Massachusetts project does as well. So I can turn to some of the results now, first in the US study and I'll turn it back over to Carol for the Massachusetts study.

So for the US study, the research is listed on the left included myself and a number of other folks all much more qualified than I am but we put together a great team. We looked at 50,000 transactions around the US in nine states around 67 wind facilities. We collected—this doesn't look like this is the updated presentation. So we collected 104 post-construction transactions inside of a half mile with I guess around 370 inside of a mile.

And we focused the work on the rural settings of wind facilities around the US where there are large wind facilities—often any more than 50 turbines in those facilities. And as I mentioned, we tested a spatial air model. Data that were collected for this report is comprised of three broad tests -- wind turbine data, real estate data, and census data which are all described in detail in the report so I won't go further here.

As I mentioned, the US report studied a generally large facilities, but those also encompassed a wide range of facility sizes and turbine types. The most turbines were over one-and-a-half Megawatts in size, name plate capacity and larger than 380 feet in total height but ranged all the way up 476 feet. And most facilities had more than 30 turbines—some as many as 150 turbines. So obviously this covered a broad set of possible wind facilities.

So how did the model perform? In general, it performed quite well considering the broad data set across the US and across time with an adjusted r-squared of .64 to 67 depending on the model specifications. The various controlling characteristics such as the home and sites and time variables and micro-spatial effects all performed as expected, often being highly statistically significant and depending on the particular wind facility..

So to talk about the specific variables of interest, we're looking at first the pre-announcement effect and did we find whether we looked at the base model or the spatial air model a pre-announcement difference in home prices near where wind facilities were ultimately located And those same transactions that occurred further away from where those were located but in the same period. We found price differences that were positive but the end (unintelligible) is not statistically significant. And as Carol mentioned, that means that we can't identify a difference in price that we are confident is not there by chance.

So the best we can say from a statistical point of view is we cannot—we did not find evidence of a difference in price there. So in the post-announcement pre-construction period where we think that there's possibility for actually larger negative effect than in the post-construction period because the actual wind facility is very tough to quantify. And the theory says that maybe the impacts would be slightly larger and more negative during this period than they would be in any other period.

We find relatively large and negatively impacts. Again, these are not statistically significant. So although they look quite large—as much as -8.1% in the spatial air model that are not statistically significantly difference. And so we cannot say with confidence that that is not due by chance. But you will notice that these are more negative and slightly larger than these next set of figures which are those that occurred in the post-construction and mostly operation periods.

These are still negative but not statistically significant and a little less negative than the previous set of results I showed you for the post-announcement pre-construction period. Again, these are not statistically significant, so we can't say that we found evidence of an impact. So I mentioned that both models look at a set of—a suite of robustness models here. The results from those robustness models compared to just those set of (unintelligible) I showed you on the last slide—the post-construction and operation period.

And we find that—and I don't describe the robustness models except to numbers in 1 through 5 in any detail on this slide, but obviously they're discussed in great detail in the report. But the point of this slide is to show that regardless of model specification, we find that the impacts in a post-construction period are always non-statistically significant and fall within a

relatively narrow band. From the low, it's -5.6 for the spatial air model to as high as positive 1.3 in the fifth robustness model.

This gives us a sense that our results are likely to fall within that band as well and give us more confidence that the results are—or the claims that we've made that we can't find evidence of an impact. So in conclusion, we looked at 52,000 transactions—a little more than that -- 375 that were in a mile. And the results don't seem to support the claim that wind turbines affect nearby wind property values. In other words, we don't find evidence of an effect either in the pre-announcement or post-construction period—excuse me, pre-announcement or post-announcement, pre-construction or post-construction periods.

So with that, I'll turn it back over to Carol.

Carol Atkinson-Palombo: Great; thank you Ben. So I'm not going to talk about the Massachusetts study. So some of the unique features of this study are that we used a large amount of data—we had 312,677 total sales. And there were around 26 facilities. So in comparison to the number of post-construction sales that Ben had mentioned for his report where the—the study area was relatively rural, we had 1,503 transactions that occurred within a mile of where turbines were eventually built.

So this is a function of the fact that we're looking at much more urban settings than in the larger US study and the mostly small facilities. And one of the other characteristics of our study here is that it's the first one to test wind turbines effects alongside other environmental amenities and dis-amenities. So we used four different sets of data—some of them are slightly different from the sources that Ben showed you for the US report. We used wind turbine data

from Mass (unintelligible) real estate data, census data and amenity and dis-amenity data that we got from Mass GIS.

So here is a table showing all of the turbines that we analyzed for the Massachusetts study. So I just want to point out these are not all of the turbines that currently exist in Massachusetts but we picked out those turbines that were over 600 Kilowatts that were fully operational by November 2012. So one thing that is quite evident, if you look towards the right-hand column of this slide, there are Xs to indicate the core location of amenity and dis-amenity characteristics.

So as we mentioned in our report and as I will discuss in more detail later, many of these turbines are core located with other potential dis-amenities. So this includes waste water and water treatment plants, landfills, and industrial sites. So just some main points. We included 26 different projects that were—that comprised 41 turbines in total. Most facilities are just one or two turbines and we had turbine capacities of between 600 Kilowatts and 1.8 Megawatts for an average capacity of 1.4 Megawatts.

And we had quite a variation in blade to tip height, going from 87 to 126 meters for an average of 110 meters. So I had mentioned earlier, one of our unique contributions in this particular study is that we examined the effects of wind turbines in relatively urbanized areas with population densities that have not been studied before in the United States. This next map shows how the transactions are distributed across the study area.

So these dark blue crosses represent the turbines. The light green dots represent transactions within five miles of the nearest turbine. And the green dots show the location of transactions between five and ten miles. So we

collected and analyzed every transaction in the housing market that took place within ten miles of a turbine.

We included in our base model those transactions that occurred up to five miles as our control group. But similar to what Ben had done in the US study, we also conducted a series of robustness tests to identify whether the way that we had sorted some of the data had an impact on the outcomes. So we had a total of 312,677 single-family transactions that were conducted at arm's length and had—there were 122,000 of those that occurred within five miles. So as I've mentioned before, in order to control for potentially competing effects and to examine impacts from environmental factors using the same data set, we collected a suite of variables on amenities and dis-amenities.

And this map here shows the various amenities and dis-amenities. And you can see that it's quite a complex landscape. So again, the blue crosses represent the turbines. And we have the brown squares to represent landfills, the green lines, the transmission lines—high-voltage transmission lines, the black lines are highways, the gold holes are beaches, and the red circles with - the red icons are prisons. So that's quite a lot of amenities and dis-amenities across the study area.

But quite importantly, we couldn't get good data on the waste water treatment plants. And so the—even though we know some of our turbines are located there, we know that that is missing from our model. So I just want to move straight into the results. So we've got a lot of information on this slide.

The main thing to focus on is the adjusted r-squared, which will tell us how well the data fits the model is quite high at 0.80. So it's a well-fitting model. And one of the other things to do is to look at the coefficients of control variables just to make sure that the model makes sense intuitively. So just to

provide you with an example in the final row of this table here, we can see baths.

So that represents the number of bathrooms. And if we look across the columns we can see that—across the—that represents the price of that variable across the various wind facility development periods. We can see that the presence of an additional bathroom adds about six to eleven percent to the price of a house. So the takeaway is that when we look at these coefficients, we can see that the models performed as expected in terms of the magnitude and direction of the individual coefficients.

So what we wanted to know is to look at the amenity and dis-amenity variables that we have included in our model as well. So this is the various ones for which we had data. So what we can see here is that in the various wind facility development periods, the coefficients for the amenities and dis-amenities that we had measured and included in our model were fairly consistent and highly statistically significant. So if we look here at the first row which is beach site and retreat—so that is a binary variable that is one, if a property is within 500 feet of a beach.

So that was what we determined would represent a beach (unintelligible) property and zero otherwise. So we would imagine that that coefficient—the value of that coefficient would be quite high. And indeed it is. It ranges between 20.8% and 30.4% across the wind facility development periods.

And those three asterisks after the numbers indicate a high—a very high level of statistical significance. So if we move now and look at the final line for that (unintelligible) half, and that is a binary variable that describes whether or not a property is located within a half a mile of a landfill. We can see that it's not statistically significant in three of the periods. But the—in one of the periods,

it is statistically—highly statistically significant and it generates a discount of about 12% on a property.

And then if we move up to the line above that, we can see that being within 500 feet of a major road will produce a consistent and highly statistically significant negative impact in the order of two to three percent. So this is very consistent with some of that previous literature that I had pointed out earlier. So what this indicates to us is that buyers and sellers in this data set and the way that we've modeled these transactions care about the environment that's surrounding the home and placed those concerned into the value of the home.

And this gives us a lot of confidence that the model is picking up geographic variations in locations so that it's sort of very spatially-sensitive. So we've move now on to talking about the main findings with respect to the treatment—which is the construction of a wind turbine during the various facility development periods. So as Ben had mentioned earlier, one thing that we wanted to do was to test if there was a pre-existing difference in the price houses where turbines eventually ended up being located.

And this is important to test for because if you're going to do a difference in difference calculation which is what we needed to identify the net effect, you need to take any pre-existing price differential—either positive or negative—into consideration. So if we look at this table, the variable that we have the coefficients shown here is half-mile. So that is a binary variable that is one, if a transaction is within half a mile of a wind turbine and it's zero otherwise.

And this first column here of the results is—that says prior announcement—shows a coefficient of -5.1% with three asterisks. And what that means is even before there was any discussion that began about wind turbines, houses that were within half a mile of a wind turbine had a statistically significant price

difference of 5.1% compared to houses that were further away. So the next thing—the next column that we'd like to look at is the post-announcement and pre-construction column which is the second-to-last on the right-hand side here.

So we can see that the value associated with being within half a mile of a wind turbine in this time period is -7.4% and it's again highly statistically significant. So the net difference between 7.4 and 5.1 which was the pre-existing is -2.3%. So we can say—we would say that the house prices dipped by 2.3%. But if I pointed here to the statistical significance for that—for the actual difference, we did—we can see that the—this is not statistically significant.

What that .264 means is that there's a 26% chance that that statistical difference happens by random chance which is not sufficiently sort of tight in its scope for us to draw any strong findings from. So if we move now to the final column on the right-hand side which is the post-construction, we can see that the house prices—or the price of those houses that are located within half a mile of a wind turbine are 4.6% lower than houses that are located outside of a half mile and up to five miles. But again, we can see that this difference is not statistically significantly different.

So this is—this chart just shows a summary of our findings. We can see that our model is consistently picking up the effects of amenities and dis-amenities. So homebuyers and sellers consistently price the proximity to a beach, a highway, or a major road into the negotiated selling price for homes. So for the dis-amenities here which are located on the left-hand side, we can see that landfills, transmission lines, and highways all register a negative effect in our model—even major roads.

If we look at the amenities, we can see that beaches and beach front properties carry a significant premium. In contrast, we can see operating turbines, the net effect of a turbine being built on the landscape is 0.5% but the green color of the bar indicates it's not a statistically significant impact. I just want to move now to talk about one of the research questions that we'd ask in this particular study which was a little bit different to the one Ben had indicated in—for his US report which was to check whether there were any statistically significant differences in the transaction rates of properties in the different time periods.

And this was undertaken to address concerns or to verify comments that people had made that some of the impacts of wind turbines weren't evident in the data because the house transaction rate was lower. So we conducted a statistical test to see if there was any difference in the transaction rates across the different time periods. So we can see them highlighted here across the columns and we tested it for a various—a set of various distances here.

And we concluded that there was no statistically significant difference in the transaction rates. So just to summarize the conclusions of this Massachusetts report, our results did not support the claim that wind turbines affect nearby home prices. And what we were quite confident about is that the study did find effect from a variety of negative features as well as positive features. We had the—when I had indicated earlier that we had a confidence interval of .26% associated with the post-announcement pre-construction impact, this is called an announcement or an anticipation effect in the literature.

And we did have very weak evidence there that suggests that the announcement of the wind facilities had an adverse impact on home prices. It wasn't statistically significant but it's extremely weakly—it's weakly evident there that there could potentially be a little bit of anticipation effect. As Ben mentioned earlier, this was—this is a point in the project that is associated

with the greatest level of uncertainty. So overall, the analysis did not find any impact on the rate of home sales near wind turbines.

So our overall conclusions are across a broad (unintelligible) of those facilities and homes, we don't find any evidence of an effect near operating turbines. So the main thing to note here is that these results did not imply that no effects exist and they can't describe impacts on individual homes. But instead, they imply that the impacts that do exist are either too small or too sporadic to be discovered in this sample using this very fine methodology that we have used for this analysis.

The results from turbines seem to align with expected effects given findings from other amenity and dis-amenity studies which are relatively small. And so again, just to recap on that last point, there is some evidence that impacts might exist in the post-announcement pre-construction period when buyers and sellers cannot actually assess the risks of projects that are coming on-stream. So with that, I'd like to thank you for listening and Ben and I would be happy to answer questions about the study. Thank you.

Ian Baring-Gould: Great. Thank you both Ben and Carol for your presentations. Just to remind everybody that the way you ask questions is go up to the top of your screen, hit the Q&A button and there you can type in questions to ask. We do have a few questions that are out there. The first one from (Alex Dipilus), who determines the stigmas? In other words, are there standard categories of stigmas or are they determined through surveys or something of that nature?

Ben Hoen: I'll take a...

Ian Baring-Gould: (Unintelligible).

Ben Hoen: Yep, I'll take a stab at that one. I'm assuming (Alex) you're referring to the three stigmas that were mentioned at the beginning of the presentation -- the area stigma, scenic vista stigma, and nuisance stigma. These are theoretical stigmas. They weren't collected via organized survey. They were theorized originally for the work that we published in 2009 and have done—I think a decent job of trying to frame the research questions in which this research fits.

So there isn't empirical basis, let's say, for that except to say there's a nuisance stigma which is this idea that homes very close to amenities or dis-amenities would be impacted is used elsewhere in the literature. So in that case, we're just borrowing from other researchers.

Ian Baring-Gould: Great. Thank you. Another question from (Richard Snaders), I believe. And this is regards to a specific project. So I'm not sure if you'll be able to answer those questions. But how many lawsuits similar as to that affect the Hard Scrabble Wind Project in New York have been filed? And then how many adjustments did they—and with what findings are the property values damaged from wind farms?

So to a degree, expanding the question a little bit more potentially is, is the studies you have done indicate that at least statistically speaking we find now evidence? But can you point to lawsuits or other things that have made awards—they kind of put in legal precedence regardless of what the scientific evidence has indicated?

Ben Hoen: (Unintelligible).

Carol Atkinson-Palombo: (Unitnelligible).

Ben Hoen: Go ahead, Carol.

Carol Atkinson-Palombo: Oh, I would—I just wanted to point out that we have not looked at lawsuits in relation to any specific wind facilities. So we're not—this is sort of beyond the scope of our study. And I think I've just mentioned in general, we do have very specific criteria in sort of certainly the Massachusetts study. And it's quite difficult to extrapolate the findings from one study to another case study location because there are so many things that vary.

So you can get a little bit of an estimate, but I think you'd have to go and do a similar study to determine the conditions and the empirical impact that wind facilities may have had in any particular incidence.

Ian Baring-Gould: Great. Very, very good points Carol. Ben, do you know of any kind of litigation even from a broad perspective on this issue?

Ben Hoen: I'm aware of an—a—there's—I'm thinking of the wrong—the term here.- challenging the appraisal of—or the assessment of a property in Canada as part of the Wolf Island wind facility. And in that case, there a number of experts that provided evidence to the various parties. And in that case, the assessment review board ruled that there didn't appear to be evidence of a difference in home price, and therefore did not award a lower assessment for that home.

So I'm aware of that one. I feel like there are others out there that I'm aware of. But I definitely have not seen a lawsuit that tried to bring this issue that has been adjudicated. I'm only familiar with the things involving the assessments of homes. So they might be a little different in the minds of the questioner.

So maybe that provides some context.

Ian Baring-Gould: Great. Thank you. A quick question to both of you from (Connie Grammar). How do we get copies of your studies? And I think she asked specifically about your—yours Carol—but for both of you, could you give a web site or at least directions on how we can find your studies?

Ben Hoen: Yes, both of these are available on the (unintelligible)-Berkley Lab site. So I think the easiest would be if anyone on the phone wanted to Google Ben Hoen LBNL, you'll come to my page. And below my name are listed the various studies that I've participated in and so both of those studies are listed there. As well, Ian, would you—are expecting to list us somewhere on a site related to this Webinar?

Ian Baring-Gould: Yes. Yes, I mean we certainly will. We'll—we have the papers. We've done news articles without a paper so they're accessible through the Stakeholder Engagement and Outreach web page. And additionally, as with the Webinars, this Webinar has been recorded and will be made available on the web site as well for more people to review. One last question—so, we're a little bit over. But if people still have questions, please don't hesitate to submit them.

But one from (Elizabeth Hardball) and this is in relation to a response. And she quotes a critic of the studies and so wanted to get one or both of your views on this. "In Hoen's latest study"—and this is a quote not from (Elizabeth) but I'm assuming she's taking it from someplace else—"In Hoen's latest study, he compares property sales transactions within five miles of turbines for single-family homes that are priced from as low as 40,000 to as high as 2.5 million. By averaging these desperate home characteristics but leaving only one difference—the difference with turbines, Hoen's claims this study found no evidence that the turbines negatively impacted property values. No other state appraiser would work with such widely varying data".

How would you respond to that, Ben or Carol?

Ben Hoen: Sure. So I'll take a stab at this Carol and you're welcome just add to it. I have a feeling I know where this quote comes from. It appears that who wrote this has not actually understood what the methodology is. So they're confused that we're just simply looking at home prices on average, meaning just the home prices, and just comparing close homes to far homes and that's the end of it.

And that of course leaves out the entire bit of discussion we had on methodology as regards to that model and how it controls a variety of different characteristics about the home and the neighborhood and the amenities and dis-amenities and of course, time as well. It also discounts the entire literature on this kind of research which looks at the property value impacts from a variety of amenities and dis-amenities. But—and I should point out as well that a appraiser—who is also a professor and serves on the Standards Board for the Appraisal Institute reviewed the work in Massachusetts and was a participating author in the US were.

As well, a number of other academics reviewed the work. As Carol mentioned, this is the standard kind of research that is done for this area. And that's why that's in the academic literature. It is often not...

Ian Baring-Gould: Okay so...

Ben Hoen: Okay, then I'll stop there.

Ian Baring-Gould: No, no, no. So just for when—I mean, a number of the people on the line could certainly be at a meeting and they're talking about your study and a person could stand up and throw this quote out saying I understand it. You can't do this study or the study's invalid. And so the kind of response to it is

really that it actually is taken into account because it is one of the variables that are used. So you are not averaging home values, you're looking at a range of home values.

And the home values are actually compared to other home values of similar prices and it's part of the methodology that is commonly used in these types of studies and has been peer-reviewed by assessors and things of that nature. Would that be a kind of a pretty accurate response?

Ben Hoen: Yes, and I can even now think about it—even a shorter response which is that we are looking for a relationship between changes in price and any one of the many variables in our model. So we're looking at differences in changes of price for larger homes of more square feet and those—as compared to those of smaller square feet. And we're—so not only are we comparing price differences across these price variables, but we're comparing price differences across this one additional variable which is whether homes are close to turbines or not.

And so using that exact same methodology to measure price differences related to bathrooms and the size of the home and the number of acres as it does for these other characteristics. So it takes—it allows for difference in overall home prices. And in fact, it requires differences in overall home prices because it's looking for difference in home prices across these various variables. So...

Ian Baring-Gould: Great; perfect.

Ben Hoen: I...

Ian Baring-Gould: No, no, that's fine.

Ben Hoen: I hope so. And I'd be glad to correspond with any of these people that are on the call in more detail. And I'm sure Carol would too.

Carol Atkinson-Palombo: Certainly.

Ben Hoen: It's tough to answer questions succinctly.

Carol Atkinson-Palombo: Yes.

Ian Baring-Gould: Great. Thank you, thank you. One last question, and we're almost ten past so I know people have to hop off. This is from (Owen Grant). What is the (unintelligible) drop in average price for any individual project you've studied?

Ben Hoen: Yes, so that's exactly what we don't have—is we don't have studies—we don't have price differences for any individual projects or any individual homes or looking at averages across the set of facilities and—by the way, hi (Owen). So I'm sorry I can't help you there on any one project. Carol, do you have anything to add in that (unintelligible).

Carol Atkinson-Palombo: No, I think it was just to reinforce this idea that you need a lot of observations in order to test for statistical significance. So we did try and break down the data into different sub-sets. And—but just it would leave us with so few observations, we couldn't do a statistically significant robust analysis which is—it's sort of one of the tradeoffs between looking at a very few observations and a large data set.

Ian Baring-Gould: Great. Thank you. So those are all the questions we have. As I said the—this presentation is going to be up there in about a weak for people to take a look

at. And then clearly Carol and Ben are available to answer questions that anybody might have. So again, really want to thank Carol Atkinson-Palombo—try a second chance at your name—and then of course Ben Hoen for all of the work in this area and then coming on to this presentation to come and talk to us.

We have—just in the last few seconds here, the Webinars happen every third Wednesday at 3 o'clock Eastern. We have two of them coming up. The next one is Introduction into Class 3 Wind Turbines. So these are the new, larger wind turbines that are just starting to be deployed here in the United States as well as looking at how—what the impacts of this is going to be from a where you can deploy turbines economically. And then how some of those impacts might take effect in looking at specific parts of the country.

So this should be a good combination of technology as well as how this technology is changing the market. And then in May we're going to be talking about the farm bill. So it passed just recently. People are getting an understanding of what its impacts are really going to be.

And so we'll have a number of people coming to speak about the current farm bill and then how organizations who are interested in using the farm bill to promote projects can start engaging in that. So without further ado, again, thanks to both of our speakers. And as always, thanks to the Department of Energy that funds these—the workshop series. If you have any questions, comments, or would like to suggest other Webinar topics, please don't hesitate to contact, (Bre), (Susanna), or myself.

We're more than happy to follow-up with any of you. Thanks again to Carol and Ben for their time today and for all of you joining us. Have a wonderful

start of spring here and look forward to seeing all of you on next month's Webinar. Thanks and have a great day.

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

END