Jimmy Jones: We have Gail Mosey and Eric Lantz. Gail Mosey is a member of the Market and Policy Impact Analysis Group at the National Renewable Energy Laboratory. She works primarily with economic impact with development issues associated with renewable energy and energy efficiency. She also works closely with the Environment Protection Agency to identify and evaluate high potential sites for renewable energy and energy efficiency.

Eric Lantz is also a member of the Policy Analysis Group at NREL, and he works with the issue of state policy in expanding markets for renewable energy. He concentrates also on evaluating the economic development impacts of wind power and other generation technology.

Gail Mosey: Hi. This is Gail Mosey, and Eric and I are going to talk to you today about estimated economic development impacts from renewable energy. The questions that we would like to address, during this presentation, are how are economic development impacts measured? NREL's approach to economic development impacts? And we'll also describe the jobs and economic development impact model otherwise known as JEDI and run through some screenshots and how to run the model so that you can be comfortable with the model once we finish this presentation.

We'll start out with definitions and background, and then we'll explain how to access and use the JEDI model. We'll go from there toward interpretation of the results and describe some highlights and examples from recent NREL research where we used JEDI and also kind of review some challenges to modeling renewables.

Eric and I, as I mentioned, are both going to present today. So, with that, I'll hand it over to Eric for the next few slides.

Eric Lantz: Okay. Thanks, Gail. The first item I'm going to show you guys here will deal with kind of general methodology that's used to measure economic development impacts. This is a basic methodology that underlies the JEDI model and most standard economic development impact analysis tools.

It's referred to as the input output methodology, and the way it works is that aggregated economic data, from a variety of sources including the Bureau of Economic Analysis, the Bureau of Labor

and Statistics to name just two of them, are used to recreate or map all the inter-industry transactions that are happening in the economy over the course of a year.

Essentially, what this does is it creates a static snapshot of the economy that maps all the interrelationships between industries during the year of the analysis. Then once we have this map of the economy, we can go in and measure how much spending in one industry affects spending in other industries.

So you can see how a dollar invested in one place essentially cycles through the business that invests that dollar and then the supply chain that it's related to.

When we go in and measure how the impacts are – how the – all the inter-industry transactions are occurring in the actual businesses in their supply chain. What we're doing there is measuring multiplier relationships between these specific industries, and really what the multipliers allow is to do is actually see how new investments are going to impact the industry and the broader economy.

So, here at NREL, we don't actually compile this multiplier data? We purchase this from a third party who aggregates the data and derives all the industry specific multipliers, but there's a few different ways of getting at these multipliers. We choose one that's widely recognized throughout the industry, and then these multipliers go into what they call input output models.

And you can see some examples of that here on the slide. A commonly known one is IMPLAN. There's also a number of others, and then there's the JEDI model which actually relies on IMPLAN derived multipliers. So IMPLAN actually offers a software tool and derives multipliers, and we use IMPLAN multiplier data.

Now, a few things to keep in mind with regard to this type of analysis is that, in their boast basic form, the analyses are static and linear. So you have a single snapshot of the economy, and it reflects the actual year that the multipliers are derived from.

Fortunately, for us, broad industry-wide and economy-wide changes occur relatively slowly. So this isn't a huge issue, but it is something that you want to be aware of. Using current multipliers is generally a good practice.

In addition, these types of models are generally linear. So it doesn't matter if you invest $100,000.00 or $100 million. You're using the same multipliers. So, again, in the short term, this isn't likely to be a significant factor on your results, but over the long term, as industries evolve and gain efficiencies, business activity increase, especially if it increases dramatically to the extent that economies of scale come into play. One needs to be aware of this dynamic also.

Finally, two other notes is that, when you're running an economic impacts analysis for a specific project, there's no – it's kind of presumed that the project or the amount of investment you're going to be making is worthwhile or economically viable – an economically viable investment.

Basically, your input output model – the JEDI model in this case – is just going to report the impact from the investment with the presumption that it's a worthwhile investment. In addition, the results for the JEDI model and for most standard input output analyses are gross impact.

In their most basic forms, these models don't do comparisons. They're not involved with trying to determine whether investment is better in one industry versus another industry. Basically, you're just looking at the impact from the investment in the specific industry that you already know there's going to be a large investment.

So economic development impacts are generally measured at three levels. In standard parlance, what you might have heard commonly is direct, indirect and induced impact. However, if you're really intimately familiar with input output analyses, what's defined as a indirect or induced impact really kind of depends on the perspective of the analyst.

You can design a specific analysis so that direct impact, in one case, might be very different from direct impact in another case, and that's really up to the individual analyst to determine. So you have to use a little bit of care in interpreting and understanding what's included with direct, indirect and induced impacts.

After a number of years of years of relying on these traditional terms which, as I noted, are not defined by certain – any standard definition, user feedback, in our own experiences, presenting the results of various audiences, made us here at NREL start to think, "Well, there must be – what can we do to make these results more

intuitive to our audience?"

And so, recently, we decided to redefine how we report our results, and although this has created some transition related challenges by this decision, we really believe it's for the better and makes our results more intuitively understood.

Just a few notes on that transition. At this point, all the models are updated and consistent between models. If you go to the website and download those, which you'll learn a little bit more about later on, you can see that. If you are – or have used some of the older models, you may notice some differences in how the results are broken down, but you shouldn't see a change in the total impacts as a result of this effort.

We're still working on updating some of the supporting literature and descriptive documents on the website and so on, but the models are up and ready to go with these new definitions. So with that in mind, the terminology we're now using is kind of the first tier impact or the onsite labor and professional services.

This really focuses just on what's happening at the project site, and it's specifically focused on the labor related to that, and I'll get into that in a little more detail in just a second.

The next is that we have the turbine production and supply chain impact or, more generically, the equipment product and supply chain impacts. This is where all your manufacturing and the whole supply chain, as well as accountants and bankers and so forth are factored into the equation, and then both of those feed into the induced impacts. Essentially, when you increase employment as a result of onsite and turbine and supply chain impacts, then you can increase income.

So just a little bit more detail on those tiers of economic impact. So onsite labor and professional services, as I mentioned, really focuses on that labor that's happening onsite. It also includes management, legal, engineering support for the project and basic project management, but as I noted before, there's no material or equipment purchases that are concentrated here. So it's not entirely labor, but it's mostly labor.

Second tier, again, is equipment production and supply chain impacts. Again, this is where all of your manufacturing occurs. It also – it includes finance, banking and accounting, some of those industries that support project developers, and it includes

components all the way – the whole tier of the supply chain from – in the case of the wind industry, this would be blades down to the nuts and bolts that are used to assemble this foundation and ____.

Again, many of these examples are actually derived from the wind industry. This is the model that NREL has put to use to the greatest extent, and so some of the results, that we will discuss later on – some of these examples are a little bit wind-centric. However, we do have a full suite of JEDI tools and –
So the – and the general descriptions also apply to the other tools. However, obviously, a solar PV manufacture – or the solar TSP model will not include wind turbine blades or the like.

So, finally, our last category of impact of the induced jobs, services and materials. Essentially, when you have economic activity generated at the onsite and in the supply chain levels, you're going to increase income. You're going to increase employment and disposable income, and that results in additional spending, kind of another cycle in that initial investment, and that's captured in the induced impact. You can see it's for general just generic goods and services at retailers, maybe home care, buying a new car, so on and so forth.

So now you've seen a little bit about kind of the methodology for measuring economic impacts and how we here at NREL categorize specific economic impacts. There are a few challenges that relate specifically to renewables, and that – this is really where the JEDI tool and suite of models comes into play.

In conventional multiplier datasets, including those that we use here at NREL, the economy is broken down into specific industries. In the specific dataset that we use, there's 508 individual industries that essentially describe the whole economy, and if the industry you're interested in looking at the economic impact from is one of those individual 509 industries, then your analysis is pretty straightforward.

However, for renewable energy technologies, because they're relatively new, they're not one – and it's relatively small part of the entire economy, they're not one of those individual 500 industries that are broken out in this data.

So what this means is that an analyst, whether that's you or anyone else, would need to go through each of those industries and determine which of these industries are involved in the development of a renewable energy project. And this requires a

highly detailed knowledge of line item costs breakdowns for projects and knowledge of all the industries that contribute to a given project.

What the – and really, this is where the JEDI suite comes in. Essentially, what we've done is done all of that for you. So what we do is provide you with a line item cost breakdown and identify – we've already identified specific industries and pulled those existing multipliers out of the existing datasets. So we identify the industries and the expenditures that are associated with that specific industry, and then we apply the multipliers that are in the existing dataset.

So, at the most basic level, really all you need to do is enter in the project size, and you can get a rough estimate of economic development impact from a renewable energy project, the JEDI model. That said, the more project specific data that you have, the better off your results are going to be.

And with that, I believe I'll turn it back over to Gail.

Gail Mosey: Okay. Thanks, Eric. So in terms of JEDI model availability and models that are available for download, as Eric mentioned, there's more than just the JEDI wind. There's also concentrating solar power, dry-mill corn ethanol, lignocellulosic ethanol, natural gas combine cycle and solarized coal. These are all available on the site which I'll show you the link to on the next slide.

JEDI models that are under development are JEDI _____ tag. That includes a residential new and residential retrofit component, a small and large commercial and a utility scale, and the release of JEDI PV is soon. It should be available soon. We're just putting some finishing touches on it, and then we're in the beginning stages of JEDI hydro. We're working on a conventional and a marine and hydrokinetic version.

So the JEDI models are available for download at the link at the bottom of the slide. You can also just Google ENREL JEDI, and the link will pop up. So it's easy to find the page. The models are very easy to download. They're Excel based format, and all that's required to download them is an email address. And you just need to provide us some additional contact information, and then an agreement with the – user's agreement that's provided in the download page.

So this is the screenshot for the start page for JEDI wind. It's got some high level instructions on running the model. Essentially, all you need to do from here is press start from this page to being your model run. The model contains multipliers for analysis at the state level, but there are county level multipliers available, and the analysis can potentially be customized if that better suits your needs.

This screenshot of JEDI Wind shows the basic use input. So all you need to input to run an analysis is the state where the project will be located, the start year of construction and the project size, and at this point, once you've entered those details, you can press the go to summary impact button and use the default data provided by JEDI, or you can choose no here and input your own project specific data if you have it available.

Any cell in white indicates a place where you can input your own data, and at any time after you played with the inputs a little bit and decide you want to get back to your default values, you can click on the gray button, restore default values, to reverse any changes back to those original values.

So this screen shot shows the area further down from the screen in the last slide where you might input project specific data for materials, labor and other costs during the construction period and operating years. There's also a line – or a cell for each line item where you can modify the local share percentage. Local share is an indication of how much of the resources is coming from instate resources.

There's also an area below this screen in the spreadsheet where you can change your financing interest rate, tax rates, wage rates and percentage of employer payroll overhead. I don't have a screenshot of that, but essentially, once you download JEDI, if you were to scroll down from this point, you would see those input areas.

So this slide shows the results summary page from running JEDI. JEDI estimates jobs, earnings and output for the construction period and during operating years for the categories of project development and onsite labor, supply chain impacts and induced impacts. These categories are described earlier in the presentation. I'll go ahead and discuss, in more detail, the jobs, earnings and output categories in this next slide.

So in terms of interpreting the results for jobs, earnings and outputs, JEDI reports jobs as fulltime equivalents to FTE or equivalent to 2,080 units. In terms of construction during construction periods, projects may take more or less than a year to construct. In these cases, essentially, what you can do is you can adjust the construction results to reflect the impact during the actual period of construction.

So, for instance, if you run your analysis and JEDI reports 100 construction period jobs, you can interpret this to be 25 workers supported for four years or 200 workers supported for six months depending on your construction period. The operation period impacts are also FTEs, but they are annual FTEs. So you can interpret these results as long term jobs or jobs – or annual jobs.

Earnings is very straightforward. They reflect the actual salary required by the laborers, and then output is the sum value of all goods and services provided at each layer of the supply chain. So it's the entire sum of all the value of those goods and services. This is distinct from a metric like gross domestic product, for instance, or gross state product which they reflect only the sum of the value added – so basically, the market value of the final goods and services.

An example of that way that JEDI reports output is, for instance, for a wind turbine, it's the cost of the iron ore plus the cost of the rolled steel plus the cost of the assembly plus the cost of the final project. So the sum value. And again, just to mention that JEDI results are a result of gross economic impact. So gross versus net impact and JEDI does measure in gross impact.

So that might be a good stopping place, Misty, if somebody has some questions regarding all that that we just covered.

Misty Conrad: So how is project size defined? Can we go over that a little bit?

Gail Mosey: So project size is really just based on your specific project requirements.

Misty Conrad: Okay.

Gail Mosey: In many cases, someone will have a specific project size in mind. If they don't have a project size in mind, then JEDI does provide a reasonable project size default value that you can rely upon.

Misty Conrad: Okay.

Eric Lantz: But, in general, it's defined as the name plate capacity of the energy project.

Misty Conrad: Right. So if you add energy storage to, say a large scale system, a large wind farm, is that accounted for in Jedi?

Eric Lantz: For the wind model, there's no way of incorporating a large scale storage into it. If you wanted to do that, you would have to have – you'd have to determine, again, your kind of line item cost for that storage technology. It – but you can't do that with the existing JEDI tool.

Jimmy Jones: Okay. We have a question from John, and it's – he asks – think you addressed this a little bit, "How does JEDI compare to IMPLAN?" And basically, it's based on IMPLAN. So he wanted more detail on are the results the same. Do you get the same basic assumptions, etcetera?

Gail Mosey: Yeah. JEDI essentially uses the IMPLAN multipliers as their base, as the base for the multipliers. JEDI does aggregate the multipliers and combing multipliers from multiple industries into the multiplier for the relevant industries.

If we use every multiplier that IMPLAN provides for every industry, the results would be overwhelming. So JEDI is – the multipliers that JEDI uses are an adaptation or an aggregation, if you will, of the IMPLAN multipliers. You want to add to that, Eric?

Eric Lantz: I think that really covers, I mean, the core of it. Again, yeah. The JEDI model, the underlying data is from IMPLAN, but even within the IMPLAN software, there's a number of ways you could conduct a wind analysis. And if you happen to do it the same way that we've developed the JEDI model, which we feel like is the best way to actually do it, then you would get the same results with the IMPLAN software.

Obviously, if you don't mimic our methodology – our methodology precisely, then you will probably get somewhat different results, but the multipliers are, in theory, the same.

Jimmy Jones: Okay. We have another question from John or from another John. We only have first names one our questions, but he asks, "Can the parameters be customized to fit local electric grades, costs,

etcetera?" Does it customize at that level? Does the JEDI model deal at that level?

Eric Lantz: Well, so the JEDI model – yes, there's a lot of local customization that can occur – and that's really important. Those local share values that Gail was discussing with the _____ are really how you determine the local contribution to a given project.

Now, in terms of electric rates and so forth, the – this is an economic impact analysis of the construction and operation of the project. So it doesn't take into account whether or not the electricity from this facility is expensive or it's cheap.

As I said earlier, the kind of underlying presumption is that the project is financial feasible. It also doesn't necessarily take into account if you have really large renewable energy deployment, and the electricity from those projects is more expensive or more – or is cheaper than – it doesn't take into account the effect on the broader economy from a large scale deployment of renewable energy for better or for worst.

It really is kind of looking at what is the impact from the construction and operations from this project knowing that there's a market for the electricity, and that the project developer or owner is making a rational, financial investment.

Gail Mosey: And something else to keep in mind, I'll add, is that resource – there's some resource consideration that needs to happen in terms of the natural – or the renewable energy resource availability. JEDI assumes adequate resource availability.

So the onus really is on the user to conduct an analysis for a particular technology that makes sense for that area based on resource availability.

Misty Conrad: And Jake is asking when you say CSP, he assumes that you're talking about solar thermal, and I know that same – correct but could we talk a little bit what CSP is really quickly and then also several questions have come in. Is it or will you be looking at solar thermal or hot water heating in the future?

We've got a long list of questions like that. What about geothermal? What about biomass? And of course, I hear these questions all the time. We're doing the best that we can with putting these different models in, but let's start with CSP.

Eric Lantz: So the CSP model really refers to what you would think of as kind of a utility scale concentrating solar power plant. As Misty mentioned, it's not talking about solar thermal in terms of solar water or solar pool heaters or things of that nature.

What the existing model – it really deals with utility scale concentrating solar power plants and, specifically, parabolic troughs plant. So I don't know if, Gail, you want to speak a little bit more into that.

Gail Mosey: That's adding the different technologies to the JEDI models is something that we're always interested in doing and becoming a little bit more specific and making the models as useful as possible in terms of drilling down into those particular technologies.

We've been able to do that fairly successfully with PV, which hasn't quite been released yet but is really close, by getting those more specific technologies and providing them as a dropdown options within the model. Certainly, discussions are on the table for CSP to add technologies. I can't say – I can't give any kind of timeline or make any kind of promises in terms of being under development with those kinds of technologies, but it's something we can consider.

Jimmy Jones: Well, along those lines, Anthony asked, "Does this model – can this model be used to measure energy efficiency impact?" So there you go.

Gail Mosey: That is the million dollar question. That's right. Yeah, that's an excellent question and something that we would really like to make happen with JEDI. We've been talking about energy efficiency as a broad category as really too much for JEDI to take one, but it's entirely possible that we could identify the top ten energy efficiency technologies or the top five, whatever makes the most sense and try to be a little bit more specific.

As you can imagine, different energy efficiency technologies really – you can be talking about completely different industries with the different technologies. So something like a JEDI energy efficiency where we have dropdowns for the different energy efficiency measures would be an ideal way to go, and it's something that we're working on and trying to –

We're not working on the model, but we're working on trying to make it happen.

Misty Conrad: Can we go over, just real quick before we move on because we need to move on, I want everyone to really understand the ease of being able to use this, who it's available to, and I know you've already talked a little bit about you go to this site and you take a look at this and this is how you can drilldown.

So what is exactly available right now that folks can be using? So I've got a couple of questions on can small businesses use this? How readily available? Is it something we have to pay for? What type of multipliers do we have to to pay for it? And those are the different questions I have. So we can just go over that one more time, and then I think we should probably move on.

I know you guys have got a lot of questions on the line. We'll do the best we can to answer all of them.

Gail Mosey: Yeah, absolutely. The JEDI suite is a free set of models that anybody with a computer can download. It – small businesses can use it. State and local officials can use it. Developers can use it. Anybody who has a desire to use JEDI may do so just by following a very simple download process.

And it's something that is an Excel based format. We've made it as user friendly as possible. I think if you download one of the models and you go into – you open the model in Excel and you press the start button, it's all going to fall into place for you

It's going to be very clear how to run the model, very user friendly. We have a – which we'll provide this at the end of the presentation, but we have a support email address where you can email a real live person and ask any questions about running JEDI, and we can certainly try to help you out in that regard. We try to be supportive in any way that we can.

Jimmy Jones: You know, Gail, along those lines, at the end of this presentation, we will leave the TAP Webcast page loaded onto this platform onto this presentation today, and right in the center here, it says, "Link to JEDI." And you can go there and just start downloading.

So right – if you just leave your browser open, at the end of this presentation, you'll see that webpage come up, and you'll be able to start linking right this afternoon.

Gail Mosey: Awesome.

Misty Conrad: Okay. Let's move on.

Gail Mosey: Okay. So Eric is gonna take over from here and discuss more specific JEDI analysis and give you some examples of how you might actually use JEDI and interpret the results.

Eric Lantz: And again, these – many of these results are going to be wind focused, but that's not to diminish the role of the other JEDI models. It's just where we have happened to focus most of our applied research and our use of the JEDI tool. And actually, the wind program here at NREL is actually first to develop a JEDI tool, and then we moved into developing the technology tools.

So this slide here, that you're looking at, is one of the ways that you might see results from a JEDI analysis presented. In this specific example, you're looking at the impact for 1,000 megawatts of wind power built in Illinois, and this is actually – it's a couple of years old. The analysis was completed in 2006, and so we're using some of the more traditional economic impact terminology.

You can see there's the direct, indirect and induced impact, but you can think of that. Here in this slide, we have direct and indirect included together, and that's really because – so that includes the onsite and all the supply chain and manufacturing impact.

And so that's the wind industry and then all those industries that are supporting the wind industry there, and then induced impacts are broken out separately because that's kind of another cycle of investment and recirculation of the dollar.

You can see that the impacts are reported for a construction phase and operations phase separately. Again, often times, you'll see a big boom in activity for a short period of time during construction. Then the operations phase impacts are somewhat smaller, but they remain over the life of the project, and they continue to accrue at those annual rates that are listed there.

I don't want to focus too much on the numbers here. As I mentioned, this analysis is about two years old, and the markets do look a little bit different at this point in time in terms of costs and allocation of cost and so on and so forth. The wind industry has matured somewhat.

But you can see there was nearly, from this estimate, 5,000 FTE jobs they're estimating during construction and roughly 200 jobs

per year during operations. Just kind of a side note, there was a study that was just released in June, I believe it was, from the Center for Renewable Energy at Illinois State University in which they conducted analysis of all the completed projects in Illinois at least roughly 11,000 megawatts of completed wind projects in the state.

In their retrospective analysis, which is in – is different than the results I'm showing you here which are projections, but their – so they're looking at completed projects results – generated results that were roughly ten percent to 30 percent higher on a per megawatt basis that those we estimated in this projection.

Such – these kinds of differences are not necessarily uncommon in these analyses. If you perform very many JEDI modeling runs or if you're familiar with economic impact analysis like this, you'll find that it's somewhat sensitive to the impact you apply.

So if – when we're doing our projection, if we're just off a little bit and it's somewhat different from what actually happens from projects that are completed, it's not uncommon to see a little bit of variability, and we'll talk a little bit – more about that later on.

This slide here, that you're looking at, was taken from an analysis we conducted in – on Nebraska, and it's based on 7,800 megawatts of wind power which happens to be the forecast installed capacity from a Department of Energy report which looked at the technical feasibility of providing 20 percent of the electricity in the U.S. from wind energy by 2030.

And in that report, it forecasts that Nebraska's going to be about 7,800 additional megawatts of wind energy. So this specific set of data shows a few different things. First, what you're looking at, is the construction period impacts only, and you can see that, because the construction period is concentrated between 2010 and 2020, that that's really where the bulk of construction period impacts are concentrated.

As many as 7,000 workers are employed kind of at the peak of construction, and then that drops off as the deployments rates kind of drop off. Now, this concentration there between 2010 and 2020, obviously, that's a modeled result. It's not necessarily the case that all of that will happen during those – really in those years from 2014 to 2018 or so. If the deployment rate is more gradual, then those impacts will be spread out over a longer period of time.

As well, you can see you can do different scenario analyses. We looked here four different scenarios based on the level of local ownership that was involved in the project. Nebraska has some specific policies in place that incentivize local ownership in wind projects, and also, in – at different levels of application of local business services and materials and contractors and manufacturer of equipment and so forth.

Whether that comes from Nebraska or not makes a big difference. You can see some of that there in the construction period impact between our low and high scenarios. It's a – the high scenarios is 75 percent greater than our lowest scenario. So it's pretty significant.

This next slide, that you're looking at, is some recent work that we've done. This is actually retrospective analysis similar to the Illinois work in methodology where we went in and looked at projects that had been completed in community wind projects and then projects that were completed in Colorado and Iowa.

And you can see, on the left side of the chart – actually the left side of the groups of bars, those are the community wind project impacts relative to the absentee or what you might term conventionally developed projects. And you can see, during construction period, it's actually much greater for community wind power projects and then moderately greater during the operations period.

That's actually somewhat in – an interesting result for us. The construction period impacts, in the past, have been projected to be more similar. So that was kind of a surprise for us.

This is another slide where we're looking at results from comparisons of community wind projects to absentee owned wind projects. This focuses on the operations period result. What you're looking at here is a ratio. So, if it's equal – if the bar there lines up with one, that means the impacts are equal between community wind projects and absentee owned projects, and if it's greater than one, then the impacts are greater for community wind projects.

Really, what this kind of shows is that our retrospective analysis wasn't quite as positive as some of the prior projections had been, but it's relatively comparable. In addition, the percentage of local ownership in a project makes all the difference. So, if you have a community wind project or any kind of community power project that only has one percent local ownership versus one that has 40

percent local ownership, that's gonna make a big difference in terms of the economic development impact because far more revenues from that project will be flowing into the community over the life of the project.

You can also use the JEDI tools to make comparisons between specific technology. So, in this case, we looked at wind energy versus coal power in Colorado for energy equivalent facilities – yeah, for energy equivalent wind and coal facilities of a – on the scale of a 500 megawatt coal power plant, and what you see, basically, is that the impacts from the coal power plant are greater if you rely on more than 50 percent instate coal. At least, this is the case for Colorado.

So if your state is a coal producer and they're going to purchase a large proportion greater than 50 percent of their coal from the state where the project is located, then you may have a greater impact for coal power than for wind power.

However, if they do not use coal that's mined in that state – you can see on the far right hand side of the graph – the impact is much lower, Likewise, the more turbines you put in the ground – so, actually, if you have a better wind resource – the 43 percent capacity factor on the far left hand side of the graph there – you are putting few turbines in the ground. You have a smaller investment to your economic development impact are reduced accordingly just because it's a smaller investment in that project.

This last slide of data here shows really the impacts of manufacturing on economic development impacts on economic development from renewable energy. Renewable energy tends to be relatively capital intensive. So if you're not buying your equipment from the state or local area where you're located and you're missing out on a large portion of the potential economic development impacts.

Here we can see that, for the first 1,000 megawatts of wind power that were built in Iowa, they didn't purchase any of their equipment from the state of Iowa. Obviously, at the time, there wasn't really the opportunity to do that. Things have changed in today's economy, but Iowa actually now has a quite robust wind energy supply chain and manufacturing economy.

And so, moving forward, they could eventually purchase as much as 80 percent of new install capacity in Iowa from Iowa built

facilities, and that has a huge impact – nearly six times the impact during that construction period.

So just a couple more notes here. From this data, you can see that our results do vary somewhat. The community wind analysis showed that and so forth, and some of the factors that are – that go into variability are the size and the cost of the project. As I mentioned, if you're putting more turbines in the ground, you're going to have a greater impact than if you're putting fewer turbines in the ground.

Likewise, if the project is more expensive, you're also going to get a greater impact. So, as I mentioned before, the multipliers are linear and static. So whether you invest a small amount in a low cost project – maybe it's built on flat land, doesn't require as much labor as something that's built on more mountainous or ridgeline wind energy project. Those are going to require more labor and result in great impacts.

You also have to consider the size and diversity of the local economy. This is especially true if you're doing county level analyses for which you would actually – if you want to do a county level analysis with the JEDI tool, you do have to purchase the multipliers, and we can arrange that for you. It's a relative nominal fee associated with that, but especially for rural counties, they might not have the resources to contribute a great deal to the development and operations of a project.

And so, in those cases, the investment is going to leave that county much more rapidly that if you're looking at a whole state or a state with a really robust wind construction and manufacturing industry. And that's really kind of the result of the multiplier effect there.

You also have to think about developer preferences and individual developers have their own preferences with regards to contractors they're willing to work with and contractors they're not willing to work with. Some developers may have – may like to use the same companies for all their projects. And so, if those developers – if those contractors come from out of state, then that's going to reduce the impact of your analysis of your project.

Likewise, as I noted before, where the equipment come from – comes from, whether it's wind turbines or solar panels or whatnot, where that equipment comes from is a big part of the economic development picture.

And lastly, then, you have to look at the magnitude and allocation of project revenues. If you have local ownership in a project but that project is not profitable, then that local ownership isn't going to result in increased cash flow to those local communities. Likewise, if the project is owned by individuals or entities that are not located in the state or community where you're interested in assessing the impact, then it doesn't matter if the project's profitable or not as long. As long as it's viable, then those dollars are going to remain in the community, and they won't be generating the economic development impacts on the site there.

So, with that, I'll turn it over to Gail for a little bit of wrap up. Then I think we'll get back to some questions.

Gail Mosey: Yeah. I'd like to take this opportunity to summarize what we've talked about. As we all know and as is evidenced by the participation in this call analyzing jobs and economic impact is an important task even more so in today's economic climate.

We need to keep in mind that economic impact analysis for a project is only one component, however, of an overall task. There are other things to consider besides jobs and economic impact, and JEDI is a high level tool which should be considered on part of the analysis – of a broader analysis.

The JEDI model does provide a user friendly platform to carry out the economic impact analysis. We based it in Excel, made it very easy to download, and hopefully, very friendly to use, so that we could reach the broadest audience possible.

There's a lot of variability in different projects that can affect the economic development to state and local regions. There may be as much as five to ten times difference depending on the type of manufacturing you're speaking about and the different technologies. So Eric kind of went through the challenges to modeling renewables and the things that you need to keep in mind, but the better project specific information that you have, the better the analysis will be.

That we have a saying the better the inputs, the better the outputs. However, JEDI does provide default values for different project sizes and different states and different technologies, and that would allow you, without any project specific data, to get a handle on the economic impact of your project until such time as you were able to develop some more project specific data.

And here's the email address that I referred to earlier on. We can provide answers to general questions. It's JEDI support at NREL dot gov and feel free to email us your questions. We've got the blog in addition to – this email address is separate from the blog associated with the TAP Webcast, and this is an ongoing email address.

What we do with this is we take questions and we try to send them to the right folks who can answer those questions specific to the technologies. So look forward to hearing from you and hope that everybody has the opportunity to download the models and takes a look at them and plays around with them a little bit and finds out how easy they are to use.

Misty Conrad: Thanks, Gail. Eric, the wind that you were talking about, does it also look at offshore wind or is this just land based wind?

Eric Lantz: This is just land based wind.

Misty Conrad: Okay.

Eric Lantz: At this point in time. There had been discussion around developing an offshore wind model, but at the current time, that's not completed.

Misty Conrad: Thank you. Another question: "Does the JEDI model adjust for changing trends?" So looking at newer wind farms, for instance, as an example that has _____ an operating – operation and maintenance associated with it currently compared to past models?

Eric Lantz: There are two things here. There is the ability for the user to go in and adjust the costs input, and that's really what drives the results is what are – how much money is going into each specific industry? So each of those line items costs inputs in the job model allows the user to adjust those to reflect their project, and so you can adjust your own end costs and so on and forth.

Now that said, we do try and keep the wind model as current with the industry as is possible. So, actually, last December, we just released an updated version of the wind model that went through a whole series of updates to those line item cost expenditures, and we did see, actually, some changes and some maturity in the industry that were reflected there.

And so that has – it's caused a little bit of – it's raised some questions because, when you do an analysis with the new model, your numbers look somewhat different than they did with the old model, but that reflects the maturation of the industry and just the simple – yeah, the evolution of the industry.

So we're working to keep on top of that, but for individual projects, you have the information, we certainly endorse you using your project specific information because that will ultimately be what drives the results.

Misty Conrad: And Burt is asking, "Is the code open source for consideration?"

Gail Mosey: Is the code open source –

Misty Conrad: For customization. I can't read Jimmy's handwriting.

Gail Mosey: The model is password protected – mostly, to protect the confidentiality agreement that we have with the IMPLAN multipliers. You can edit the model to the extent that you can change the inputs that are in white cells. You cannot change the coding of the formulas within the model.

Misty Conrad: Another question: "Where do these assumptions in the JEDI tools come from originally and continuing."

Gail Mosey: Yeah. So the cost input assumptions, which I'm assuming you're referring to, is – they come from industry. They come from literature review. In some cases, there's studies out there which are very specific, and we're able to get really strong cost data.

There's also direct connections with folks in the industry where we're able to gather data. In the case of wind, for the update that occurred, the process was to –

Eric Lantz: The wind updates that occurred last December, that was largely based on interviews with industry and project developers. There were a few presentations that – and so those pieces of research that we were able to get a hold of that also focused on those issues, but it was largely taking some of those initial numbers and then discussing that with project developers and industry officials and so on and so forth.

We work closely with a number of industry representatives as well as – in the case of wind, with AWEA – the American Wind Energy Association – and they are often using our model. And so we're

really trying to stay on top of those things and keep it as current with the industry as possible.

Gail Mosey: And, in some cases, the programs, which is how we refer to our technology programs – for instance, biofuels and solar and wind as well – they'll have their own set of cost inputs that we can use and then we can vet with the industry to make sure that we're on the right track with those assumptions.

Jimmy Jones: Okay. Gail and Eric, we have a series of questions that I'm going to summarize from two dealing with the accuracy of the model and how you validated it. So, from Floyd, where – what have you done to verify the accuracy of this model, and Chris asks, "Other than Illinois, has NREL checked to see how the projections of the JEDI model match the actual impact – economic impact that you generate?"

Eric Lantz: So, with regard to the accuracy, kind of take it in two stages here. Really, the easiest measure is those onsite impacts. What's actually happening on the ground. It's much more difficult to go and kind of try and quantify the induced impacts for us as researchers.

But really, the methodology for calculating those induced impacts is well established. This isn't something new that NREL's come up with. This methodology has been in practice for 30 years and dating back, actually, to prior to that. But really, it's been applied widely in the last 30 years for estimating the more kind of manufacturing and induced impacts.

But we do go in and try to validate the – at least those kind of first tier of onsite impacts, and often times, individual county commissioners and so forth, that's really what they're interested in, and we've done a lot – we've really exhausted a lot of energy trying to validate that with what actually happens on the ground at projects.

Obviously, for some of the new technologies, that's more difficult. So we have to rely on the methodology that's been developed and assume that it's robust. We have started to do these retrospective analyses which gives us the opportunity to compare between some of our projections and some of – and completed projects.

When the projects haven't been built yet though , we kind of have to go with what the industry tells us is reasonable for a given project, and sometimes what they tell us is reasonable doesn't

always agree then with what actually happens when they take the steps of actually completing the project.

So that's an issue that – that's a critical issue and one that we're always working on and trying to – we really want these results to be as valid as possible, but it's – the methodology – aside from that, the methodology is a robust methodology that's widely applied in a number of different industries.

Misty Conrad: And it's also widely accepted as well.

Eric Lantz: Yes.

Misty Conrad: For a lot of – it's also widely accepted as well for a lot of governmental agencies which I know leads into Jimmy's next question that we've seen, but I guess, Jimmy, ask that question. I'm getting ahead of myself.

Jimmy Jones: There you go. Well, that's the best lead in I can get, and this is a question from Nazreen Nabia. And we apologize if we get the pronunciation wrong. Is the JEDI model accepted by government agencies that approve funds or guarantee private sector funds for projects undertaken by private parties? Is there any – that's the question.

Gail Mosey: I might know where you're heading with this with the – maybe with the EECBG funding and the block grant applications and proposals that we've got out right now. I would say that the preliminary answer to that is not yet.

We're looking at different ways to assess those impacts and those benefits. JEDI is on the table as one of those methodologies, but I would say, as a definite answer right now, we're just not there yet with JEDI. It's a generally accepted modeling practice and methodology and model for estimating the economic impacts and benefits from the different projects for the associated renewable energy technologies however.

Eric Lantz: And just to add to that, to take one step back from the really high level federal funding and so forth, often times, a local county may require an economic development impact analysis before a project moves forward or before they give the final approval for a project, and we've had a number of consultants and individual companies come to us and ask for support and technical assistance with using the JEDI model to provide those analyses.

So, at the more local level, that's certainly been the case that's it's been used, but the federal level and the rigor around those analysis that have yet to be decided, I think.

Jimmy Jones: Okay. Well, that's a good lead in to our next question on the youthfulness of this model at the county level. So Naynad Czkowski asks, "Is there a model that – a single model that has the ability to analyze all technology?"

So if the county wanted to compare what the best alternative is –

Gail Mosey: Yeah. We would love to have – we call that the uber-JEDI, and we don't have that yet. We thought it would be great if we could roll all these technologies into one JEDI and actually either come up with a way to compare the technologies and or a way to get nets impacts.

So maybe devise some sort of a portfolio of different renewable energy technologies that you wanted to use in a state or a community and run JEDI that way. And that's the next one on the list in terms of just – the wish list of how we would like to – the direction that we might like to see JEDI go.

Jimmy Jones: Well, Catherine Graham has a related question. If you download the model and use for one technology and use the county level multipliers, are they the same? Are they applicable to all of the technologies in the different models?

Gail Mosey: Yeah. So to clarify, with the county level aspect of things, basically JEDI, right now, is set up on the state level. The answer to that question, if we're talking about the state level, is, yes, the multipliers at the state level are gonna be the same for the different technologies.

The difference with the state versus the county level multipliers is that we're not set up to run JEDI right now at the county level. That would be – have to be a specific request that we would somehow have to accommodate at the county level.

So, for instance, if you were to – and I think I might know where you're going with this – if you were to purchase the county level multipliers, we would need to talk about whether or not we could certainly –

You would purchase the county level multipliers once, but applying them to the different JEDI models, there would be a little bit more involved in actually building in those multipliers to each

of the technologies. So that's something that maybe to use the blog or to use the JEDI support email address to – we can talk more specifically about that if that's of interest.

Misty Conrad: Thank you, Gail.

Gail Mosey: I thought of one more thing to say about the county level, and I think Eric mentioned it. But I really want to caution. We mentioned using JEDI at the county level, but bear in mind that the more – the finer you make your analysis in terms of geographic area, the fewer economic impacts you are going to have mostly because of the local share impact.

So, for instance, if you live in a county where you've got all the manufacturing facilities associated with that technology that you're analyzing, you're going to have awesome economic impact. If you live in a county that has almost no manufacturing capabilities, all you're dealing with, at this point, is the labor – the labor impacts associated with the facility.

So bear that in mind when you're – I guess what I'm cautioning against is getting too excited about the county level analysis and moving too far away from the state level.

Misty Conrad: And so there might be a benefit in looking at a state analysis first and then drilling down later. I mean we hear this quite a bit. I really hate to cut you off, Gail. I want to thank you so much for you being here.

Gail Mosey and Eric Lantz for being here. We've got tons of questions already that we have not been able to answer, and we will start posting these on our blog as we hope you will as well.

Thank you, Jimmy, for co-hosting. As always, it's been a pleasure. You're welcome, Misty.

Gail Mosey: He's saying with his eyes.

Misty Conrad: He's saying it with his eyes. He's saying, "You're welcome, Misty." I just want to let everybody know to please visit our TAP web – excuse me – Webcast blog, but I really want to welcome – ask everyone to please see us again next time next – when? In August?

Jimmy Jones: August 26th.

Misty Conrad: August 26th. Revolving loan funds.

Jimmy Jones: Revolving loan funds. So how to use the ____ is the Recovery Act Fund in a smart way. So we'll hear about that.

Misty Conrad: Yeah. That will be great because I know that's one of the biggest questions we heard from most of you. So, August 26th. If you have any questions, comments, concerns or complaints – although I would hope that there's very few – please give us a call.

Otherwise, from a very cloudy Denver, as this moment and time, which is rare. As I sign off, and I want to thank everybody for joining us. Bye-bye.

[End of Audio]