

Introduction to RETScreen Clean Energy Management Software

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Webinar Panelists

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Sean Esterly

Today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with CanmetENERGY, Government of Canada. Today's webinar is focused on "The Introduction to RETScreen Clean Energy Management Software."

One important note of mention before we begin the presentation is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is features in the Solutions Center's resource library as one of many best practices, resources reviewed and selected by technical experts.

And before we begin I just want to go over some of the webinar features. You do have two options for audio: you may either listen through your computer or over the telephone. If you choose to listen through your computer please go to the audio pane and select the <mic and speakers> option. Doing that will just help eliminate any feedback and echo. And if you choose to dial in by phone please select the telephone option and a box will display the telephone number and the audio PIN that you should use to dial in.

If anyone's having technical difficulties with the webinar you may contact the go-to webinar help desk at 888-259-3826 and they can help you out there.

If you'd like to ask a question at any point during the webinar – and we do encourage all attendees to do so, you may go to the question pane and type in your question where it will be submitted to us. And if you're having difficulty viewing the material through the webinar portal we will be posting PDF

copies of the presentations at CleanEnergySolutions.org/Training. And you may download those there.

Also, following today's webinar we will be posting an audio recording to the Solutions Center Training Page and also adding that recording to the Solutions Center YouTube channel, where you'll find other informative webinars as well as video interviews with thought leaders on clean energy policy topics.

Today's webinar agenda is centered around the presentations from our guest panelists: Dinesh Parakh and Michael Ross. These _____ have been kind enough to join us to introduce the powerful capabilities of the RETScreen suite software which includes the RETScreen for project analysis software and the RETScreen flex performance analysis software.

Before our speakers begin their presentations I'll provide a short, informative overview of the Clean Energy Solutions Center initiative, and then following the presentations we'll have the question and answer session where the panelists will address those questions submitted by the audience, followed by some closing remarks and a very brief survey for attendees.

Our slide provides a bit of background in terms of how the Solutions Center came to be formed, and the Solutions Center is one of 13 initiatives of the Clean Energy Ministerial that was launched in April of 2011. It's primarily led by Australia, the United States and other CEM partners.

So now come to this unique initiative, includes support of developing countries and emerging economies, through enhancement of resources and policies relating to energy access, no cost expert policy assistance, and peer-to-peer learning and training tools such as the webinar you're now attending.

And there's four primary goals for the Solutions Center. Our first goal is to serve as a clearinghouse of clean energy policy resources. Second is to share policy best practices, data and analysis tools specific to clean energy policies and programs, and third the Solutions Center delivers dynamic services that enable expert assistance, learning, and peer-to-peer sharing of experiences. And then lastly the Center fosters dialog on emerging policy issues and innovation around the globe.

And the primary audience for the Solutions Center is energy policy makers and analysts from governments and technical organizations in all countries. But then we also strive to engage with the private sector, NGOs, and also civil society.

One of the marquee features that the Solutions Center provides is its no-cost expert policy assistance, which is known as the Ask An Expert service. And the Ask An Expert service has established a broad team of over 30 experts from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost.

So for example in the area of energy efficiency policy we're very pleased to have Jeff Diessen, senior analyst for the Climate Policy Initiative serving as one of our experts. So if you have a need for policy assistance in energy efficiency policy, or in the RETScreen software, we do encourage you to use this valuable service. Again, the assistance is provided free of charge to you.

If you have a question for our experts please submit it to our simple online forum at cleanenergysolutions.org/expert, or to find out how the Ask An Expert service can benefit your work please feel free to contact me directly at Sean.Esterly@NREL.gov, or my number: (303) 384-7436. And we also invite you to spread the word about this service to those in your networks and organizations.

So now I'd like to go ahead and provide a brief introduction for today's panelists. First speaker we'll be hearing from is Dinesh Parakh, a program advisor with RETScreen International, where he manages strategic partnerships, communications and business development. Dinesh is the lead author of the RETScreen Clean Energy Legal and Policy Toolkit.

And then following Dinesh we will hear from Mr. Michael Ross. Michael is a training and applications expert with RER Energy, Incorporated. And Michael has developed much of the training material available on the RETScreen website, and has been supporting the RETScreen team as a consultant since 2001.

And so with those introductions I'd now like to go ahead and turn things over to Dinesh.

Dinesh S. Parakh

Okay, good morning everyone. Good morning, good afternoon, good evening to all of you. Welcome to everyone, and thank you for coming, especially those of you in far-flung time zones from around the world. I think you can all see my first slide there: RETScreen Clean Energy Management Software.

The seminar today is going to provide a very basic introduction on how to use the RETScreen Clean Energy Management Software for project analysis. I'm going to provide a very brief overview of RETScreen, and then Michael Ross, who is a RETScreen training and applications expert, is going to introduce the software. And then in the bulk of the presentation he is going to show you a live demonstration of how RETScreen works in practice.

Just a few words, first of all, about RETScreen for those of you who may not be familiar with it. What is RETScreen? This particular slide depicts the world of RETScreen. So RETScreen is free software that is provided by the Government of Canada that significantly reduces the cost, both the financial costs and the time costs associated with identifying and assessing potential clean energy projects. These time and financial costs can be substantial barriers to the deployment of clean energy projects. And so by minimizing or reducing or removing these costs RETScreen reduces the costs of getting projects on the ground. It removes barriers to doing business in clean energy.

So essentially RETScreen enables clean energy by preserving capital and then redirecting it to more productive purposes. So for example away from pre-feasibility and pre-feasibility studies and other initial steps such as legal, accounting, etc. towards the actual construction of viable projects.

So this current slide, it's showing the many facets of RETScreen. There's images here of projects being built around the world, a number of university theses. There are over 700 universities that we know of that are using RETScreen for teaching and research; probably many more than them. There is a sampling of here are professional reports, screen shots of how governments have been using RETScreen for clean energy policy. And also a few photographs here of training seminars and training classes worldwide on RETScreen.

So what does RETScreen really actually do? What RETScreen does is it allows the user to determine whether or not a proposed renewable energy or energy efficiency, heating and cooling, or cogeneration project makes financial sense. If a project is viable, financially viable, or if it is not viable, RETScreen is going to help the decision maker or the user understand this very quickly, unequivocally, in a user-friendly format, and at relatively minimal cost.

So I'm not going to go through all of these bullets here but I would like to point out that RETScreen is for clean and cleaner energy. So for example you can use RETScreen to make a coal plant more efficient, or to do the analysis. RETScreen can compare the impact of different conventional fuels, for example coal to natural gas. It can compare conventional to renewable, for example, coal to biomass. So you'll see there that we have close to half a million users now all around the world, and massive amounts of user savings since 1998, well over \$8 billion in transactional cost savings directly through using the RETScreen software.

And you can download the software, RETScreen, right after this webinar by going to the website, which is the top right corner there: www.RETScreen.net. It's free of charge and you can download the software in the language of your choice (well, 36 languages anyways).

Now this slide quickly demonstrates how RETScreen has become the de facto global standard for clean energy project and performance analysis. We find ourselves on an exponential growth curve; RETScreen has by far the largest number of users of any clean energy software, more than all other clean energy software programs combined.

On the right of the slide there you'll see a depiction of the top 20 user countries, and you'll notice that almost all of the largest economies of the world are represented in these top countries. Some of them are perhaps unexpected: Romania, Belgium and Greece, which is quite interesting because it's pointing to, or hinting perhaps, at a lot of clean energy activity, whether that's being stimulated through projects or through policies, things like that. So it's interesting to note.

So as per an earlier slide and as I mentioned, RETScreen is available in 36 languages, which are spoken by about two-thirds of the world's population. This is a screen capture of the actual software, and this is your first glimpse before Michael is going to show the software live in just a few moments.

And here is another screen capture where the software interface has been changed to standard Chinese with the click of a button. So this is interesting because the user can work in his or her own language and send a very small, RET file to a colleague in another country perhaps, who can work in his or her own language. So suppose you have colleagues in China in your project team. Well, you can work in English or in German or in Hindi or Swahili or whatever and send the file to your Chinese colleague, who can with one click switch the analysis to standard Chinese. And then you can switch it back. So it's a great boon for collaborative work worldwide in project teams.

Just before I turn over the presentation to Michael for an introduction to the actual software and then the live demonstration I'd like to mention one important point, and that's sort of iterating what Sean has mentioned in his introductory slides.

So Natural Resources Canada has provided the services of RETScreen experts to the Clean Energy Solutions Center Ask An Expert service, and that's what Sean had mentioned in the introduction. So this service is offered completely free of charge to representatives of developing country governments and technical institutions. Our experts can help you conduct analyses, review analyses, etc. using RETScreen. So really it's like having your own RETScreen consultant even for complicated tasks or analyses without any cost to you.

So if you are from a developing country national, with any sort of government or technical institute affiliation I definitely encourage you to have a look at the Ask An Expert service and take advantage of this fabulous resource.

These have just been a few glimpses of RETScreen, a brief introduction. I am now going to turn it over to Michael to tell you more about the actual software and then get into a live demonstration and show it to you.

Michael Ross

Hi. Thanks very much, Dinesh. So I will continue with Dinesh's presentation here, introducing the RETScreen software suite. And then I'll actually give a demonstration of the software.

If you visit www.RETScreen.net you can download from that website a RETScreen software suite that will install two separate programs. We're going to talk about one of those programs today, that's RETScreen 4. It's the one that Dinesh has made reference to. So RETScreen 4, as Dinesh said, is a free piece of software for quickly and easily and inexpensively looking at a proposed energy project and seeing whether it makes sense technically and financially. The project that you can look at might be a renewable energy project or an energy efficiency project or a cogeneration project. That's the software we're going to talk about today.

But if you install the RETScreen software suite there is another, completely separate piece of software which we're not going to talk about today which is RETScreen Plus. So RETScreen 4 was for looking at the performance of a proposed project; RETScreen Plus is for following the ongoing performance of an existing project that you're collecting data from, either through, say, fuel bills for energy consumption in a building, or output from a, say, energy producing project, like a photovoltaic project.

So RETScreen Plus is for monitoring the ongoing performance of an existing project to see whether it meets expectations or whether it's improving or deteriorating, and RETScreen 4, this piece of software we're going to talk about today, is for looking at the performance of a proposed project.

So this RETScreen 4 software deals with many different technologies, but regardless of the technology you're treating, the same five-step analysis is used. So initially there's a start page where you configure the software with the settings and site conditions that are applicable to your particular project, and then you go through a standard five-step analysis.

The first step is an energy model where you determine the energy performance of your proposed system. The second is a cost analysis where you provide information on the initial, the ongoing and perhaps even the periodic costs associated with the project. And costs may be negative costs or savings as well. You may have savings with respect to some base case scenario.

The third step is an optional emissions analysis. You can determine the greenhouse gas emissions reductions associated with your project compared with a certain baseline.

The fourth step is a financial analysis which ties together the findings from the energy model, the cost analysis, and the emissions analysis into an assessment of the financial viability of the project.

And finally there's an optional sensitivity and risk analysis that helps you figure out how sensitive or how much your results in the financial analysis change, depending on uncertainty in your emissions analysis, your cost analysis and your energy model.

RETScreen has a number of built-in, integrated features that are really nice. Some of them are helpful just as standalone features; others are very useful when you're actually using the software.

So the climate data is a database built into RETScreen that covers the entire globe and provides monthly average data for a wide range of parameters that are often useful in energy efficiency and renewable energy projects.

There's also a product data database that is useful for finding, for instance, in the example we're doing today we're going to be doing a wind energy example. Well, to know how much power our wind turbine produces we need

to have a power curve, and you could get this from a manufacturer, or you can find it in the RETScreen product database.

There's also an online manual which is contact sensitive. So if there's a parameter in RETScreen, you're not sure what to enter, there's a very good help typically associate with most parameters that will assist you in picking an appropriate value for the input. It's also a great resource for just understanding better the different terms and the different terms associated with a particular technology and what their importance is.

There's a page of tools that's helpful with things like unit conversion or steam tables or heating value of fuels. And then largely exterior to the software itself but associated with the RETScreen software and available on the website. There's a distance learning course and training materials, so presentations such as the one we're giving today are available online. There's an engineering textbook that gets into more depth about the technologies, as well as the software itself. And there's case studies both built into the software and on the website that help you understand projects by looking at example projects.

For the emissions and financial analysis you can choose to do a method one analysis, which is somewhat simplified, or a method two analysis, which goes into more detail. So in a method one analysis there's a single page that integrates the emissions, cost, and financial analysis, whereas in method two they're broken out into separate pages. And we'll see that again in a bit.

For project types Dinesh mentioned that you can use RETScreen to look at a wide range of different projects. So energy efficiency measures is one type of project you can look at. But you can also look at virtually any type of power project, or a power project that integrates multiple technologies. You can also look at heating projects and cooling projects and combined heating and power projects.

For instance, if you have a power system that's combusting a fuel it's going to have waste heat coming off it. And you can recover that heat and supply that to heating load. And you can analyze that kind of project with RETScreen as well. Obviously other combinations of cooling and power, heating and cooling, or combined cooling, heating and power are possible. And if you just want to use the cost emissions and financial analysis capabilities of RETScreen with your own energy project that doesn't, for whatever reason, doesn't fit within the RETScreen software, you can have a user-defined project where you basically specify fuel consumption and costs. And then you can benefit from those other aspects of the RETScreen tool.

I think we're keeping questions until the end. Rather what we'll do is we'll jump into a demonstration of the software itself because it's much more interesting to actually see a piece of software being used or use it ourselves than to hear someone talk about its capabilities. It's better to see them online.

I've put together a hypothetical example that we can use to demonstrate the software. I've made up this example, so it's a wind farm proposed for the

northeast of Brazil. If you're very familiar with wind farms in Brazil you may find that there are certain assumptions I've made that aren't exactly right. I'm not sure. I haven't built a wind farm in the northeast of Brazil.

But the point of this exercise is to show you how we can quickly model a project, assess whether it's an attractive investment or not, or whether it's financially viable, and then see what changes we could make to the project very quickly to determine their impact on the project financial viability.

The project I'm proposing consists of ten three megawatt turbines, so it's a 30 megawatt wind farm. The turbines will have 90-meter rotors on 90-meter towers. I've gone to a wind resource map and seen that in this area there's lots of sites that have 7.5 meters per second wind speed, annual average wind speed. And that's measured at an 80-meter height.

Wind turbine costs tend to be around U.S. \$1,700 per kilowatt, and I'm going to use U.S. dollars because I think it's a currency that everyone will be familiar with. But if I was doing this in Brazil I might choose to do this in Brazilian reals.

Purchasing the turbines is going to cost U.S. \$1,700 per kilowatt of turbine capacity, and installing them is included in that cost. Then every year I'm going to have to have some ongoing costs associated with maintaining and operating those turbines. And I've assumed that these are going to be \$15 per megawatt hour of output from the turbines. So that's 1.5 cents per kilowatt hour. For every unit of electricity that I produce I can sell it onto the grid for \$60 per megawatt hour, or six cents per kilowatt hour.

The inflation rate is going to be three percent, which seems low for Brazil historically but you've got to remember I'm doing this with U.S. dollars, so it's actually an inflation rate that's more appropriate for U.S. than for Brazil.

I'm going to assume that my turbines last 20 years, and that I'm going to pay for 30 percent of the initial cost of the project out of my own funds, so a 30 percent equity payment. And the remainder, this remaining 70 percent, is going to be debt financed. So I'm going to go to a bank or some other lending institution. And they're going to lend me the 70 percent remainder of the cost of the project at an 8.5 percent interest rate over a 15-year period. That's what I'm going to look at.

Let's see if this is an attractive investment. I'm looking at this from the perspective of someone who wants to do this type of project. Now you may not be a project proponent but it's useful to be able to do this type of analysis even if you're, for instance, a policy person, to see whether particular changes to policy you might be thinking about doing are going to encourage or reduce interest in investment in renewable energy projects.

I just, you might have seen there, clicked on the RETScreen for menu item and it opened RETScreen 4 in the Excel software. So as you can see RETScreen 4 runs under Excel. So if you want to run RETScreen 4 you need to have Microsoft Excel installed. And when Microsoft Excel opens with

RETScreen 4 there is an additional toolbar across the top. And this is for functionality specific to RETScreen 4. And this kind of gives us a clue that RETScreen 4 is not just a standard Excel spreadsheet, it's an RETScreen spreadsheet with a lot of additional functionality built into it through a code running in the background. So there's access to the help, to the databases, and then to things like Goal Seek, which can be very useful for setting parameter values.

When we open the software it drops us in this first Start page that is the first place that – so this is the part of the software that we deal with before we do the five-step standard analysis. So on the Start page we can configure the software to do the type of analysis that we want to do at the location we want to do it.

Also along here you'll see there's the energy model and the tools page. So there's the energy model and there's the tools page. When I say that the Start page configures the software to do the type of analysis that we want I mean that we can change the contents of these tabs by changing these settings here. So I mentioned that we have a method one simplified analysis where everything is on a single energy model, or we have a method two, more detailed analysis, where the cost analysis is broken down on a separate page from the energy model, the emissions analysis is a separate page, financial analysis is a separate page, and the risk analysis is a separate page. Today I'm going to stick with the method one simplified analysis, but that's an example of how this permits you to configure the software.

You'll note as well that there's different cells with different colors. And there's some check boxes and there's some blue hyperlinks. The different colors are not there simply to make it look pretty they signify that this is an input, an output or some other information. So these gray cells, for instance, for the project name, the project location and prepare for and prepared by I could enter anything I wanted there and it's not going to affect the calculations that RETScreen does. I can call my project Project Brazil or I can call it Demonstration Project and my results will be exactly the same.

So gray cell means it's for informational purposes.

These yellow cells – yellow means it's an input. So we have to provide some input there – and there may be a dropdown list to help us provide that input. But it's definitely going to affect the calculation when our input value's entered there.

Down here we'll see there's also some blue cells. Those are also inputs, but the blue indicates that there is a built in database in the RETScreen software to help us populate the values. So this is climate data location, or climate data for a particular location. I didn't have to go through and enter those values, these are the default values that appear. But because they're blue I know that there's a database, the climate database, that helps me populate these values.

And you'll see at the bottom there's also these white cells, and those are outputs. So the outputs I can't change directly. For instance if I tried to enter

five here for the annual air temperature it would give me an error message because I can't change the output except by changing the inputs.

So let's – the other thing you'll see is the blue hyperlinks. So here and here. So if I click on one of these it accesses a database, typically, or it may take you to another part of the project. So I clicked on the project database, and the project database is how I access built-in example projects – so you see there's a wide range of built-in example template projects and case studies that I can use as examples either to start my analysis from a starting point that is similar to my existing project, or just to look at similar projects so I can learn from them. And this is also how I can access my own user-defined projects. So this is an analysis I did a little while ago for a client.

We'll start from the default screen. So for project name I'll simply enter Demo Project, wind, and a project location: Northeast Brazil. And it's prepared for CC and it's prepared by Michael Ross. And this is once again gray cell information only. The project type, by default, is energy efficiency measures, but that's not what I want. I want a power project for a wind turbine. You'll see I have a wide range of choices there.

And once again this is going to configure what appears in these energy model and other spreadsheets. So here currently with energy efficiency I have facility characteristics which are things that I'd be really interested in looking at if it was an energy efficiency project, so things like the ventilation or the electrical equipment or hot water pumps, but that has nothing to do with a wind farm. So if I click here and I go Power, it automatically defaults to wind turbine. And when I go back to this I see that now I have parameters associated with a wind turbine, and no longer so I have parameters associated with energy efficiency.

As I mentioned, it defaults to wind turbine but there's a wide range of choices for the power technology we could look at. So we can look at fuel cells or ocean current power. There certain technologies that are dealt with in more depth than others. So the ones that have the most depth in the analysis are wind turbines, photovoltaic projects, and hydro projects.

I can also specify what type of grid connection my project has. So the grid is the connection of distribution and transmission lines with generators and dispersed loads. This project in Northeastern Brazil is going to be connected to the central grid, so it's going to supply loads all over Brazil with its power. But if it was not connected to the grid, if I had an off-grid wind farm, or wind project, I could select off grid here and if it was for an isolated community, so there was a very small grid but it was not interconnected with the rest of Brazil's grid I could choose Isolated Grid. So I'll stick with central grid here.

I mentioned the method one and method two; I'll leave that with the method one and method two. And then we get to this heating value reference. Well, what's the heating value reference? Well, it's interesting. In RETScreen if you don't know what to enter in a cell it's good to develop the instinct to click Help. Because unlike a lot of software, which doesn't have good help, RETScreen really does have typically very helpful help. So it's contact

sensitive. I clicked on that cell, heating value reference, and then I clicked on the Help and it opened the heating value reference help.

Firstly it tells me what it is: "The heating value is a measure of the energy released when a fuel is completely burned." And there's two different conventions for that: the higher heating value or the lower heating value. And then it tells me that the higher heating value is typically used in Canada and the USA while the lower heating value is used in the rest of the world. So it tells me essentially, "Ah, my project's in Brazil. I should use the lower heating value." So I close that and I pick Lower Heating Value here.

Here's a box for Show Savings. I can choose the language, as Dinesh said, the user manual, which is that online help that we just looked at, is available in English and French. And then I can choose the currency that I want to do this in. I said U.S. dollars, so we'll leave it at dollars there, but if I was doing this project in Brazil I'd probably do Brazilian riyal. So I click there.

And now when I go to the energy model page you'll see that cost savings are in Brazilian riyals. But you can see that there's a wide range of currencies, pretty much all the currencies are in there. The only one that's an obvious exception is the bitcoin. But as an example of how even that can be accommodated you can have user-defined currencies. So if I wanted to do my project in bitcoins, for example – I'm just using that as kind of a fun example, I could use that symbol from Bitcoin, and then when I go to the energy model I'm specifying my costs in bitcoin. But we will go back to the dollar here. For units we have a choice between metric units and U.S. customary units. I'm going to leave it with metric units.

So there we've configured the software to do the type of project we want to do: an on-grid wind farm. The only thing that we really need to specify now is the climate data because if you think about it most renewable energy projects and energy efficiency projects are – their performance is quite closely related to the climate they're being installed with. So it's important that we have data related to the climate. And RETScreen has a built-in climate database that covers the entire planet. So by default it's for Canada because the software comes from Canada. But every country is in the database.

If I click on Brazil I can see that the different provinces of Brazil are all present. This project is in the northeast, in Rio Grande do Norte, and I said it's at Natal. So I'm going to pick that. And these are then average annual and monthly climate parameters for this particular location.

Now just this climate database can be useful for a wide range of projects. So even if you don't end up using the rest of the software it's a really nice climate database that covers the entire planet, that provides you with monthly averages.

Here, for example, are the air temperature, the relative humidity, and the daily solar radiation on the horizontal by January, February, March, April, May, June, etc. And the other thing you'll notice is that there's a column here called

Source, and there's a row here called Source, which indicates that source of the data. And there's two values you'll see in there: ground, and NASA.

Ground means that the data comes from a ground measurement station, so perhaps there's an airport that's measuring these values. And NASA means that it's satellite-derived data. So NASA has a very useful set of programs for deriving climate parameters from satellite observations. And there's a collaboration between NASA and RETScreen that integrates that information, that data, directly into the RETScreen software.

When I've picked my site I can overwrite the default values that are in here by clicking on this green check box here, Paste Data. You'll see that this selection of data is going to get pasted into the software. So these all got updated. If I wanted to overwrite one of these values I could. Like if I thought that the air temperature in January was actually 28 and not 27.6 I could do that. But they are still just inputs. But there is this helpful climate database that I can use to populate these values.

That's the Start page. We've configured the software and specified their location. Let's go on to the energy model now.

Right off the top I have to say what my proposed case power system is. Now RETScreen has built into it the notion that the cost effectiveness only exists by way of a comparison. So we have to compare our wind farm to something else. And in this case the something else is simply not doing the project. So does doing this project make sense compared with not doing the project? That seems a little bit almost absurdly obvious but [audio glitch] for other projects it's necessary to [audio break] thinking of using solar water heating. You have to say, "Well is that cost effective compared with heating your water with natural gas, or heating your water with electricity?" So in that case it's really important that you specify what the base case is.

This is a proposed case power system. It's going to be our wind farm, and there is a selection method one, method two, method three here, which similarly the method one and method two on the Start page allows us to say how much detail we want to provide in our analysis. So method one is a very simple analysis based just on the power capacity and the average output from the turbines.

If we pick method two we actually can calculate the output of the turbines based on the climate data, the annual climate data. And in method three we can base our calculation on the monthly climate data. I'm going to do it based on the annual climate database data here.

If we look back on the slide here we see that we've got a wind speed of 7.5 meters per second, measured at an [audio glitch] 80-meter height. So we're going to provide information about our resource. And our resource is measured in the wind speed, as opposed to the power density, which is another way of specifying the wind resource. And the annual wind speed is 7.5 meters per second, measured at a height of 80 meters. So I've taken that

from a publicly-available map of the wind resource in Brazil, available online.

Then there's this wind shear exponent that I have to enter. So once again it may not be a parameter that you're all familiar with, so go to the Help. And if I look at Help it tells me, "Ah, this relates wind speeds at different heights above the ground," because as you go higher the wind speeds tend to increase. It says that the range of this varies between 0.1 and 0.4; a value of 0.14 is a good first approximation when the site characteristics are yet to be determined. So I'm just going to go with 0.14. That'd be something we might look at in more depth. If we proceeded with this project we might figure out what the actual wind shear exponent at the site is.

For the air temperature I can use the average air temperature that comes from the climate database. So I click "=" and I select that. This is running under Excel so I'm using essentially an Excel formula. I'm saying the value of this cell is equal to the value of this cell, which is being taken from the climate data. See, this is the 26.7° C average annual temperature that you find on this location here at the annual air temperature. I can similarly say the atmospheric pressure is equal to the atmospheric pressure from the climate database.

So there we've specified the basic parameters needed to calculate how much power we can get from the resource, which is the wind. But we also need to say what type of equipment we're using to convert this wind energy into power. So there's a lot of blue cells in here, which indicates there's a database built into RETScreen to help us pick those values. So power capacity, number of turbines, rotor diameter, hub height, swept area per turbine, these are all available as well as the power curve, so this relates the power output of the turbine to the wind speed. These are all available from a product database and that product database is accessed over here by clicking there.

And it opens this product database, and if you look back on that first slide I said that we're going to use turbines that are three megawatt with 90-meter rotors installed at 90 meters. So here is a turbine that has that. And each of these turbines is three megawatts, so we want ten of them to get a 30-megawatt project. There's the power curve data built into the database. Here's the hub height, rotor diameter, swept area per turbine. I click to paste that in and it updates these values.

And you see now that we've actually specified what our wind turbine is and what its key technical characteristics are. There's also this energy curve data which says standard or custom – that essentially permits us to specify the distribution of wind speeds around the annual average wind speed. So we said the average annual wind speed is 7.5 meters per second at 80 meters. RETScreen has calculated that at the 90-meter hub height the wind speed is actually 7.6 meters. See, we've gone a little bit higher than the 80 meters, so the wind speed's going up a little bit.

But that's the average. It doesn't always blow at 7.6 meters per second. Sometimes it's calm, sometimes it's light winds and sometimes there's really

strong winds. So that distribution of winds is specified through the selection of this parameter, standard or custom, with the shape factor.

And then that actually gets to be a little bit more complicated, so I don't want to get into it, but for most calculations if you don't know what the distribution should just saying standard is going to be a reasonable estimate.

Here's our power curve data and our energy curve, so I can click on this blue hyperlink over here, "Show figure," and I see that here's the wind speed, the instantaneous wind speed, and here's the power output. And that's the green line. So at very low winds puts out no power; at about three meters per second it starts generating power. Power ramps up quickly until about 15 meters per second. And then you achieve the full three megawatt output of the turbine, and then it holds that steady until 30 meters per second.

Of course there are always sources of losses associated with any piece of equipment and we have to specify what some of those losses are going to be. So the first one here is the array losses.

What are array losses? Well, we go to the Help. This is our standard approach. And it tells us this is the losses because we have ten turbines and when the wind blows past one turbine it interrupts the wind flow to the wind turbines that are downstream of it, and therefore they generate less power.

It tells us there that for a cluster of less than 8 to 10 turbines should keep array losses below 5 percent. Well, let's put in 4 percent here because we've got 10 turbines. So that should be okay. So I put in 4 percent. And I could similarly go through the Help and pick air foil losses, miscellaneous losses and availability but I'm just going to speed this up by saying 2 percent air foil losses, 5 percent miscellaneous losses and 97 percent availability, which are reasonable parameters.

Based on that RETScreen has calculated the capacity factor. So the capacity factor is the average output of the turbines, of the wind farm, expressed as a fraction of the [audio glitch] name play capacity. So we've got a 30 megawatt wind farm; on average it's putting out 28 percent of 30 megawatts, or I guess – yeah, about 8-1/2 megawatts. And that's because there are calm periods and there are low wind periods, so it's not always blowing at 15 meters per second or higher.

So on average, over the course of an average year it's putting out about 28.2 percent of 30 megawatts, or 8-1/2 megawatts. And if you multiply that by the number of hours in the year you end up with the electricity being exported to the grid.

I can see that in more detail by clicking on that Show Data. I see there's the unadjusted energy production and then there's adjustments for the air pressure, the temperature, the losses that we specified, and that ends up getting this figure which works out to this amount of energy per square meter of swept area of the turbine. So if we're interested in the technical details they're there; if we're not interested we just ignore them.

Finally there's the electricity export range, which is the amount we're being paid per megawatt hour of electricity that we're generating. And we said that's going to be \$60 per megawatt hour, or six cents per kilowatt hour. So \$60 per megawatt hour, and if you're not too familiar with megawatt hours versus kilowatt hours if we go to the top here and click "Show Alternative Units" you'll see that it provides some unit conversions there, including this one. It's six cents per kilowatt hour.

That's the energy model. It's told us that we're going to provide about 75 gigawatt hours of electricity per year. Now we have to go through and provide some information on costs and then we're going to have to look at the greenhouse gas emissions reductions.

For costs if I had done, on the start page, a method two analysis here I'd have a whole in-depth cost analysis page that I could fill out. And if I wanted a lot of detail I could click method two there and have even more detail. However, I want to keep things really, really simple, and I've made the assumption that turbines cost \$1,700 per kilowatt. So I'm going to go back to the method one where everything is on a single page and it gives me one box here, the incremental initial costs for specifying the initial costs.

So at \$1,700 per kilowatt I'm going to enter =1700 and I'm going to use a formula to multiply those, and I come up with \$51 million as being the initial cost for my project. I'm going to have to enter my operation and maintenance cost, my annual operation and maintenance costs a bit later on because they come further down the page.

Let's look at the greenhouse gas emissions. Here's the emissions analysis. If I'm not interested in [audio glitch] – if I'm not at all interested in it I can unclick that and it goes away, but I am interested. So I'm going to do a very simple emissions analysis. If I wanted to do a more flexible emissions analysis based on the actual types of grid generation that my wind turbines would offset then I could use a method two analysis to do that, but I'm just going to assume that the emissions, the electricity produced by wind turbines reduce emissions associated with the average for generation in Brazil.

So I click on Brazil here and you can see that the GHG emissions reduction emissions factor for Brazil in terms of tons of CO₂ per megawatt hour of electricity produced in Brazil are very low. They have a lot of hydro generation in Brazil. So the base line is very low, so it means that our wind turbines do not result in a huge GHG emissions reduction: 6,500 tons of CO₂ per year. If we picked another county, let's say if we go down to Alberta in Canada, which is a lot of coal generation you see there's a very high emissions factor and you'll see that we have ten times more emissions reductions. But in Brazil, where they're using hydro, the average emissions are very low and we have a low emissions reduction. I could adjust those based on losses in the transmission and distribution but that's detail that I don't want to get into right now.

In the base case I'm not going to assume that any value is being placed on the emissions. We're not selling our emissions reductions to anyone. We can go back and revisit that in a bit.

So let's not look at the financial analysis.

We said that inflation, because this is in U.S. dollars, is going to be around three percent, so I'll enter inflation of three percent. And that's being applied in a simplified analysis to all future costs. So the ongoing operation and maintenance costs but also the electricity, and amount we're being paid for electricity production. If we wanted to use separate values for those two different inflation rates, so one for the electricity, another one for the ongoing operations and maintenance costs, we could do that in a method two analysis.

I'm going to assume that my turbines last 20 years, and as I said, we're going to pay 30 percent out of our own pocket and 70 percent out of debt. So I'm going to pick a debt ratio of 70 percent here. The debt interest rate I think we said was 8-1/2 percent. Let's go back – 8-1/2 percent interest rate over 15 years. So I'm going to enter 8.5 percent. And it's over 15 years. So let's just go back and look at these.

Pretty much entered all of that except for the \$15 per megawatt hour O&M costs. So I'll go down to here, the O&M savings or costs, and I'm going to use a formula. So \$15 per megawatt hour times our annual production, which is here, the 74,000 megawatt hours. And I see that my annual operation and maintenance costs are about \$1.5 million. So the initial costs are \$51 million, and then every year I have to pay about \$1.1 million to keep these turbines running.

With that I have some results about the financial viability of this project. Here's the cumulative cash flow graph. So here's the 20 years of the project. These are positive cash flows above zero and this is negative cash flow. So initially I have 30 percent of the project being my equity portions. So what I take out of my pocket to put the payment for the turbines and the wind farm. So 30 percent of \$51 million is about \$15 million. And there we go: there's our \$15 million outlay of equity.

Now every year I get some money from my electricity sales but it looks like it's actually less than what I have to pay each year to service the debt, to pay the banks for the debt, and for the O&M costs. So you see that over time this goes downwards. Eventually, though, the payments for the electricity, they're going up over time because they're inflating at three percent, whereas my debt payments are fixed. So this gradually goes up until 15 years, when I've paid off the debt.

At that point in time debt payments disappear and I quickly achieve positive cash flow once the debt is paid off. However, it's really not that attractive, right? We don't achieve positive cash flow until nearly 18 years into the project. And it's only a 20-year project. That's reflected in the pre-tax IRR and equity. So on the 30 percent portion that we put in out of our own pockets we're only getting a three percent return on equity. That's not very good.

Where our ultimate goal was to answer this question: will this attract investment? And the answer is no, this isn't going to attract investment because you can see that we're earning three percent on money that we've having to borrow at 8.5 percent, and who knows what our overall cost of capital is but it might be 10 percent. So it's going to be hard to find an investor who wants to earn 3 percent on money that they're having to borrow at 8-1/2 percent.

So the next following question is: What would we have to do to turn this project from being one that's not going to attract investment into one that does attract investment? So there's a couple of suggestions here. Let's go through those.

Well, we can move this to a windier site. The wind resource is really important. If we find a windier location in this province how is that going to change things? We can also change the equipment we're using. If we use a slightly more expensive turbine but one that's going to generate more power per unit capacity by using the same size rotor but on a smaller generator, so the capacity factor goes up, or the average output goes up. And putting it on a higher tower, 105 meters instead of 90 meters, we should increase the amount of power this is producing per unit of capacity. And of course we're going to have to pay a bit more for these turbines, but maybe overall that leads to a more profitable project.

Also, we could seek better financing. We could try and get an interest rate of six percent instead of this 8.5 percent here, and maybe we can put a monetary value on the greenhouse gas emissions reductions. Even though it's small, maybe if we get \$30 per ton of CO₂ equivalent that'll have an impact on the project. So let's see what impacts those have.

So we go back, and the first thing I said is move to windier site. So just so we can remember what our project looks like now it's a three percent pretax IRR and equity, and that's the cash flow graph. That's at 7.5 meters per second wind speed. If I go to 8.5 meters per second, yeah, it looks significantly different. We've gone up to 7.8 percent. So it made a huge difference, from 3 percent to nearly 8 percent. But it's still not enough to make this a viable project.

What else can we do? Well, we said we could change the turbines to a model that might be more appropriate for this wind resource. So let's go to a Vim 92 megawatt at 105 meters. Now that's a two megawatt turbine, so I'm going to need 15 of these turbines to generate 30 megawatts power. And the price has changed as well. So it's now \$2,000 per kilowatt. So at 105 meters the wind speed's gone up from – we were looking at 7.6 meters per second at the hub height before; now we're at 8.8 meters because we're at a higher height at a better wind resource.

This should have an improvement in our capacity factor. Yes it does. Before, we were at a 28 percent capacity factor, so on average we put out 28 percent of 30 megawatts; now with the change in the equipment that's more

appropriate for this wind resource we have a 42 percent capacity factor. So that's more in line with what you would expect from a good wind farm.

Dinesh S. Parakh Michael, if I could interrupt for one moment. You have about ten minutes left for this part of the presentation

Michael Ross Yep. Good. Thanks.

Dinesh S. Parakh Thank you.

Michael Ross So that improved the pretax IRR and equity a bit. It went from just under 8 percent to almost 9 percent. We've still got a long period before we achieve positive cash flow but it is looking more promising.

The next thing that we talked about doing was changing the debt interest rate. Convincing investors, or rather banks, that this was a safer investment, and seeking better terms for the debt, and changing that to six percent you'll see that in fact this improves this quite a bit and we're now up to 11.6 percent. So we're kind of approaching the neighborhood where you might start seeing some private sector investment interest because you'll see that we're borrowing at 6 percent and earning 11.6 percent on our equity portions. So that's starting to be a relatively good return given the riskiness of the project.

The last thing we wanted to look at was trying to monetize some of these greenhouse gas emissions reductions. So you'll see we have more production so we have more greenhouse gas emissions reductions now. And if we said, "Well maybe we can get \$30 per ton for this," and maybe we can do that over a 20-year project lifetime, and let's assume that this will inflate also at the same rate as general inflation. So this may or may not be a reasonable set of assumptions. It's going to depend on project proponent being able to find someone willing to pay \$30 per ton.

What impact would that have? Well, we went up slightly from 11-something to 13.1 percent. So it didn't have a miraculous impact, but it did kind of take us over the top to the point where we have a project that might start attracting equity investment. It's still a bit risky because the equity payback period is very long, but the return on equity is reasonably attractive. So given that it's exceeding, say, a 12 or 13 percent threshold we might get private sector investment.

The point of this exercise was first to demonstrate the software, but it was not to suggest that you can take any underperforming wind farm and miraculously turn it into a good investment opportunity simply by changing some numbers. What it showed was how we could start out with a set of assumptions and then determine what would have to change in order to take this project from being a lemon to something that people might want to invest in. And we identified that the wind speed was a really important consideration. The type of equipment that we were using was a really important consideration. The debt financing was an important consideration. And even the greenhouse gas emissions reduction's credits were a

consideration. And if we were able to change those for our project we might end up with something that made sense.

The next step would be to say, "Ah, maybe this is a reasonable project. Can I find the site which has the wind resource that I need? Can I find debt financing at these terms? Are the costs of my turbines reasonable? You would do on and you would refine your assumptions. But you'll see that within the course of about a half hour we did a really quick but somewhat in-depth analysis of a wind farm using this RETScreen 4 software.

I think that's all that I had to say about the software itself.

Dinesh S. Parakh

Okay, well we do have a lot of questions so if you're finished with that particular part of it I think the questions will definitely clarify – you'll probably have to show a little bit more of the software in the question and answer, so we can move on to that.

We had a bunch of questions come in while Michael was speaking and I just tried to respond to some of them quickly. I'm just going to summarize a few of those. Some of them are just quick and easy responses.

Somebody asked does it work on Macs, and it does work on Macs. I did send the response to everybody. It doesn't work on Macs but it can be made to work with Macs, and there is a section on Help on our website which describes how to do that and I sent that link to All.

Somebody asked if a cloud-based version will be developed. It will not – we're not looking at it right now but it is on the horizon for the future. But for now RETScreen is going to remain a desktop tool.

Somebody asked in the climate database can you select a specific year to get historical weather data. This can be done through RETScreen Plus, which is included in the download of RETScreen Suite and that is – you can get historical weather data through NASA satellite data.

Another question was are all of the Help files and built-in databases incorporated into the downloaded software so they can be used without access to the internet. That is correct: if you download RETScreen 4 it's a standalone tool; you don't need access to the internet then to use all of the features of RETScreen 4. For RETScreen Plus you do need internet access for live NASA satellite data but I believe you're able to sort of disable that and work without that if necessary.

And we had a question as well about – yes, about how often the databases are updated. They're typically updated about once per year. And if you want to look at the – usually the databases have some sort of year identifier on them. So yeah, they are updated fairly regularly.

Now some of the other questions I saved for Michael here to be able to answer during the Q&A session. And I'll start off with this one, Michael: how do the accuracies of the output data vary between the three methods and the

energy model? So I think a bit more detail on perhaps method one, two and three.

Michael Ross I'm assuming this is specifically related to the wind analysis.

Dinesh S. Parakh I'm assuming so, yes.

Michael Ross The accuracy is probably not going to be so closely related to the method as to the input data. So firstly between method one and method two: method one, there is no calculation of the capacity factor. You're assuming a capacity factor. So if you had another very sophisticated piece of engineering software that gave you the capacity factor for this 30-megawatt wind farm you could still use the RETScreen software, which would probably have an easier-to-use interface and an easier-to-use GHG and cost and financial analysis. By saying, "Okay, it's a 30-megawatt wind farm and my sophisticated piece of engineering software has said that it's got a capacity factor of, say, 39 percent, so there is no calculation being done within RETScreen itself, essentially. The capacity factor is assumed there.

In method two we're using annual data here. So here essentially the accuracy of the calculation is going to be related to the accuracy of the estimate of the hub height wind speed as well as the accuracy of the modeling of the distribution of wind speeds. And in the standard, if you're familiar with wind energy technology the standard involves a relay distribution which is typically found. But if you actually knew what the distribution was you could specify what it is using a custom selection here, which then allows you to specify any Weibull distribution. So if you know what the distribution is you can enter it that way.

If you don't know what the distribution is that's going to be your source of air here. Or if the distribution isn't real modeled by Weibull distribution that would be the source of inaccuracy.

The third method, it's a monthly calculation, so then if you know what the distribution is for the wind speeds and it's well modeled each month then in theory you could get a better accuracy here, but I actually think that the part that's more useful is the ability to enter a different export rate every month. So that would actually be for me more of a selling point of methods for even the accuracy.

In short I would say that between method two and method three in general the accuracy is going to be very similar. It's going to be more limited by what you know about your wind resource than by the actual calculation itself.

Dinesh S. Parakh Great. Thanks Michael. The next question is – and I think this is specific to the wind example: Shouldn't array losses increase if you go from 10 to 15 turbines?

Michael Ross That's a good point, yeah. Yeah, perhaps I should have increased my losses here to like 5 or 6 percent. To determine that accurately you might have to use a sophisticated modeling tool but yeah, we're still in the ballpark, but

that's a really good point. If we've gone to 15 turbines, yeah, all our losses should have gone up. Thank you for that astute observation.

Dinesh S. Parakh The next question is: How do you arrive at factors which increase the project's financial viability?

Michael Ross I'm assuming that --

Dinesh S. Parakh Sounds like a big question.

Michael Ross Yeah. How I arrived at these factors was through personal experience doing projects. But if you don't have those personal experiences during projects the great way to figure that out is to actually do the analysis and then start changing values here. And you can test different values, you can see which ones are having a big impact on this.

For instance, I just changed my array losses from 4 to 6 percent, and it had a small change in this. It had a small impact on this, but it didn't radically change the profitability of my project. So I would suggest – and that's not something that's a huge concern. Whereas in comparison when I changed the wind speed that did have a huge impact. So you can learn about that by changing the values. And it's actually not that hard an exercise. Take half an hour, go through, check what's changing here and you'll be able to identify the parameters that are really important.

If you want to try and automate that, if you look at the start page and you select method two here you get this risk analysis, and that involves sensitivity analysis and a risk analysis –

Yeah, so I opened on the Start page method two, and that permitted me to do a risk analysis. And on the risk analysis page there's a sensitivity analysis and a risk analysis and then this allows me to look at changes in different sets of parameters and see which ones are important.

I'm not going to show this in depth, but if I change one of my initial costs here – doesn't work because I'm in method two. And I haven't entered the cost data for method two. But if I quickly do that it doesn't look like it should because I've jumped between method one and method two without entering the data associated with method two. But you see this would be a way to automate that process of determining what are the key parameters by doing a sensitivity analysis using these dropdown lists to identify the parameters you would want to investigate. So you can either do it manually or you can do it automatically.

Dinesh S. Parakh Will the software scale for small projects, for example single family homes or smaller multifamily homes?

Michael Ross Absolutely. It scales really well, particularly on the energy efficiency side it works really, really well for small projects. For renewable energy projects as well it's great. You can do a 5 kilowatt PV system for a home, or a solar hot

water system for a home; software works great for that. So yes, very good for small projects.

If you were interested, for instance, in policy and you wanted to see what type of incentives would make a difference for encouraging homeowners to install solar domestic hot water systems you could definitely investigate that with RETScreen, yeah.

Dinesh S. Parakh

We have a question: How can I specify the wind velocity over 90 meters? What tool can I use for that? How would you do that in RETScreen 4?

Michael Ross

Well, you specify the measurement height. So if you had a tool that said – if you had access to data that told you that the wind speed at 120 meters was – see, I entered 120 meters there – was, say, 9.5 meters per second you could specify it like that. And now you see that the conversion has been from a 120 meter measurement height down to the 105 meter hub height. And if you knew exactly what it was at the hub height you could specify your wind speed at the hub height.

I'm not sure if that answered the question but that's how you specify within RETScreen the measurement height for the wind resource. And if you have it at a value other than 80 meters you can enter that here.

If you want to determine what the wind speed is at a height other than 80 meters you can use the wind shear exponent in RETScreen to scale this up or down, or you can try and find that data from other tools.

Dinesh S. Parakh

We have two questions coming in asking if there's going to be a RETScreen Plus seminar, and somebody's asking if there's going to be a CHP seminar. I can answer that by saying that I'll definitely speak with the organizers at CESC, Sean and Stephanie, and see if we can organize something. It seems like there is some good interest in RETScreen Plus, at least we'll – stay tuned, we'll work on that.

Another question for you. Actually I can answer this one too: Will there be another webinar that goes deeper into the financial part, risk and sensitivity? So one, yes, there will be. And if you look at CESC's schedule we have a webinar in April that is focusing on RETScreen 4 financial analysis. And that's actually going to be using the new RETScreen Expert software which I'll speak about just in a few moments. So yes, that is going to be covered.

But Michael, I know it's a large topic but you might want to take a few minutes maybe and explain some more on the financial measures that RETScreen uses, for example the different measures, IRR assets and equity payback period, maybe a couple minutes on that.

Michael Ross

Okay. So in the method one analysis these are the financial viability parameters that are provided by RETScreen. But if you go to the method two analysis you actually get even wider range of parameters. Obviously they won't be defined here because I haven't entered the input data but you have the pretax IRR and equity analysis, the after-tax IRR and equity analysis,

simple payback, equity payback, net present value, annual life cycle savings, benefit to cost ratio, energy production costs and GHG reduction costs. So a wide range of parameters.

The IRR, the internal rate of return, is akin to the interest yield on the investment. So if you put in, say, 30 percent, so that's your equity portion in the last project you deal with, what does that earn you on an annual basis over the lifetime of the project? That's the internal rate of return.

You can measure that based on your equity portion, so that 30 percent you put in, or on the entire value of the project, which is the assets. So the total initial costs, that would be of interest, for instance, to lending institutions because if you default on your loan they'll want to look at – they'll essentially take ownership of our portion and then the overall return on the total investment would be of interest to them. So that's for pretax.

Of course if you have taxation RETScreen can deal with that. It has a very simple tax analysis component that is surprisingly powerful. And it will help you determine how the profitability of this project is affected by the taxes on the earnings from the wind farm. And that's also on the equity and the assets portion.

Now those are measures of profitability, so does this project learn you money over time. But there are also measures of quickness of return. And those are, for example, the simple payback and the equity payback.

A simple payback is the number of years required for the initial costs of the project to be paid back out of the savings or earnings from this project. If you had a project that cost you say \$10 million to do and it earns you \$5 million a year in savings or in earnings then it would have a simple payback of two years. So it's a measure of how quickly the project pays for itself.

Note that it doesn't say anything about what happens after that two years. So you could have a project that has a simple payback of, say, three or four years, so it seems a little bit long for many investors. But it could be very profitable following the payback for a long period of time.

The equity payback is essentially when the cumulative cash flow graph returns to positive territory. After you're put in your initial equity investment it takes a while for it to become positive again. That's when your equity portion has paid itself back out of earnings, net earnings from this project. And it's another measure of quickness of payback.

So ultimately everyone should look at the profitability, I think, of a project. But for certain organizations quickness of return is also very important because they may not have the luxury of a long-term outlook. They may have to earn quick cash flow in order for their organization to stay solvent over the next few years. For them a quick payback may be really essential because if you don't get a quick payback you may go bankrupt.

There's also net present value which then requires a specification of this thing called the discount rate. It's very similar to the IRR in what it tells us. It essentially says that if the value of the project, considering the time value of money, over the entire life of the project is positive then it's a profitable project. If it's zero it's a breakeven project, and if it's negative then it's not a profitable project. Those are the main indicators.

The annual life cycle savings is another way of essentially expressing the net present value but on an annual basis. The benefit to cost ratio is another way of kind of couching that same information. And then the energy production and reduction costs, GHG reduction costs, are ways that couch the costs or the profitability in terms of megawatt hours of production or the tons of CO2 emissions reductions.

Dinesh S. Parakh

It's a large topic. Thank you for summarizing it very well.

We have a lot more questions here. We're not going to be able to get to all of them in the time that we have; we only have about seven minutes left. But I'm going to summarize one or two of the questions which sort of touch on several different things.

We had a question early on about RETScreen Expert, when that's going to be made available. Some of you, I'm sure a number of you probably have a similar question. RETScreen Expert is the new generation of the RETScreen software. Quickly, it's going to be made available, our anticipated launch is the second quarter of 2016. We don't have an official launch date yet. If you're on our mailing list, if you've downloaded the software you will get the most recent information. The most recent Clean Energy bulletin, which is just going out now – some of you may have received it, some may not have yet received it, has a link to a sneak preview webinar on RETScreen Expert which you can have a look at.

The April and May webinars that are scheduled with CESC on financial analysis with RETScreen, one of them is in English in April; one is in French in May. Those are actually going to be using RETScreen Expert so you will get to see the new software there as well, okay?

We've had some questions here about whether RETScreen includes a reporting tool. The new RETScreen Expert is going to have a reporting tool integrated, a very nice functionality. The new RETScreen Expert is also going to include in the professional version of it – so I can't get into too much detail but you can find information on our website. But the professional version of RETScreen Expert is going to include training as well, web-based training, web-based customer support, etc. So look for that to come.

However, let me stress please that you can do a tremendous amount with RETScreen right now. You don't have to wait for the new software. RETScreen has led to well over \$8 billion in euro savings until now, so there's a tremendous amount you can do. So I encourage you to download the software, learn how to use the basics of RETScreen 4 because that's going to be very helpful even if you do then move to the new software later on.

Michael, all right, for decentralized systems which grade should be selected, for example home-based systems?

Michael Ross

Well if it's a home that's tied to the grid then it should be central grid. So even though it's a decentralized or distributed energy generation this is still tied into the central grid typically, so you would use central grid.

Of course if it's an off-grid home, so there is no grid connection, there's no power line coming to the home, then you would use off-grid. But most homes, say with a PV system on the roof, also have a grid connection. So they would be tied to the central grid.

Dinesh S. Parakh

Let me just – we have logged all of these questions and we can respond to them later on by email. You can always contact us as well, too. So there is always a way to get in touch with us; no need to worry. Maybe we'll try and squeeze one more question in. Let me just also mention there were a couple questions about RETScreen in French. So the entire software is in French, everything: the user manual, etc., and there's going to be a French webinar with CESC on using RETScreen for policy analysis in March and there's going to be a webinar in RETScreen for financial analysis using RETScreen Expert in French in May. So all of that is on CESC's website. You'll be able to find that information there.

Let's try one more quick question here. Michael, are there case studies available with real site data?

Michael Ross

Yes there are. If you go to the project database from the Start page here and you look at case studies here you'll see that these actually are from real projects, so they are based on real site data. If you actually click on one and you click on the Help you can see there's a real project there.

Dinesh S. Parakh

And I'll quickly answer two more questions here: How often are the base assumptions updated, for example solar costs dropping annually? On average we're updating once a year. If there are significant changes that can be done more frequently, but on average to do update all the databases and review all the assumptions quite regularly. So you can use this software with confidence.

We've also had a couple questions about getting assistance to use RETScreen. Look, there are – I'll just very briefly answer this by saying that there are a number of companies that provide RETScreen consulting services. You can find a listing of those on our RETScreen marketplace. Just google that. RETScreen Expert, as I mentioned, is going to have a premium version of the software which will include access to customer support and training. But there are many different ways. So if you have specific questions, again, you can always contact us through the website and we get back to people within a couple of business days maximum.

We're not going to get to all these questions; there's still a whole bunch more. But I'll assure you we'll have a look at those and try to respond to those as

soon as possible. I believe Sean and Stephanie have to – there's a brief survey we have to do.

Sean Esterly

Yeah, thank you, Dinesh and thank you Michael for the presentations. And as Dinesh said, we do have all the questions saved so we can respond to those following the webinar through email directly to the attendees.

We do have a couple quick questions for you to just help us evaluate how we did and improve for our next webinar. So I will show the first question and you can respond right through the Go To Webinar platform there. The question is: "The webinar content provided me with useful information and insight."

And the second question is: "The webinar's presenters were effective."

And: "Overall the webinar met my expectations."

And yes or no question: "Do you anticipate using the information presented in this webinar directly in your work and/or organization?"

And one final question: "Do you anticipate applying the information presented to develop or revise policies or programs in your country of focus?"

Thank you very much for answering our survey. And on behalf of the Clean Energy Solutions Center I would just like to once again thank our panelists for their presentations and also our attendees for participating in today's webinar. We very much appreciate everyone's time and do invite you to check the Solutions Center website if you'd like to download and view the slides that we used today. Or also we'll be posting a recording of today's presentation within the next day or two.

Additionally on the Solutions Center website you'll find information on upcoming webinars and other training events. And just a reminder: we also post our webinar recordings to the Clean Energy Solutions Center YouTube channel, along with other clean energy-related videos.

So with that I would just like to wish everyone the great rest of your day and hope to see you again at future Clean Energy Solutions Center events. And this concludes our webinar.