Policy Analysis with RETScreen

—Transcript of a webinar offered by the Clean Energy Solutions Center on 9 February 2016—
For more information, see the clean energy policy trainings offered by the Solutions Center.

Webinar Panelists

Dinesh S. Parakh   CanmetENERGY

Michael Ross   CanmetENERGY

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Tim Reber   My name is Tim Reber, with the National Renewable Energy Laboratory, and I'd like to welcome everyone to today's webinar, which is hosted by the Clean Energy Solution Center, in partnership with CanMetENERGY, part of the government of Canada.

Today's webinar is focused on how to use the RETScreen Clean Energy Management Software for policy development.

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

And before we begin, I'll quickly go over some of the webinar features. For audio you have two options. You may either listen through your computer or over your telephone. If you choose to listen through your computer, please select the "mic and speakers" option in the audio pane. Doing so will eliminate the possibility of feedback and echo. If you choose to dial in by phone, please select the telephone option and a box on the right side of your screen will display the telephone number and audio pin you should use to dial in. If anyone is having technical difficulties, anyone apart from ourselves, that is, with the webinar, you may contact the GoToWebinar help desk at 888-259-3826 for assistance.

If you'd like to ask a question, and we please encourage everybody in the audience to do so, you may use the "questions" pane on the right side of your

screen where you can type in your question directly. If you have difficulty viewing the materials through the webinar portal, you will find PDF copies of the presentations at cleanenergysolutions.org/training. You may download them and follow along as our speakers present.

Also, an audio recording and the presentations will be posted to the Solution Center training page within a few weeks of the webinar, and it will also be added to the Solution 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 panelists have been kind enough to join us to introduce the RETScreen Clean Energy Policy toolkit and concretely demonstrate how RETScreen can be used for different elements of the policy development cycle. Before the presentation, they'll provide a short, informative overview of the Clean Energy Solution Initiative. Then, following the presentations, we'll have a question-and-answer session moderated by Mr. Parakh where the panelists will address the questions submitted by the audience. We'll finally close with a brief survey.

This slide provides a bit of background in terms of how the Solution Center came to be. The Solution Center is one of 13 initiatives of the Clean Energy Ministerial that was launched in April 2011 and is primarily led by Australia, United States, and other Clean Energy Ministerial partners. Outcomes of this unique initiative include support of developing countries in emerging economies through enhancement of resources on policies relating to energy access, no-cost expert policy assistance, and peer-to-peer learning and training tools, such as the webinar you're attending today.

The Solution Center has four primary goals: it serves as clearinghouse of Clean Energy Policy resources, it serves to share policy best practices, data and analysis tools specific to clean energy policies and programs, it delivers dynamic services that enable expert assistance learning and peer-to-peer sharing of experiences, and finally the center fosters dialogue on emerging policy issues and innovation around the globe.

Our primary audience is energy policymakers and analysts from governments and technical organizations in all countries, though we also strive to engage with the private sector, NGOs, and civil society.

One of the marquee features of the Solution Center is the no-cost expert policy assistance known as Ask an Expert. The Ask an Expert program has established a broad team of over 30 experts from around the globe who are available to provide remote policy advice and analysis to all countries at no cost. For example, in the area of renewable policy, design and analysis, we are very pleased to have Terri Walters, president and founder of Katevan Consulting, serving as one of our experts. If you have a need for policy assistance and renewable policy design and analysis, or any other clean energy sector, we encourage you to use this valuable service. Again, the assistance is provided completely free of charge.

If you have a question for our experts, please submit it through our simple online form at cleanenergysolutions.org/expert, or to find out how the Ask an Expert service can benefit your work, please contact Sean Esterly directly at sean.esterly@nrel.gov, or call him at 303-384-7436.

We also invite you to spread the word about this service to those in your networks and organizations.

Now, I'd like to provide brief introductions for today's panelists. First up we'll have Dinesh S. 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.

Following Dinesh we'll be hearing from Michael Ross, a training and applications expert with RER Energy, Inc. 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 with those two introductions, I'd like to go ahead and hand it over to Dinesh to get started.

Dinesh Parakh   Thank you very much, Tim.

All right. One moment here. All right. Can everybody see my screen there, "Policy Analysis with RETScreen"?

Tim Reber   Yes, looks good.

Dinesh Parakh   All right. So, good morning, everyone. Welcome to everyone from all around the world and thank you all for coming.

So policy analysis with RETScreen is the second in the series of CESC RETScreen webinars. The first one in January introduced the software, and that webinar is available on the CESC website, as Tim had mentioned. There are plenty of clean energy policies out there. Unfortunately, there may be some more bad ones than good ones. So, for example, policies that are too generous and thus fail; policies that are not generous enough and thus fail; incentives can be too high or too low; the regulations can be onerous or inappropriate; there is inconsistency and a lack of certainty in both incentives and regulations. All of this causes financial pain and it wastes resources. And what it does, it has the effect of either delaying or denying otherwise viable clean energy projects.

So what does RETScreen have to do with this? RETScreen allows one to quickly test and compare policy options at no cost. And so, therefore, you can use the software to design and implement clean energy policies that are sound and viable the first time around, and thus possibly avoid very expensive mistakes. So the webinar today is going to demonstrate how specifically to use RETScreen to do this.

This slide is an image from a forthcoming study that's coming out in May 2016 by Yonsei University, which is one of South Korea's most prestigious universities. It's going to be published in renewable and sustainable energy reviews. The researchers at Yonsei University use RETScreen to model and develop more attractive incentive structures for investment in residential photovoltaic systems.

What they did was examine a number of target cities in the United States, and they developed 16 different scenarios for improving state solar incentives, all of which could make an investment in residential photovoltaic systems more attractive to investors. So the whole purpose was to show how do we get people to invest in residential PV systems. So this is a classic example of how RETScreen is being used for policy analysis. Essentially, RETScreen allows the testing of different policy options. And I just bring this up as a very recent example of how RETScreen is being used.

So before we get too far though, first, just a few very quick words for those of you who may not be familiar with RETScreen. RETScreen is the world's leading, clean energy decision-making software. It allows the user to determine whether or not a proposed renewable energy, energy efficiency, heating or cooling, or co-generation project makes financial sense. If a project is viable or not viable, the RETScreen is going to help that decision maker understand this quickly, unequivocally, in a user-friendly format and at relatively minimal cost.

As you can see there, we have—it's built on 36 languages, covering a majority of the world's population. We have over 460,000 users now in every country and territory of the world. Well over 700 universities and colleges use RETScreen for teaching and research. And RETScreen has been responsible for well over $8 billion in direct-user savings since 1998.

You can download the software right after this webinar by going to www.retscreen.net. It's right in the top-hand corner there, the URL. The software is free of charge, and you can download it in the language of your choice. I'd just emphasize also what Tim had said earlier in the introduction is that you can request support on how to use RETScreen for policy through the Ask an Expert service. So if you fit the criteria feel free to submit a request for assistance in terms of using RETScreen to analyze policy.

So RETScreen for projects and policies. So RETScreen has been known and has built its reputation as a tool to demonstrate the viability of clean energy projects. But it's also very well known for using—for planning, designing, implementing, and reviewing the viability of clean energy policies. And as I mentioned in the previous slide, RETScreen has always been used for policy. The Clean Energy Policy Toolkit, which I'll show in a few minutes, makes this point very clear.

There are a number of different actors that use RETScreen for policy, primarily at different levels of government, but also universities. For example, like the example I showed from Yonsei University. So this is just an example of some of the things that are in the toolkit. You'll see there are

different categories of sample documents. There's one example from each. For example, there's international organizations that are using RETScreen like UNFCCC, national, subnational, the state or provincial level, municipal and utilities.

On the screen there is a screenshot of the State of New Hampshire in the United States a solar thermal incentive application. And you'll see the highlighting there is to highlight the RETScreen requirement, "All applicants shall submit a RETScreen modeling analysis." So that's just an example of how RETScreen is being used for policy, to implement policy. And you'll be able to see the full version of this document, as well as many more examples, in the policy toolkit in the "sample policy document" sections. And again, I'll show you that in just a few minutes.

The policy toolkit also contains case studies and templates that have been specifically written for the policy toolkit. So you'll see here four of them. One of them, there is—the first one there is photovoltaic, a feed-in tariff. The second one looks at greenhouse gas reduction income. The third looks at a capital cost incentive. And the fourth one is a detailed study of tax and finance measures, how those can be applied.

My colleague, Michael, is going to go through this PV case study with you in some detail in the second part of the webinar.

In addition to these case studies and templates that have been written for the policy toolkit though, there are over 50 existing RETScreen case studies and templates that have policy applications, and they're highlighted in the toolkit as well.

This image really encapsulates how RETScreen can be used for each step of the policy cycle, and the toolkit breaks it out by sections. So, for example, RETScreen, for informing policy, for designing policy, implementing, monitoring, reviewing, et cetera. Okay.

So I keep telling you about this policy toolkit; let me go to it now on the website and show it to you. So I'm just going to make this a little bit bigger, okay, so it's easier to see. So this is the RETScreen website, the homepage here, all right. And if you just go to the left menu you'll see here under "Training Material", click on "Training Material", and you'll go—you'll see here all the different categories of training material. And you can click here on the "Clean Energy Policy Toolkit" and you go to the policy toolkit, okay. And this is all freely available on the web.

The first thing here is a set of presentation slides. And if you go there, you can download it in PowerPoint format, okay, or just a quick view here. So this is not only how to use RETScreen for policy analysis but it's also a general introduction to clean energy policies, so it can be very useful pedagogically. Again, all of our resources are free to use. We make them available that way.

The second resource here is a textbook chapter, so, again, it's an overview of clean energy policy and policy analysis with RETScreen. So it goes through

the different categories of clean energy policies, and then it goes through RETScreen as a tool for policy analysis. Again, that can be potentially very useful.

The third part here is sample policy documents here. So, for example, if you go to—click on the international section, you'll see UNFCCC, European Union, CARICOM, et cetera. And it's divided up here, you'll see, by inform policy, design policy, compliance, et cetera. You can go then to national. You'll see here it's divided up. There's different countries. We've just put different kinds of documents here. You can open up any of those documents and have a look. Okay. And different categories.

And that's subnational, so that's the provincial or state level. I'm going to go back to the policy toolkit here. And then the case studies. So the four case studies I mentioned here: the feed-in tariff, greenhouse gas reduction income, et cetera. So, for example, if you click on any one of them it gives you a nice, detailed case study that takes you through step by step on how to actually go through the analysis with RETScreen. Okay. And again, Michael is going to show that to you, but there's a lot of resources here for you to go through it on your own and a lot of different hints and notes and things. So a lot of resources. We've tried to make this as user friendly as possible.

There's a nice section here on other case studies and templates. Now, the list looks a little overwhelming at first, but what it allows you to do is choose a technology or a country or something that's of great relevance to you. All of these case studies and templates have policy applications. So, for example, this heating—let's see if we go here. Heating, solar water heater—hotel/motel/India, okay. This case study, along with the technical aspects of it, it includes concessional debt financing, AKA a soft loan. It includes a tax analysis. It includes immediate expensing. Okay. So there's a lot of these things that are in these existing case studies.

If you go to Energy Efficiency Measures—Commercial, this one here, the Model National Energy Code for Buildings, it actually demonstrates how one could model proposed energy efficiency regulations. So, again, a lot of resources for you to look at at your leisure.

Okay. So a brief and related aside, this is very much related to policy, is the legal toolkit. So there are significant legal barriers at the pre-feasibility stage of clean energy projects, for example the cost of creating new documents, lack of knowledge and capacity, clean energy law being a relatively new field of law. So the legal aspects, again, very related, very linked to policy aspects. They're all about identifying, managing and mitigating risk, as well as shielding project developers and investors from liability.

So the legal toolkit provides resources to help do just that, including a large number of sample legal documents. So, for example, power purchase agreements, interconnection agreements, operations and maintenance, et cetera, et cetera. It's not a do-it-yourself toolkit. It's meant to familiarize project teams with legal issues and then also to provide tools to lawyers and to your legal teams to help reduce legal costs.

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So, again, I'll just show that to you really quickly. So I'm back on the RETScreen website here, and just above Clean Energy Policy Toolkit is the Clean Energy Legal Toolkit. And you'll see here, again, we have presentation slides, a textbook chapter that guides you through the various legal aspects of clean energy projects, so it's a nice primer, actually, for what are the issues, what are the primarily legal issues around clean energy projects.

And then really the central point of the toolkit here are these sample legal documents. So it's different categories of all the different kinds of agreements that might be useful or necessary in a clean energy project. I'll show you, for example, you go to Power Purchase Agreements, and you'll see here it's all separated out, so it's separated out by general agreements, by different technologies, by country, so it'll have the various countries here: Canada, Sri Lanka, France, et cetera. And also languages. So there's a French agreement, a Japanese agreement, Spanish, et cetera, et cetera, Portuguese.

So we've really put a lot of effort into sort of making these documents. These are all freely available documents on the web, okay. So we've tried to put a lot of effort into getting these together as a resource for clean energy project teams.

Okay. So that's enough background, I think. Let's get now right into the demonstration, which is going to be presented by my colleague, Michael Ross. He's actually going to show you how to do policy analysis in the RETScreen software using a photovoltaic example. You can then download the software and then try it for yourself.

That will be followed by a brief question-and-answer session, so if you have questions as Michael is presenting, feel free to send them through. And just I'll make one final note that this presentation will be conducted in French— almost the same presentation will be done in French on March 1, again, through CESC. So if you have any French-speaking colleagues you think might benefit from this, do direct them to CESC's website for the French webinar on Policy Analysis with RETScreen on March 1.

And with that I'll turn it over to Michael.

Michael Ross   Hi. And let me know if you can't hear me. Is everything okay with the audio.

Tim Reber   Yes, I can hear you loud and clear and see your screen.

Michael Ross: Okay, great. So as Dinesh mentioned, I will be giving a demonstration of the software, the RETScreen software. Just to introduce that demonstration, we're going to use a PV example, a photovoltaic example based on an exercise that was actually done in a province of Canada a number of years ago. I know that Canada may be a slightly different situation than many of the people attending this seminar will find themselves in, but I wanted to pick an example that was based on a real exercise that was done, and also you can see from this demonstration, I think, how easy it would be to change the assumption so they fit the particular situation of your country or your jurisdiction.

So the exercise was that the government of Ontario decided that it wanted to have more grid-tied photovoltaic systems, and it wanted to attract private investment to achieve that. And it felt, based on experiences elsewhere, that private investors needed to have about a 12 percent internal rate of return on equity for them to pour in the money and build significant grid-tied photovoltaic capacity in the province of Ontario.

So 12 percent was their target for the internal rate of return, and I just want to clarify that on equity part. SO when the project is being built, let's say the project costs, hypothetically, $1 million, the equity portion is the part of that $1 million that comes out of the pockets of the investors themselves. So typically they won't pay for the entire project out of their pocket; they will pay for a certain percentage, maybe 30 percent. And then the remaining, say 70 percent of the project, is lent to them for the purposes of doing this project by a bank or other lending institution.

So the 12 percent internal of return on equity was felt to be a target that should be achieved by whatever policy they were going to implement in order to attract sufficient investment, but it wasn't so high, they felt, that investors would be making windfall profits that would then be costing rate payers or taxpayers excessively in the future.

So to see how different policy options would play out, we're going to look at a single test case, and that's for a 50 kilowatt system located near Toronto, which is the largest city in Ontario. And this 50 kilowatt photovoltaic system is going to be fixed, so it's not tracking the sun. It's fixed. It faces the equator, so it faces south, and it's tilted at 25 degrees to the horizontal. I'm going to assume that the costs for a system like that would be around $2,500.00 per kilowatt installed. If you don't like that assumption it's very easy to change. You'll see where I put it in. You can change that assumption, as all of the assumptions can be changed.

The total O&M costs will be $15.00 per kilowatt per year, excluding inverter replacement. And that will cover things like not just operating and maintenance cost, administration cost, but also things like land lease as necessary or insurance.

Photovoltaic systems are very reliable. The only component that may or may not have issues typically is the inverter, so we're going to allot $15,000.00 in today's dollars for inverter replacement after 12 years. The project will have a 20-year project lifetime, and we're going to assume, as I mentioned earlier, 70 percent debt financing, so 30 percent of the initial cost of the project comes out of the pocket of the investors and then 70 percent comes essentially from a bank. But of course the bank wants to make money on that, so they're going to charge a 6 percent interest rate over a debt term of 15 years.

And finally if this electricity—if there is no policy to incentivize photovoltaic systems, the electricity tariff that would be earned by this photovoltaic system would be $0.10 per kilowatt hour, escalating at 3 percent annually, so every year that tariff of $0.10 per kilowatt hour would go up by 3 percent. The inflation, however, would not be 3 percent. It'd be lower than that, 2 percent,

and that would be applied to, for example, the O&M costs. So they would be going up by 2 percent annually.

So let's look at what different policy options might be considered, each having a target of achieving a 12 percent IRR in equity. First would be no incentive whatsoever. The question is, as it stands, will the situation attract investment. Will a 12 percent IRR in equity be achieved? If not, how high would a feed-in tariff—so that is a preferential fixed payment for the electricity generated by this system—need to be to attract the 12 percent—to attract investment by achieving it with 12 percent IRR in equity.

Another option might be carbon credits, so a price per ton of CO_2 emissions reductions that would be paid to the owner of the system. This would be an additional revenue stream that would increase the profitability of the project. How high would the payment be per ton of CO_2 be required to attract investment? And we can look at that under different assumptions for the baseline. That is the emissions associated with generating that electricity if you don't have a PV system in place. So the PV system is going to offset generation by various conventional generators, and the mix of generation is going to establish how much CO_2 is being emitted if we don't have the PV system in place. So we can check different assumptions for that baseline.

In the first case, we're going to just assume average emissions for the province of Ontario. In the second case we're going to assume that the system is offsetting gas generation.

And finally, if we have time, we'll look at capital incentives, just reducing the capital costs of the systems, and soft loans, which Dinesh mentioned. Lower debt interest rates, making financing the project easier.

Okay. So the tool, RETScreen, when you download it, RETScreen 4 runs under Excel. So I'm going to assume that either you've had some experience using RETScreen 4, so I'm not going to necessary go through all of the details that I'm doing. I'm trying to introduce features and make it clear what I'm doing, but this is—if you're interested in learning the nuts and bolts of learning the tool, you might go back to the webinar that was done last month.

As Dinesh mentioned, there are all sorts of case studies built into the software, including the policy toolkit. So if I go to the case studies here, so I clicked on this blue hyperlink to open the project database, and that's where I find the policy toolkit examples. So if I look under the case studies and I look for photovoltaic systems, I'll see there's one here for Toronto that's a feed-in tariff policy. And if I click on that "help" button there, I should see some information on that. It's not coming up for reasons that I don't understand. Wait a second, I don't have it selected. There we go. Sorry about that.

So there's a description of a very similar feed-in tariff policy case study to the one I'm doing now. I've used more updated cost information because obviously the cost of photovoltaic systems has come down greatly within the last few years. But if I wanted to start from that case study template I could click here and it would fill out the form, the spreadsheets that are built into

RETScreen with the values associated with this case study, but I'm actually going to go through and do this all from scratch.

So these gray cells are just for informational purposes. So this is PV policy test case, and the location is near Toronto. And it's prepared for CESC, and it's prepared by Michael Ross.

These next cells are for configuring RETScreen. So RETScreen, the worksheets appear in these tabs down here. I'm going to configure it to do a PV analysis. As Dinesh mentioned, it works with a large number of technologies. By default it's energy efficiency measures, but this is a power generation technology. The default power generation technology is a wind turbine. I actually want a photovoltaic system. It's grid tied, so I'll leave that with central grid.

This Method 1, Method 2 for analysis type, it permits me to enter the inputs and get the analysis either in a more simplified way or a more detailed way. Method 1 is more simplified. If I choose Method 2 I get my cost analysis and emissions analysis and financial analysis broken out into different spreadsheets. I'm going to do that because it allows me some more flexibility for doing the emissions analysis, and it also lets me permit at electricity escalation, right, so the 3 percent that the tariff on the electricity is increasing by each year to be different from the inflation rate, the general inflation rate on O&M, so I'm going to leave it at that.

If you look here you can see there's show settings. I'm happy with this being in English, but there are many other languages there. You can use currency. For instance, if I didn't like to use the dollar sign because I was concerned that there'd be confusion about this being either in Canadian or US dollars, I could choose a different currency, for instance, the Canadian currency there, or I could even choose user defined. So, for example, here I could enter USD just to make it clearer that I'm doing this in US dollars.

I'm going to leave that in metric units.

Finally, I have to specify the climate data because we're going to actually calculate the amount of electricity generated by the photovoltaic system, so obviously that's a function of the climate. By default it opens with Ottawa being the climate data location. That's the capital of Canada. But that's not what I want. If I was in a different country I could pick climate data locations from different countries, but I'm okay with Canada. Ontario is fine. I just need to pick a different city. And if I look down this list I see that Toronto International Airport is here. I pick that, and these are the values for the air temperate and the daily solar radiation on the horizontal for—averages for each month of the year. And those are the two key parameters for estimating the generation of a photovoltaic system, so I have the data I need.

I'm going to paste that in like this, and where it got pasted is if I click here to show data, here is my data for Toronto. For example, in January -5.1 is the air temperate for Toronto on average.

So that's configured the spreadsheet. Let's now do the energy model. And if I go up here right off the top I get a Method 1, Method 2 question. This is different from the Method 1 and Method 2 here. But in a parallel sense, this lets me either do the simplified or more detailed analysis of the electricity generation of my PV system.

If I knew the capacity factor, that is the average output of my PV system expressed as a percentage of the power capacity, I could just enter that here and I could enter the size of my system. So I'd say it's a 50-kilowatt system, and then I could say, oh, the capacity factor is 20 percent or whatever it might be. And if it was 20 percent then that's equivalent to saying the average output is 20 percent of 50 kilowatts, so 10 kilowatts. That's including night time when there's no generation, cloudy periods, things like that.

However, I don't know what the capacity factor is. I need to calculate it. So in order to calculate it, I'm going to click on Method 2 here, and now this gives me cells that allow me to specify how the array is oriented, so that I can calculate the generation of the photovoltaic system. I can specify different technologies here, different losses, the inverter, the piece of equipment that converts the DC output of the array into AC. And there at the end there's a capacity factor calculated for me. I don't have to specify.

So let's go through that. We know it's fixed. It's not a tracking system, although we could include tracking systems. It is a fixed system. The slope or tilt is 25 degrees to the horizontal, and the azimuth, which is the orientation with respect to north or south, east or west, that's zero, that's due south. And for many people, that's not intuitive because they say, well, zero should be north, but if I click on help it opens some actually genuinely useful help. So here is a diagram that shows that the convention adopted by RETScreen is south is zero. So a south-facing, equator-facing array would be zero here.

And what's that done is it's taken the daily solar radiation on the horizontal, which are these values here, and they're coming directly from the climate database. The climate database for January says that the measured daily solar radiation of the horizontal is 1.68 kilowatt hours per meter squared per day. If I look here, there's that 1.68. However, that's on the horizontal, and I know my array is actually tilted up by 25 degrees. So when I tilt it up because the sun is close to the horizon during winter, by tilting it up I get a lot more out of the array in winter but less in summer.

So these are the values of the tilted array. And this is the value over the entire year, 1.5 megawatt hours per square meter. So it's slightly more than would be achieved if I had left it horizontal.

I can specify the electricity export rate here. So the electricity export rate is simply what I'm being paid for electricity. And if you look back at the slide, it was $0.10 per kilowatt hour was the assumption that was made here. So $0.10 per kilowatt hour is equal to that times 1,000 to get it in US dollars per megawatt hour, different units. So I'm showing you how you can use a formula in RETScreen because it still is Excel. And then I can also copy this down by using a formula. And the advantage of doing things like that is now I

can change a single cell here and all of the cells change, and we're going to use that in a bit.

But for now we're going to leave it at that $0.10 per kilowatt hour or $100.00 per megawatt hour. Now I've got all of these division by zero errors, and some people really don't like to see that, but it's actually not a problem because this is the electricity that is being exported to the grid each month. And in order for RETScreen to calculate that, it needs to know how big your photovoltaic array is, what the efficiency of your inverter is, what the miscellaneous losses are, et cetera. And we have not specified those yet, so clearly it's impossible for it to provide a value here, so it's normal that it would give an error. Once we specify those values, those errors will disappear.

So I could look up the product database to find a particular technology for photovoltaic systems, but for now I'll just assume that's 50 kilowatt mono-silicon photovoltaic system, and with an efficiency of 16 percent. The only thing the efficiency is affecting is the physical area required for the array. So I'm not too concerned about what the actual level should be.

Here's the miscellaneous losses. This is miscellaneous losses prior to the inverter. So if I look up on help, it shows this might be due to the presence of dirt or snow on the modules, or mismatch and wiring losses. Values range from a few percent to 15 percent. Well, in the absence of better estimates I'm just going to pick around 10 percent and for the feasibility analysis that might be reasonable. In your own climate you might have to ask around what a more reasonable value might be.

So those are the miscellaneous losses prior to the inverter. The inverter is this power electronics that we use to convert the DC to AC. Typically they're very efficient, say around 96% for a 50-kilowatt inverter. I'm just going to assume the inverter capacity is equal to the capacity of the photovoltaic system. In reality it might size it a bit smaller, but we won't worry about that here.

And for miscellaneous losses, these are miscellaneous losses that are occurring after the inverter, different from these ones which occurred before the inverter. So if I look up help for this, it says these might be due to DC to DC converters or step-up transformers. In most cases this value will be zero. So I'm going to put in zero for this. And there we have calculated the capacity factor. So rather than having to assume the capacity factor, it's been calculated for us and our estimate is 14.5 percent. It may seem a bit low, but keep in mind that this is a capacity factor based on the DC power, not the AC power.

If I multiply that 14.5 percent capacity factor by the power capacity by the number of hours in a year, I'm going to get the electricity that's generated in a year, and it works out to the 63 megawatt hours per year. So that's what's being generated _____ from the system at $0.10 a kilowatt hour. So these error messages have disappeared, as I said they would.

So that's the energy analysis. We know how much we're generating now. Now the question is how much did the system cost. So if I go to the cost analysis—

Dinesh Parakh   I'm sorry, Michael, if I could interrupt you for one moment, there's a question just related to what you just did. Somebody is asking how did you get the 16 percent for efficiency.

Michael Ross: I got that out of my knowledge for PV systems. You could go to the product database here and look up an individual system or an individual technology and find the efficiency. For instance, for this particular model here it's 13.7 percent. So you could look it up in the product database. But just to save time I picked 16 percent. And the point was it has no rule other than to establish the solar collector area, so it's really not a critical factor.

So, for instance, if I change this, here's this generation per year, if I change this, say, to 20 percent, generation didn't change at all. All that changed was this number, so that's why I didn't make a big deal out of it.

Dinesh Parakh   Thanks, Michael.

Michael Ross   Yeah, no problem.

So cost analysis, how much did the system cost? Well, on the slide it said that it was $2,500.00 per kilowatt peak installed system cost. Now, that's to put the system in place, but we also have operations and maintenance costs that are incurring annually, and then 12 years into the project we have to replace the inverter. So we have three different sets of cost: the initial, the annual, and then longer-term recurring costs associated for replacements.

And that's reflected in the RETScreen cost analysis sheet. Here's the initial cost, which I can specify in some detail if I wish. And if I wish to give it way more detail I can click Method 2 here, and then I can really fill it out in detail. But for now I'm going to do it very simply. So here's the initial costs, here's the annual costs, and here's the periodic costs.

So for the initial costs we said it's $2,500.00 per kilowatt. If you don't like that assumption all you have to do is change that one number to fit your assumption. That works out to a $125,000.00 system. However, we also have annual operation and maintenance costs, and I've said they're $15.00 per kilowatt. So I'm going to say that this is equal to that, so there's our 50 kilowatts, and for each one of those 50 kilowatts we're paying $15.00 per year. So that works out to $750.00 in O&M costs.

But that doesn't pay for the inverter that needs to be replaced after 12 years. So inverter replacement is a periodic cost, but it's actually only going to occur after 12 years, so I'll put that in. And we said that it was $15,000.00 in today's dollars, so there it is, appearing there, $15,000.00.

So those are the specification of cost. If you wanted to enter it more detail obviously that's available to you. But if you have just lump-sum numbers like I did, you can do it like that.

Now we go on to the emissions analysis. Here again we see Method 1, Method 2, Method 3. In Method 1, we have a database that gives values of the average emission factors for different regions, different countries. However, if we want to specify the actual mix of fuels that are going to be in the generation that's offset by our PV system, we can choose Method 2 here. And if we really want to have full flexibility we can choose Method 3.

So for Method 1, if you look at Canada as a whole, the emissions are fairly low. And if I go and look for the province of Ontario, I see they're extremely low. That's because Ontario has a lot of nuclear generation and some hydro, which are essentially carbon free sources of electricity. As a result, the baseline emissions per megawatt hour of grid-generated electricity are very low—about 100 kilograms per megawatt hour.

So if I take that 100 kilograms per megawatt hour, if I don't put a PV system in place then that means there are going to be emissions of 6.4 tons of CO_2 associated with the 63 megawatt hours of generation that my PV system would generate if it were there. Now, by putting the PV system in place I get that 63 megawatt hours but I don't generate emissions from the PV system, so it's zero in the proposed case. The different between the two, of course, is simply 6.4 tons of CO_2 emissions reductions per year.

Is that a lot or a little? Well, to put that in context there's this little calculator down here. You can see that that is equal to about 15 barrels of crude oil. So it's not very much. The reason it's not a lot is mainly because the emissions are really low in Ontario. Now, in reality, would you—would feed-in photovoltaic electricity into Ontario cause a nuclear reactor to reduce its level of output? No. They tend to be operated at a fixed output loading level all the time. So it would be other generation on the grid that would adapt its output to compensate for the additional generation from the PV system. And that might be natural gas. So we're going to come back to this and see if changing this to natural gas makes a big difference. But for now we're going to leave it at the average emissions level.

So let's go to the financial analysis, and this is where we really get in to looking at the policy options. So the first thing is the fuel cost escalation rate. This is a PV system, so there is no fuel costs, so I can just leave it at zero. It doesn't matter. It doesn't impact.

The inflation rate, which is being applied to operation and maintenance, we said is 2 percent. The discount rate is used to calculate the net present value. The net present value and the internal rate of return are, under many circumstances, identical measures of the profitability of a project. So if the internal rate of return is equal to the discount rate, then the net present value will necessarily be zero. That's just a mathematical equivalence between the two.

So what I'm going to do is I'm going to say my discount rate is 12 percent. It's essentially establishing the hurdle, or the target rate, for my IRR. And we're actually—and this is important because we're going to use this equivalence between the IRR and the net present value because the IRR and the net present value are equivalent except under some tricky situations, which we're actually going to run into, so we're going to see that.

The project life is 20 years. I put in 20 years there. Initially there's no incentives or grants, but there is debt finance, and 70 percent of this is coming from debt financing. So 70 percent of the initial $125,000.00 for this power system is going to be from debt. So there, 70 percent is $87,000.00. The equity portion, what's coming from the investors' pocket, is $38,000.00. The debt interest rate, we said, was going to be 6 percent, and the debt term is 15 years. So the debt payments are $9,000.00 per year.

Okay. I'm not going to worry about income tax analysis. The only thing I have to fill out here is the electricity export escalation rate. So back here on the energy model page, I said that it's $0.10 per kilowatt hour, but that's only in the first year. Every year that's inflating by 3 percent, so here this escalation rate lets me model that. I put in 3 percent here.

So how does this look? Well, we can look at the cumulative cash flow graph. So this is zero. The project cumulative cash flow never goes past zero. We start off with our equity investment of $37,000.00, right, so there's the $37,000.00 there. So that's coming out of our pocket. And then for the first 15 years of the project we have to pay $9,000.00 for debt each year, plus $750.00, inflating at 2 percent for O&M. But we're only earning electricity import income of $6,336.00 per year. So the net is negative, and that's why this keeps going down. It doesn't going down linearly, however, because the 3 percent escalation rate means that the value of the electricity this is generating over time is getting bigger and bigger in terms of a comparison with the debt payments, which are fixed at the $9,000.00, plus the O&M, which is inflating at 2 percent.

At 12 years we see a dropdown here. That's when the inverter gets replaced, and at 15 years the mortgage has been paid off, the debt has been paid off, and the payments for the electricity much exceed the O&M costs, so this rockets upwards. But it still never gets to—at least over the 20-year lifetime of this project—gets to positive cash flow. And that's reflected on an IRR tax on equity—an pretax IRR in equity of 4.1 percent—minus 4.1 percent. So not an attractive project.

So we've answered the first question here. Without incentive, will this attract investment? No, not at a chance. Only people who are doing this for reasons other than profitability will be involved in this.

Dinesh Parakh   Before you go on to the next example, just another question that's related to that. Someone is asking how did you choose the inflation rate? Is it just an assumption?

Michael Ross	Yeah, the inflation rate here of 2 percent is an assumption. If I go to, for instance, the Bank of Canada, I can find a time series that shows the inflation rate in Canada over the last 25 years, and I'll see that it's been around 2 percent, 2.5 percent over that period. So that's how I picked 2 percent here. If you don't like it, you can change the assumption.

So the next policy option is a feed-in tariff. So how high would a feed-in tariff need to be in order to attract investment. So how can we do this? Well, one way is simply to go back to the energy model page. See, this is our kind of point of departure, this cumulative cash flow graph and this pretax IRR in equity of minus 4.1 percent. We can go back to the energy model page and change this and say, well, obviously this needs to be higher. So if I change that to 110 or $0.11 per kilowatt hour, I can go back and look at this and see, oh, okay, the pretax IRR in equity has gone up to minus 2 percent. So it's improved, but I still need to go back and change this over and over iteratively to find when this reaches 12 percent.

A faster way to do is to use Goal Seek. So the RETScreen tab here has Goal Seek on it. I pick Goal Seek. I say I want this value to be 12 percent, and I want to achieve that by changing the tariff here. So I click "okay". This gets set to 12 percent. Here is my cash flow graph. Still a long period before the cumulative cash flow is positive, so there's still a bit of riskiness associated with this project, but ultimately it is achieving this 12 percent return on equity.

And you remember I mentioned that the IRR and the net present value are equivalent measures of the profitability under normal circumstances. You'll see that we've got 12 percent there, 12 percent there, and the net present value is exactly zero like I said it was going to be. So when the discount rate equals the IRR in equity, the net present value will generally be zero. I say generally because that can be fooled if there is multiple crossings, like there is here. It's okay. But if there are multiple crossings sometimes that gets fooled. So the ultimate check is to check the net present value. That's really what you want to see. You want to see it being zero when you've got the discount rate set to your target.

So that was the mechanics of setting this pretax IRR in equity 12 percent. The real question though was how high did the tariff have to be. So I go back to the energy model page and I see that it's been updated to $0.187 per kilowatt hour. So at $0.187 feed-in tariff, I would achieve this 12 percent return on equity that I'm seeking.

So that answers this question, how high does this need to be to attract investment. Now, there is one catch in there though, which was I left my electricity export escalation rate at 3 percent. So that means that this feed-in tariff is escalating at 3 percent every year as well. That might not be realistic. You might want to have it fixed over the 20-year lifetime of the project. So I can model that too.

Set that to zero so there's no more escalation here. You'll see this had an immediate effect on the IRR. So I'll go back, do Goal Seek again, so you get

to see this exercise again. I want to set the pretax IRR in equity to 12 percent, and I want to do that by changing the tariff here. And there it works out. Net present value is zero, pretax IRR in equity is 12 percent, and that's achieved when the feed-in tariff is $0.23.

Now, that's a lot higher than what it would be in many other locations. So, for instance, in very sunny locations there are projects being done, bigger projects, but projects being done where it appears that the tariff that's required to make the project profitable is only in the something like the $0.08 to $0.09 per kilowatt hour, and that's without any subsidy whatsoever. There's even been a project in the Middle East where it was less than $0.06 a kilowatt hour. But that reflects different assumptions about the cost of the PV system, which may be lower in different markets for different types of systems. And it reflects assumption about the climate, which Canada is not the sunniest climate in the world. It's not bad, but it's not particularly sunny.

So under different sets of assumptions about climate, which you can easily change by picking a different location here, or about costs, which you can easily change by changing this number, you would end up with different results. So the point is not that a feed-in tariff needs to be very, very high. It's just that for this particular set of assumptions that's the level it needs to be. Your assumptions are going to be different.

Let's move on to the carbon credits. So we're going to take out this feed-in tariff, so we'll set that back to 3 percent, so I'm essentially just returning us to the point that we were at before. So now we've got the electricity tariff back to $0.10 a kilowatt hour, and if I look at the financial analysis, I'm back to this minus 4.1 percent. So this is the initial situation we had before.

Now, I want to see if I can achieve a 12 percent internal rate of return on equity by putting a monetary value on that 6.4 tons of CO_2 emissions reductions per year. I can do that by saying, yes, there is GHG reduction income, and I need to put in a value for that, so I'll just put in one to begin with just as a guess, and it opens up these cells. The duration I'm going to assume is 20 years, the lifetime of the project. And I'm going to assume that the carbon price that I'm being paid is fixed. It doesn't inflate. If you wish to inflate it you can enter a number here.

So once again I can do this exercise where I say what—I want the IRR in equity to be 12 percent, and I want to achieve that by putting a value on the price of carbon. So I click okay there, and wow, $1,000.00 US dollars per ton of CO_2. It's really, really high. Why is that? Well, two reasons. Most important reason is that going to the emissions analysis, 6.4 tons of CO_2 is not a lot of carbon dioxide emissions and reductions. And why is that? Well, because we're starting off with a very low baseline. If this were actually offsetting nuclear production then there would be no benefit in terms of greenhouse gas reductions because both of them are carbon neutral, essentially.

So the other reason is because the photovoltaic system isn't a huge system, so it doesn't generate a lot of electricity to offset these emissions with. But that's

very, very high. It would make you question whether this is the best policy. If your goal is to reduce greenhouse gas emissions, whether subsidizing PV systems is the best way to go. That's what it suggests to me.

However, another thing you might say is, well, there is a fundamental flaw in your analysis, and that is that you're assuming that putting photovoltaic generation on the grid in Ontario is going to offset electricity from all the different generators on the grid, and that's simply not true. The nuclear generation on the Ontario grid is going to remain at the same loading level. Other generators are going to adjust their output to compensate for the additional PV generation, and in many locations, the generator which varies its output is going to be natural gas turbines.

So if we click on Method 2 here and say that our baseline is actually 100 percent natural gas, it gives us a value for the efficiency of gas generation. We can change this style if we want, if there was a lot of combined cycle generation, fast-acting, combined cycle generation we might choose a higher value. If we had all open-cycle gas turbines then we might choose a lower value.

I can also put in values for transmission and distribution losses, but that's not a conversation I need to get into right now. The important thing is you can see that the greenhouse gas emissions factor is now much higher. It's now 439 kilograms per megawatt hour; whereas, the average for Ontario is 100 kilograms. So this has a big impact on the greenhouse gas emissions reductions. They're now up at 28 tons of CO_2 per year, versus the 6.4 or whatever it was that we had before.

So this has a big impact, obviously, on our IRR and our pretax IRR in equity has jumped up to 71 percent. So let's see what this would be—need to be to achieve the 12 percent IRR in equity through that now. So if we were offsetting natural gas generation, this GHG reduction credit rate would only be $250.00 per ton. That's still really high compared with levels that are typically being paid for or prices that are typically being paid for CO_2 emissions reductions. But it shows you how the choice of baseline here impacts the way the policy plays out here.

I want to get back to again the equivalence between the pretax IRR in equity at 12 percent matching this 12 percent here, the discount rate. We end up with a net present value that it's essentially zero. It's 8 percent here because the precision of the 12 is not exactly 12. There's some decimal places after that.

That's going to be important in the next example because in the next example we are going to use capital incentive. So imagining that the government of Ontario simply chose [inaudible—technical issues] is not converging. It seems to be [inaudible—technical issues]. You can find the same result with [inaudible—technical issues]. So I'll do that same Goal Seek [inaudible—technical issues].

Another way you could do this is by taking it and saying [inaudible—technical issues] how high it would need to be to pay back _____. I haven't

done a tax analysis, but if _____ a little bit creative in our use of the tool and say, okay, well, _____ income, and it's going to be related to _____ kilowatts. So the number of kilowatts is 50 kilowatts, and the duration is only going to be one year. So _____ year _____. I can then say the net value—set the net present value to _____ percent internal rate of return by _____.

So here now the [inaudible—technical issues]. We put in our _____, but we immediately, in the first year get some credits back that exceed the value of our equity in _____ and immediately have debt payments of _____ negative, and then after that it comes up positive. So that's how you can model that. It's not terribly different in terms of the value, $57,000.00, I think we were at $57,000.00 before, and it's just getting paid in the first year now. So that's how you can model systems that get their money back in a tax credit after the system has been implemented.

So those are ways of looking at initial capital cost incentives. The last one that I think that was on here was soft loan. So how low would the interest rate have to be to turn this cash flow from minus 4.1 percent to 12 percent. Well, once again, we can do this using the Goal Seek. We want the net present value to be zero when the discount rate is 12 percent, and we want to do this by changing finance debt interest rate. So I click "okay" there. It's found a solution. It looks very good, right? I mean, it looks better than before.

We've got cash flow crossing the zero axis after about seven and a half years. It's a faster payback. Looks nice. Twelve percent here is zero for the net present value. The only problem is it's actually a negative debt interest rate. So you're lending—you're borrowing from the bank, and they're paying you to borrow money. It's a very unusual situation, especially when it's at a fairly large interest rate. So a soft loan on itself is unlikely to be able to achieve that 12 percent return.

Now, just as a last thing I've done each of these different policy measures individually, but you can combine them. So, for instance, if you said, well, we're not going to have negative interest rates, but we might have 3 percent soft loan rate in our country, and that might be possible. And we might not be able to pay $250.00 or get $250.00 per ton of CO_2 emissions, but maybe we can get $30.00 per ton of CO_2 emissions. So that takes us part of the way. Now, on top of that, how high would the FIT need to be, the feed-in tariff need to be.

So we can go back here, and do the Goal Seek once again to a value of zero by changing that cell, and you see there 12 percent IRR is achieved with a $0.157 feed-in tariff, $0.157 per kilowatt hour. And that's combining now three different policy options: payment for GHG emissions reduction, soft loan, and a feed-in tariff.

So that was kind of the demonstration of the software. I think we still have about 20 minutes left for questions if there are any.

Dinesh Parakh   We do, yes, thank you, Michael. So we'll get to some of these questions.

The first one here is how do you calculate the 12 percent discounting factor? Do you use the weighted average cost of capital approach?

Michael Ross   Well, here no. Here what I've done is I've gone back to this slide and said someone has told me that the target is a 12 percent internal rate of return. So I know that mathematically the net present value is zero when the discount rate is equal to the internal rate of return. So if I want to have an internal rate of return of 12 percent then it means that my discount rate has to be 12 percent. That's the target, the hurdle that I need to achieve. So that's why I picked it here.

Now, that's a typical way of formulating this problem from the point of view of a policy person. That's how it was done in Ontario, for instance. They looked at other jurisdictions that have put in feed-in tariffs, and they said, well, what do we need to provide as a feed-in tariff if we want to achieve a 12 percent internal rate of return on equity. If you're a project proponent, on the other hand, you would actually have to come up with your discount, and there, yeah, you could use the weighted average cost of capital. That would be one approach.

Dinesh Parakh   Great. Thank you, Michael. The next question is what is the GHG emission factor—or what are the GHG emission factors? How do you decide that value? What does that mean? Maybe you could give just a brief introduction.

Michael Ross   Yeah, so the GHG emissions factors essentially say how much carbon dioxide equivalent, so carbon dioxide and other greenhouse gases, are emitted when there's generation of a unit of electricity, so a megawatt hour of electricity. So this GHG emissions factor here says that if I generate a megawatt hour of electricity with natural gas generation with this efficiency here, which is a typical efficiency for gas turbines, I will generate 439 kilograms, or 0.439 tons of CO_2 equivalent. So it's just a way of saying how much greenhouse gases are being emitted due to generation of electricity. So it's tons of CO_2 per megawatt hour of electricity generation.

Now, for the photovoltaic system, the GHG emissions factor is assumed to be zero. There are no GHG emissions associated with the operation of a photovoltaic system. That is the assumption. But for natural gas generation, for example, there's about 439 kilograms per megawatt hour of generation. For nuclear it's also zero because the operation of a nuclear system doesn't involve that. If you were doing—let's see—coal-fired generation, you might have a value of one ton per megawatt hour. If you were looking at diesel fire generation it would be slightly lower than that.

The important things that affect this are, firstly, the mix of fuels that are being offset by your PV generation. So, for instance, if you have an isolated grid, so it's not connected to the central grid, and right now all of the electricity for, say, a village off grid is being provided—sorry about that—is being provided by a diesel generator, then 100 percent of your photovoltaic generation would be offsetting diesel fire generation. Then you would enter the efficiency of your generator here, and it would work out to that amount there.

Now, if you had multiple sources, like if you had not just diesel but you had 50 percent diesel and 50 percent hydro, that would look like this. So this is how you can use the emissions factor to estimate the emissions for the generation that would occur if you didn't put your PV system in place. And then with the PV system in place, the generation zero, the difference between the two is your net annual GHG emissions reductions.

Dinesh Parakh

Great. Yeah, thank you, Michael.

All right. So the next question here is about comparing a traditional feed-in versus a feed-in premium. So the question is can RETScreen compare a traditional a feed-in tariff versus a feed-in premium, or more generally a policy measure where there is a fixed revenue for each generated kilowatt hour from those where there is a range of possible payments for generated kilowatt hours, for example, a carbon dioxide trading scheme?

Michael Ross

There's a lot packed into that question there. For the first part, yes, I think most situations can be modeled, so how I would do that is let's say you thought that the tariff was going to be $0.10 per kilowatt hour, and that's inflating at 3 percent annually here. And then you wanted to put in a premium on top of that, that would be a different source—a different kind of feed-in premium.

So you could then get here clean energy production income. You've got 63 megawatt hours, and you could put in the premium there. So let's say you thought that premium should be, I don't know, $60.00 per megawatt hour or $0.06 per kilowatt hour. And let's say that it was only a ten-year project, so not over the life of the project, and let's say, assume that did not inflate, so you put that inflation rate in there. So now what you've got is every unit of electricity is getting this $0.10 per kilowatt hour, inflating at 3 percent annually over the life of the project. But for the first ten years of the project, you're getting electricity—an additional $0.06 per kilowatt hour, set this for ten years here inflating at zero, so fixed here. So that's the first part of that.

I'm not sure I remember the second part of the question. I can try.

Dinesh Parakh

I can just read this here again. Oh, I don't seem to have the rest of the question.

All right. Well, I think that's probably it for now. There will be—just a note to all of our participants, we will be answering the questions in more detail, so all of the questions you've submitted will be answered in a written form and shared with all of the participants, so we'll just get on to some of the questions that are here, Michael.

So there were two that were already answered, so I'll send quick responses. One was asking about the range of hydropower policy analysis in which RETScreen was used, so I've just emailed everybody with an example from India, which is in the policy toolkit.

Another question was does RETScreen send and store our information in a repository, and again, I emailed everyone saying that no, RETScreen is a desktop tool. There's no sharing. There's no uploading of information to any central repository. It is confidential. You're using it on your own computer.

The next question here, Michael, is how do you use the benchmark database, and I think we would say with particular regards to sort of policy analysis?

Michael Ross   Well, the benchmark database here—I thought this opened. Yeah, there. That's a good question. I haven't really thought this through. The benchmark database here can provide information on energy consumption and I think generation, though I'd have to look through that—sorted by region type of application, facility type, things like that.

So particularly for energy efficiency measures, the way that would be useful is if you wanted to know—if you wanted to have essentially a target for the efficiency of the system that was realistic in terms of being good but not so good that it can't be achieved, you can look in the benchmark database and find, for instance, actual estimates of the consumption of electricity in your jurisdiction in terms of kilowatt hours per household. And then set a target that was based on that, so it was more efficient than say the average but not so efficient that it would be impossible to achieve.

So that's how you could use that in terms of policy.

Dinesh Parakh   Okay. Thanks, Michael. A couple more questions coming in here. The next one is what if there is more than one attractiveness requirement, so I guess investment criterion. For example, the IRR level and GHG emissions level. So that might be combining different policy elements.

Michael Ross   Yeah, well, you could set up a table. For instance, even in the back here there is a—in the tool section you can have your custom spreadsheet here, and you could setup a column which includes options, and then you could have IRR and GHG reductions. And then you could go through and investigate different options, policy option one, which might have an IRR of, say, 10 percent, and then have GHG reductions of, I don't know, 500 tons. And then you could have policy option two and go through.

And if you have criteria for both your IRR and your GHG reductions you're going to be able to go through and look at which rows in these tables satisfy both of your criteria, and then those would be the policy options that you would consider further.

Dinesh Parakh   And of course those can be done in—so, for example, as you demonstrate that example, you can put in GHG reductions credits and a feed-in tariff, plus, say, a concessional loan. You could put all of those in the same analysis, right, Michael?

Michael Ross   Yeah, that's correct. That was kind of the last example I showed there. So you're going to build a table there like this going back and doing your analysis over and over again over different sets of assumptions. So at the

table, and then consider the rows that satisfy your criteria. And of course there's going to be criteria beyond just the IRR and the GHG reductions. There's going to be tons of criteria related to the political feasibility, the availability of funds, whether this is just or not, that is whether poor people are subsidizing rich people, things like that. Those are all going to be important criteria.

So, for instance, the feed-in tariff that was implemented in Ontario, a similar tariff was rejected in the province next to Ontario, Quebec, because they felt that poor rate payers ended up subsidizing rich rate payers. So that's a consideration that's not encompassed in the analysis I've just done, but it is going to be important in terms of policy formulation.

Dinesh Parakh   Great. Thank you, Michael. We have just a couple of minutes left. I know we need to turn it back over to CESC for the closing. So we'll take one or two quick questions here. And again, just to let everyone know, if you do submit questions, we will respond to those questions in writing and send those to everybody. And just a reminder as well that if you require support, if you fit CESC's criteria, you can submit an official report for support through CESC on policy analysis with RETScreen, and we'll be able to provide much more substantial support in actually doing an analysis with you or for you.

Another question here, Michael, is can you also provide a general or short description of RETScreen Plus. So maybe you might just want to show the website there, where it is, just show—explain very quickly what it is and how it might be used for in the policy process.

Michael Ross   Okay. So RETScreen Plus is another piece of software entirely. So it shares the name, but it's not the same software. So if I go to the RETScreen website and I go to the opening page, it shows right up front that the RETScreen software suite, which is this free download, consists of two things, the RETScreen 4 and RETScreen Plus. So RETScreen 4, which is what we've just been looking at, is this Excel-based tool for evaluating the profitability and the technical viability and the financial viability of prospective or potential future projects. So this is excellent for the policy toolkit.

RETScreen Plus, on the other hand, is for projects that have already been built and where you're collecting monitored data. And with that monitored data, you're tracking the performance of those systems and you want to know, hmm, is my equipment performing as it should. Are there changes in the performance of my system over time that I should be concerned with? And you can do that with the RETScreen Plus software by comparing—by generating kind of a statistical model of what you expect your system to be doing and comparing it with what it actually is doing in your measurements.

And the statistical model will often be related to factors of influence, like, for instance, for photovoltaic system it'd be definitely related to the actual level of sunshine. So as that changes over the course of the year and from year to year that affects the output of your system. So you can correct for changes in the factor of influence using a tool like RETScreen Plus, so you can essentially normalize for weather conditions and end up with an estimate of

the performance of your system that's corrected for those weather conditions. And then you can identify if there is changes in the underlying performance of your equipment. So, for instance, if your PV modules are degrading over time this would help you determine that.

So two of them come with the RETScreen suite. The difference is RETScreen 4 is for prospective projects; RETScreen Plus is for projects that exist already and you have monitored data from. And that's actually a Windows-based tool. It doesn't run under Excel.

Dinesh Parakh   Thanks, Michael. And just a quick note that in the forthcoming RETScreen Expert, which will be out in the next couple of months, all of those are combined onto one platform, so it's not two separate pieces of software anymore.

All right. There were a couple more questions, but they're a little bit complicated. We're talking about here is a question of analysis of combined approaches to RE&EE, a tri-generation, things like that. So given that it's 11:25, I think what I'll do is turn it over to CESC now to close. And again, just remind everyone that we will do our best to get our responses to these questions to you within the next couple of weeks. So if anyone has any final questions please feel free to submit them. Remember also the Ask an Expert service.

So, thank you, Michael, and I'll turn it over to CESC then for the closing.

Tim Reber   Great. And thank you again both Dinesh and Michael. Great job. Great job answering those questions. And we can certainly download those questions and send them out to you so you have an electronic copy and can make sure to try to respond to folks, so that would be great.

Before we close real quick we'd like to take a minute and do a short survey. So if you could go ahead and please answer the first question that appears on your screen in a moment here.

Okay, great. And the next one. Okay, great. Number three. Alrighty, two more real quick. All right. Thank you. And the last one. Great.

Well, thank you again for the great presentations and for answering the survey for us. On behalf of the Clean Energy Solutions Center I'd like to send a thank you to all of our panelists as well as to the audience for your attendance. We very much appreciate everyone's time.

We invite you attendees to check the Solutions Center's website if you'd like to view the slides and listen to a recording of today's presentation, as well as previously held webinars. Additionally you'll find information on other upcoming webinars and training events.

We're now posting webinar recordings to the Clean Energy Solutions YouTube channel, and that should hopefully be up there in about one week. We also invite you to inform your colleagues and those in your networks about Solutions Center resources and services, including our no-cost policy support known as Ask an Expert. With that I'd like to ask everybody to please enjoy the rest of your day.