CLEAN ENERGY SOLUTIONS CENTER

Global Renewable Energy Status and Medium-term Outlook until 2018

—Transcript of a webinar offered by the Clean Energy Solutions Center on 9 November 2013—
For more information, see the clean energy policy trainings offered by the Solutions Center.

Webinar Panelists

Michael Waldron International Energy Agency
Christine Lins Executive Secretary, REN21

This Transcript

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Sean

Welcome to today's seminar hosted by the Clean Energy Solutions Center and REN21. We are very fortunate to have Christine Lins and Michael Waldron joining us. This great group of our panelists will be discussing the key findings from two reports, REN21's Renewables 2013 Global Status Report and IEA's 2013 Medium-Term Renewable Energy Market Report, Market Trends, and Projections to 2018.

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

And I just like to 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 to your computer, please select the "mic and speakers" options in the audio pane. Doing this will eliminate the possibility of feedback and echo. And if you choose to listen to the "telephone," a box on the right side will display the telephone number and the audio PIN that you should use to dial in.

And panelists, we just ask that you please mute your audio device while you are not presenting. And if anyone has any technical difficulties with the webinar, you may contact the GoToWebinar's Help Desk at 888-259-3826 for any assistance.

Now, we encourage everyone to ask questions throughout the webinar. To ask a question, please use the "questions" pane in the GoToWebinar panel. You can type in your question there and submit it, and I will present those questions to the panelists during the Question and Answer session.

And if you have any difficulty viewing the materials through the webinar portal, we will be posting PDF copies of the presentations at

cleanenergysolutions.org/training, and you may follow along as our speakers present, and I'll be sending out that link as well in a few minutes. Also, an audio recording and the presentations will be posted to the Solutions Center training page within a week of two of this presentation.

So, we've a great agenda prepared for you today that is focused on a comprehensive overview of the renewable energy market industry, investment and policy development worldwide, as well as an assessment of market trends for renewable electricity, biofuels for transport, and renewable key factors in identifying drivers and challenges to deployment and projection through 2018.

So, before our speakers begin their presentations, I'd to just 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 followed by any closing remarks, and then, a very brief survey.

This slide provides a bit of background in terms of how the Solutions Center came to be. The Solutions Center is an initiative of the Clean Energy Ministerial and is supported through a partnership with UN Energy. It was launched in April of 2011 and is primarily led by Australia, the United States, and other CEM partners. Outcomes of this unique partnership includes support of developing countries through enhancement of resources on policies relating to energy access, the no cost expert policy assistance, and peer-to-peer learning and training tools such as the webinar you are attending today.

The Solutions Center's four primary goals. It serves as a clearinghouse of clean energy policy resources. It also serves 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 enables expert assistance, learning, and peer-to-peer sharing of the experiences. And then lastly, the center fosters dialogue on emerging policy issues and innovation around the globe.

Our primary audience 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 civil societies.

One of the more key features of the Solutions Center is the expert policy assistance. So, Ask an Expert is a valuable service offered through the Solutions Center at no cost. We've 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.

So for example, on the area of Renewable Energy Policy, we are very pleased to have Paul Komor of Renewable and Sustainable Energy Institute serving as our expert. And if you have any need for policy assistance on renewable electricity or any other clean energy sector, we

encourage you to use this useful service. Again, the assistance is provided free of charge. So to request assistance, simply go to the cleanenergysolutions.org/expert and you can submit your request.

We also invite you to spread the word about this service to those in your networks and organizations. So, we encourage you to explore the Solutions Center and take advantage of its resources and services including the expert policy assistance, subscribe to our newsletter on the homepage, and participate in webinars like this.

Now, I'd like to provide brief introductions of our distinguished panelists. First off is Christine Lins, the Executive Secretary of REN21. Christine will be providing an overview of the key findings from the Renewables 2013 Global Status Report. Following Christine, we will hear from Michael Waldron of the International Energy Agency and he will be discussing IEA's 2013 Medium-Term Renewable Energy Market Report, Market Trends and Projections to 2018. And with those introductions, please join me in welcoming Christine to the webinar.

Christine Lins

Thank you very much, Sean. Good morning/good afternoon, ladies and gentlemen. It's my pleasure to be here with you and speak at today's webinar, which gives an overview on the global status of renewable energy as well as medium-term outlook. We are particularly happy to have partnered with the International Energy Agency and I am very happy that I Michael Waldron is here with me to share insights of the IEAs report. *Together, they nicely* compliments the global status report of REN21.

Who is REN21? In a nutshell, we are a multi-stakeholder policy network grouping *sectors* from government, international organizations, industry associations, NGOs, as well as Science and Academia. Here you see that among the international organizations, the IEA is one of our members along with IRENA, the International Renewable Energy Agency. We have a series of governments and global industry associations covering all sectors of renewables. Our secretariat is based at the United Nations Environment Program here in Paris, in France.

I will be presenting today in a nutshell, the findings of REN21's annual [inaudible][00:07:43], publication of the Renewables Global Status Report. That is a report that is launched every year in June, giving an overview on the global market, industry trends, policy landscape in the field of renewables covering all technologies, covering all sectors of both power, heating and cooling, and transport, and having a special focus on the rural renewable energy in developing countries. It is based on input from over 500 contributors and researchers from all around the world, and is launched together with UNEP Frankfurt School, Bloomberg New Energy Finance Global Trends in Renewable Energy investment.

In this year's report we had a particular feature on system transformation as we see that high shares of renewable energy require specific attention to integration of renewables into energy systems.

So, let me take you through the findings of the Global Status Report in a nutshell. We do portray the top markets in the world both in terms of new capacity investment as well as total capacity investments and they're both overall of all renewable sectors as well as in different technology key areas. There, you clearly see that you have China in the pole position in many countries. Now, as far as new investment was concerned in 2012 followed by the US, Germany, Japan, and Italy. And then actually, you will see the different countries emerge. We see more and more countries from other emerging economies, but also from Africa and from Latin America joining the OECD countries in this top [inaudible][00:09:48] table.

What does renewable energy represent in the world? In 2011, renewable supplied an estimated 19% of global final energy consumption. As you see here on the graph, that is composed of approximately half of modern renewables including sustainable hydropower, and another half of traditional biomass. And you will see that the shares of the modern renewables is rapidly increasing whereas the share of traditional biomass is going down.

What does it mean now in terms of power markets? Renewable energy comprises about 26% of global power generation capacity and about 22% of global electricity is produced from renewables. We saw in 2012, renewables accounted for just over half of the estimated 280 gigawatts of new electric capacity that was installed. That means, basically, more than half of all the new power plants that came on were renewables based in some parts of the world like the European Union. This year it was even higher. In 2012, 70% of all new power capacity that was added was renewables based with a lot share of PV. So, you see the—actually the green share of the powers being the PV contribution.

As I said before, we ought to not only look into the electricity market, but we also look into heating and cooling as we are aware that this sector often does not get so much attention as the electricity sector. However, there is a big potential for renewables be it in the form of biomass and geothermal energy to provide heating and cooling on the one hand. And on the other hand, this is really an important sector when you look into how time and energy is actually used.

So, we generally *remark* transition towards use of larger systems in the field of heating and cooling, increasing use of combined heat and power for district schemes and industrial purposes. We see these solar collectors are now spreading to more than 56 countries for water and increasingly for space heating. And far as transport is concerned, on the one hand, liquid biofuels provide about 3.4 % of global road transport fuels. And on the

other hand, we see that electric transport is being promoted in many countries. Often, these policies are directly tied with renewable energy promotion schemes particularly at the local level.

Now, let me, in a nutshell, take you through some of the technology key areas. In the field of hydropower, about 30 gigawatts of new capacity was added in 2012 that increased the global capacity by about 3% bringing that to 990 gigawatts, and globally, hydropower generated 3700 terawatt hours of electricity. We see a growing prominence of joint venture business models involving local and the international partnerships as the size of the projects increase, and we see more and more a trend towards sustainable hydropower. The hydropower industry had been developed the sustainability *protocol* together with representatives from the international community and NGO sector.

As far are solar photovoltaics is concerned, 2012 was an interesting year when global operating capacity of solar PV reached the 100-gigawatt milestone. So when you look at this graph, you will see the very rapid increase over the last couple of years. Basically, when you look at the graph, you will see that it took us about 15 years to get from zero to 40 gigawatts and in just two years, we more than doubled this amount and there are many scenarios that totally are the estimated—the contribution of PV, and there are many scenarios that effectively project a much lower increase. What we have here coming with this rapid increase is that prices of solar PV modules fell. They fell already significantly in 2011. They fell again by more than 30% in 2012 partly due to overproduction posing some challenges for the industry, but in general, also with the prices coming down which is the—that the markets with PV are diversifying and we see that more and more countries are really putting in place renewable energy policies, and particularly programs for promoting PV and wind.

So when it comes to wind, in 2012, almost 45 gigawatts of wind power capacity came in operation that increased the global capacity of 19% to 283 gigawatts. And overall, we see annual growth rates of cumulative wind power capacity emerging 25% between 2007 and 2012.

Solar thermal heating and cooling, there are also significant and continuous growth. Global solar thermal capacity reached an estimated 255-gigawatt thermal for glazed water collectors and as I mentioned previously already, we see a growing trend to use solar resources to generate process heat for the industry. So, more and more high temperature assistance.

In the field of bioenergy, the use of biomass in heat power production as well as in the transport sector increased. Bio-power capacity was up 12% to about 83 gigawatts. And on the chart here, you'll see the bio-power generation of the top 20 countries. The US clearly in the pole position before Germany and Brazil.

So, when it comes to jobs, worldwide renewable energy employment continues to increase. There are an estimated 5.7 million people working in the renewables sector whereas the bulk of investment remains concentrated in Brazil, China, India, the EU, and the United States.

As far as investments are concerned, 2012 was an interesting year. On the one hand, we see that global new investment in renewable decreased 12% from the previous year's record to USD 244 billion. These are figures from Global Energy Finance. It decreased, but it was still the second highest amount that was ever invested in the renewable sector. As I've pointed out before, installed capacities continue to grow due to fall in technology costs, the investment that was more effectively done, but also some market showed quite some instability, and then, [inaudible][00:17:50].

So in general, we saw in 2012 a continuous shift in the balance of investment activity between developed and developing economies. And the shift was actually quite dramatic in the sense that developing countries out of these 244 billion reached USD 112 billion of investment which is an increase of 34% compared to 2011, and represents about 46% of the world total. So, nearly half of all the investment that is done with the renewable sector is done in developing countries and emerging economies, and they increased significantly throughout the last eight years, whereas developed countries there and especially in the US, and in Africa, and in Europe, their investment failed by 29% to 132 billion, and was the lowest ever since 2009. There are different reasons for this. Of course, financial crisis on the one hand, but also the changing policy landscape in the US stopping of the production takes credit for example. And when you actually look at the repetition of investment years on this graph, you will see the quite dramatic decrease in the United States and in Europe, significant increase in China. China invested about USD 67 billion in the renewables field, their highest amount ever. Also, quite significant increase in the Middle East where we have a lot of policy frameworks emerging and a lot of interest in renewables, as well as in some other parts of Africa, South Africa particularly well last year, and as well as in—effectively in the Americas we saw an increase.

The global status report also tracks policy developments, and there, we see that about 140 countries around the world now have renewable energy targets in place. The number of countries with targets has more than doubled between 2005 and 2012, and more than half of the countries are countries from the developing and emerging economies. So, we clearly see that the geography of renewables is spreading and countries are becoming more and more interested in putting renewable energy frameworks in place.

We see on the one hand that policymakers are becoming increasingly aware of the potential of national development through renewables. However, we also see that in some parts of the world, especially in the European Union and in the US, there were some policy changes which of

course impacted on the industry and sometimes, especially in some European countries, these changes were retroactive which make it even more complicated.

There is a campaign, and initiative of the UN secretary general which is called sustainable energy for all, which consists about ensuring universal access to modern energy services for all by 2030, which consists about doubling the global rate of improvement in the energy efficiency, and about doubling the share of renewables in the global energy mix.

Earlier this year, under the coordination of the International Energy Agency and the World Bank, in cooperation with many other agencies including REN21, we launched a global tracking framework, the kind of baseline that provides baseline for how these targets can be—should be met and gives an outlook. And basically, we see in the field of renewables the base year is 2010. So, this doubling of the shares of renewables means an increase from 18% to 36%, which when looking at different scenarios, is something that is considered feasible. It will not be feasible and reachable with conservative business *institution* type of scenarios, but clearly, scenarios putting their focus on energy efficiency and renewables are actually showing their achievement of the system energy for [inaudible][00:22:47] by 2013 is something absolutely feasible.

However, in order to make this really happen, it would take bold policy action aimed at tripling the share of modern renewables including sustainable hydropower. While you recall my slide at the beginning, you saw that the currency of renewables is on the one hand composed by modern renewables as well as a share of traditional biomass which it is not the objective of this campaign to increase this for clearly modern renewables need to grow more rapidly. In order for this to happen, stable and predictable policy frameworks are key and then think what is also—what would be very important is that both centralized and decentralized renewable energy solutions are actually considered. For this, phasing out of untargeted fossil fuels subsidies will be indispensible. We see still that renewable energy support is more than six times less than fossil fuel subsidies and as we see in the discussion arising in many parts of the world, the aspect of integrating renewables into energy systems both economically and politically, and technically, will become more and more important as the renewable share continues to increase. This opinion is only possible through very close cooperation between the public and the private sectors, something that many of us including REN21 put the focus on.

And with this, I would like to thank you for your attention and head back to the moderators and to Michael for his presentation.

Michael Waldron Hello. This is Michael Waldron. Thank you very much, Christine. That's a very good back draft from which—for me to present the IEA's medium-term outlook. I think I'm going to echo a lot of the similar scenes that

Kristine presented in her presentation. So, thank you to you, and also thank you for the organizers for having me for this event. I have the organizers actually turning the slides for me, so, I apologize to everybody in the audience for me saying "next slide" everytime, but that's the way I have it set up here. So Heather, if you could go to the next slide?

So, I will give you a brief introduction to the report. It's called the Medium-Term Renewable Energy Market Report. This is the second annual edition of the report. It covers much like the REN21 Global Status Report, the electricity biofuels and heat sectors, and this report is done within the context of other IEA medium-term report. So, the IEA also produces medium-term outlooks on coal, oil, and natural gas. So, the forecast here represents a coordinated view with those other sectors.

What makes this report distinct and what makes this—its strength basically derived from having a detailed analysis at the country level of the drivers and challenges for a renewable deployment. And we go about this analysis by looking at the policy support available for renewables, the general electricity regulatory framework in a country. We look at a country's expectations in power demand, the composition of the current energy mix, and potential competition among fuels, and we also look at grid integration.

The map on the bottom right shows you an interesting case study of Japan where grid integration is an issue where Japan has *10* separated, vertically integrated, and not very well interconnected market. So, we look at all these factors when we're looking at the outlook for the next five years.

The way we treat electricity, biofuels, and heat is slightly differently. So, on the renewable power side, we do a bottom up capacity in generation forecast with country case studies. You can see the countries that we have listed on the slide. The ones in red are the new case studies that we did this year. So, we actually have added quite a few countries this year. Many of them emerging market countries. That said, we do a forecast for every country in the word and that's reflected in the regional and global aggregates, but in terms of the analytical focus of the book in terms of the writing, it's really these country case studies which are the *meats* of the book.

On biofuels and heat, we also do a lot of analysis, but we approach it slightly differently. We do a bio-sales production forecast by country both for ethanol and biodiesel, but the discussion in the book is more of the regional level. We're also addressing the policy issues and also looking at cost. For renewable heat, this is the first time we are doing renewable heat in terms of a medium-term outlook. For renewable heat, we're looking at it more from a regional breakdown although we do a country level bottoms-up analysis when it comes to solar thermal heating.

So that gives you a little background about the report. Heather, could you go to the next slide? And I will present to you the main findings from the electricity side, from the biofuel side, and from the heat slide over the next three slides. There's a couple things going on in this graph, but there's a couple key messages which I think are worth pointing out.

The first is our outlook for global renewable electricity production, which is shown by technology, we see renewable electricity scaling up by about 40% over 2012 to 2018 in absolute terms, so, in the number of kilowatt-hours that that 40% represents. This is actually a larger increase that we foresee in 2012 to 2018 versus 2006 to 2012. So, one could say that the increase in the renewable generation is increasing over time, the way we have it in our forecast.

Another key message is to note that—and this shown by the dotted line with the scale on the right—is that the renewable electricity, we expect to rise to about 25% of global electricity generation in 2018. This is up from 20% in 2012. It sounds like a small increase, but in terms of where renewables have oscillated in terms of the role and their electricity makes, it's actually quite a large increase that we are seeing over the next five years. And so, [inaudible][00:29:22] expect for renewables to surpass natural gas and roughly double that coming from nuclear output. You can see those two bars in 2016. This is, we would say, maybe a conservative estimate this surpassing can actually happen earlier than that perhaps.

A third key message from this slide is to look at where renewable electricity stands in terms of the IEA's own scenario work in terms of the IEAs in 2° Scenario which basically is a scenario which says what the global energy sector needs to look like in order to put the world on the process of two-degree increase this century. So roughly at this point in the forecast, the renewable electricity is on track to meet those goals in 2020, but it's also worth remembering that the 2° Scenario of what we're showing here is just a portion of the energy system. There's also other areas such as energy efficiency and carbon, capture, and storage, where the picture may be a bit different. Next slide, please?

Looking at biofuels production on a global basis, the outlook for biofuels is a bit slower than that for renewable electricity. Biofuels is projected to grow significantly, but at a slower phase, and it phases an increasing number of uncertainties which affect the outlook. Roughly on average, biofuels are expected to grow by about 3.5% per year to reach around 2.4 million barrels per day in 2018 on an energy-adjusted basis which the biofuel is providing almost 4% of global road transport demand in 2018.

Where the uncertainties come from in the forecast? Primarily, from two areas and they are related to policy. One of them is the European Union where there's draft legislation that they could potentially limit the use of food-based biofuels to5% of energy demand in the transport sector, and the other is in the US where there's increasing uncertainty over the

renewables field standard and what it will be next year and also in subsequent years given problems *absorbing* ethanol into the system in the US and also the slow development of evidenced biofuels.

What is not on the slide is a chart showing our outlook for advanced biofuels which we have in the book. Advanced biofuels, we also see expanding over the medium-term, but from a very low base and quite frankly not quickly enough. We don't see admitting cost reductions in advanced biofuels to see a large amount of deployments over the medium-term, but this could change with unexpected cost reduction or a greater move towards commercialization.

Next slide, please.

This slide shows you the global picture of renewable heat. We see final energy use of renewables for heat rising by almost 25% over the forecast period. It is very important to note in this graph that traditional biomass is not included. So, we're only including modern sources of renewables for heat. So this indicator we're showing here, the percentage of renewables in the heating factor is not directly comparable with that that Kristine described in sustainable energy for all. When you take out traditional biomass, you'd see that the share of renewables in heating is still rather limited, but it started to grow more rapidly since 2011 reaching around 9% to 10% by 2018. The heating sector is, of course, a very large potential in terms of its *exploitation*, but to-date, we have not seen enough attention from policymakers.

In terms of the technologies, renewable heat is still dominated by biomass, but solar thermal use for heat is also growing quite rapidly and we actually expect solar thermal use for heat to more than double over 2012 to 2018.

In terms of the country drivers or the regional drivers, we see China and now we see the Europe driving most of the activities not only in solar thermal, but in the renewable heating in general.

Next slide, please.

The next two slides will give you a bit more explanation on the renewable electricity size of what the major driver of our forecast are. So, one of the major drivers or at least the first reason why we see renewable electricity growing robustly over the medium-term is that we see renewable power deployment starting to spread out on a global basis. This map shows you quite clearly that over the medium-term emerging markets, they are starting to compensate for some of the slower growth or maybe some of the more volatile growth that we expect to occur in Europe and the United States, particularly worth noting the graphs you see in Asia. Some of the largest upper derivations we had through this year more in China, in the Middle East, and also in Japan. And increasingly, these emerging markets are driving the forecast over the medium-term.

Next slide, please.

This slide right here shows basically the same thing, but it shows it in a different way. So now, we're looking at different technologies, we're showing the diffusion of different technologies, and we're counting the number of countries where we see a threshold level of deployment. So, we hold that to be about 100 megawatts. And this focus on non-hydro, and as you can see, non-hydro renewable electricity development is becoming increasing more wide spread. This is a more optimistic picture.

We showed the same graph in MTRMR 2012 and the bars for particularly onshore wind and solar PV in 2018 are higher than they were for last year, the addition of the publication in 2017. It's interesting to note the darker shaded parts of the column show you the non-OECD look and how in particularly in onshore wind, bioenergy, and solar PV, the incremental countries which are adding capacity are very much dominated by the non-OECD.

Of course, the diffusion of different renewable technologies does not produce—is not occurring at the same phase to cross all technologies. You can see the offshore wind is relatively slow and expanding, and a lot of the deployment have concentrated in the OECD. In CSP, even though it becomes a bit more diffused between the OECD and the non-OECD in 2018, there are still relatively a few countries where significant CSP capacity is deployed by the end of the medium-term.

Next slide, please.

And the second large reason for the robust outlook for renewable electricity is that not only our renewables deploy into more markets, but they're also—the competitiveness of renewables is increasing in a greater number of countries and circumstances. The most dynamic technologies, onshore wind and solar PV, we see them increasingly competitive in a number of markets. For solar PV, it's not just a question of being competitive at utility scale, but it's also and sometimes more of the case of being competitive on a small scale particularly in markets like Southern Germany and Southern Italy, Southern California.

The cost of solar PV have dropped by around 28% to 30% during 2012 and onshore wind cost continues to fall. These reductions in system cost are opening up more opportunities for a competitive market deployment particularly the kind of deployment is occurring with also little financial support in some areas with rising energy needs, good resources, and predictable long term revenues. And an example we would give for this would be wind deployment which is occurring in Brazil in some other South American countries.

Next slide, please.

Now, the next two slides will give you a bit more detail on the technology portfolio that we see unfolding for renewable electricity over the medium-term. It's important to underline that the growth we see in the renewables is from a portfolio of renewable technologies. In the past, hydropower is pretty much worth many of the non-hydro technologies in terms of generation, although hydropower is the largest deployer in terms of new generation over the medium-term when you actually add up a little slices of non-hydro generation that we expect over the medium-term.

So, the first time we actually these non-hydro slices on an aggregate basis larger than hydropower in terms of incremental generation. But it's also worth noting that many people believe that hydropower, it's potential is already exploited, and if there's a little upside at least in the next five years, we'd see a lot of new hydropower coming online particularly in developing markets in Asia and Latin America. The interesting take away from this slide is that this is non-hydro portion of the renewables portfolio is very much picking up.

Next slide, please.

In this portfolio, we see being led by winds at least in terms of global capacity edition. This graph right here shows you the outlook for total wind capacity edition by region. This is onshore plus offshore. Of course, the onshore part of this is much larger than the offshore and the offshore is relevant mostly in OECD Europe over the timeframe. The onshore outlook is more optimistic than we had in MTRMR 2012 particularly in emerging markets, also somewhat in the US based upon a stronger than expected 2012 baseline, but then again policy uncertainties make the additions profile volatile in some areas. And we would also point to the US in terms of this volatility, you see the large spike in wind deployment in 2012 in the OECD Americas, and then the sort of [inaudible][00:39:21] going 2013 where deployment goes down to much lower levels. This has to do with policy uncertainty over the renewable of the US's production tax credit. And if this type of uncertainty which can make the deployment pattern volatile. In other regions, we see China's deployment slowly rising over the forecast period. Of course, this will depend much on China's ability to continue to integrate more wind into a system, and we here are relatively flat. But this is a mixture of increasing offshore wind deployment while onshore wind annual edition will start to gradually decrease. In that sense, the Offshore Wind forecast overall, and I'll show this on a later slide, is more pessimistic than the MTRMR 2012 with financing and integration challenges weighing upon some of the deployments.

Next slide please.

And we see where we are much more optimistic in this year's edition versus last year's edition is in terms of solar PV annual edition. A lot of this optimism is driven by what's going on in Asia, so we revised up

China significantly, we've revised up Japan significantly based upon incentives offered in those countries but also the falling cost of solar PV system and generally, more supportive policy in market frameworks for the deployment of solar PV particularly on the small side but it is also partly used in the Middle East which is kind of a new comer in our forecast where we see a bit more or we see some solar PV starting to emerge over the medium-term. And this is a good thing that solar PV is starting to transition to a greater number of markets and is starting to transition out of Europe. One of the biggest problems in the past is, the PV growth has been relatively concentrated in just a few years in countries. This has led to so called PV bubbles and concerns about the impact of PV on retail electricity prices. So the fusion of PV is a positive sign that deployment is transitioning and it's starting to occur in areas where perhaps it is more competitive and there is more resource availability. With that said, we still see the danger of a PV bubble potentially emerging in Japan due to the very high levels of incentives there and so far, the slow level of adjustment relative to falling PV system prices. In terms of the market or in terms of where we see the annual editions, we see China becoming the first world market in 2014, but as you can see the solar PV deployment starts to pick up in most regions of the world. We also see decentralized solar PV having a greater and greater impact over the forecast period.

Next slide please.

So this slide gives you an indication of where we see other technologies that are perhaps not deploying as rapidly and these are two technologies that we revised down in this year's edition of MRMR Offshore Wind in concentrating solar power. Of course, the potential of offshore wind remains very high but technical financial, and good connection issues are opposing challenges and deployment remains relatively concentrated in Europe as of now. CSP has more diversified opportunities in terms of geographical location, it also has the added value of storage and it can also be a detachable power source but it's still hampered by relatively high costs particularly related to the solar PV.

Next slide please.

This slide right here just gives you an indication of where we see different countries in terms of the ranking of incremental generation and also average annual growth over the time period. I'm not going to read off the countries. You can see them but it's very interesting to see that, of course, the big countries dominate the average annual or the incremental kilowatt hours that we see over the medium-term but it's worth noting that you have some emerging market that are actually growing rapidly in percentage terms. You have two African countries, one and two, in terms of average annual growth, Morocco and South Africa. But if you were to go beyond just the focus countries that we have in the report and you wanted to look at the average annual growth across all countries in the

world, you would see some other interesting countries emerging in the scale largely concentrated around Asia, the Middle East and Africa.

Next slide please.

And the reason for this diversification in terms of country deployment is that we see the non-OECD basically accounting for the majority of renewable growth over the time period. So we see it accounting for 2/3 of renewable power growth. In 2018, the non-OECD comprises 58% of total renewable generation. This is up from 51% in 2006. Of course, a lot of this growth is led by China and I will talk about China on the next slide but the final bullet gives you an indication of where other growth is occurring and the technologies that we see are relevant. Of course, hydropower, I've excluded from the bullet point but hydropower would of course be irrelevant in the first two on Brazil and India and also Thailand to an extent.

Next slide please.

The slide shows you the picture for China over the medium-term, China dominates many of the categories in terms of renewable deployment. China deploys a real portfolio of renewable technologies and there are a wealth of drivers that are really depending on China's forecast. Strong government support through their 5-year plan, availability of low-cost financing, increasingly attractive economic but also attractive permitting rules and great connections rules related to small scale solar project and a robust manufacturing and technology development and domestic level. Of course, the ability of China to scale up to this extent will depend in large part of their abilities to integrate larger amounts and variable renewable particularly when it comes to Onshore Wind. It will also depend on China's ability to stimulate deployment of some less matured technologies such as Offshore Wind where China has a very aggressive target. These will be major risk factors to the outlook going forward.

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Now, of course, despite the fact that the non-OECD is growing very strongly, we also do see a very robust growth occurring in the OECD. In fact, renewable electricity is basically the dominant source of incremental growth and power generation over 2012 to 2018. As you can see on the column on the left where renewable's basically dominates new generation coming online in the OECD. Of course, the picture differs by region going from right to left. Europe is very much dominated by a renewable to a large part crowding out fossil fuels and also with nuclear declining. In Asia Oceania, it's a bit of a different story and a story—and large part depends on the ability of nuclear power to increase again in Japan which is a bit of an uncertainty over the medium-term, the degree and to the extent which Japanese nuclear power will come back and then in the OECD America, the renewables are also growing strongly but they're second to

natural gas which still enjoys very attractive economics in terms of generation of the medium-term.

Next slide please.

And on the subject of renewable power and natural gas, we put this slide together just to basically show and I'm not going to read all the points but to basically show that the relationship between renewables and gas can be quite different depending on different regions you're looking at. It's our view that renewables and gas can be complementary to each other and they can both grow strongly within the global energy system but also on a regional and country level. It's important to remember in terms to meet longer-term climate change goals, in terms of meeting longer-term climate change goals under the 2DS. Coal-to-gas switching can lead to a large reduction and CO2 emissions but gas is not enough to get us to climate change goals. So it carves out a very important position of renewables in terms of meeting climate change target over the medium-term and over the long term.

Next slide please.

This slide is from the World Energy. I've look from last year's World Energy outlook and it shows the new policy scenario and it shows the outlook for renewable in terms of the different fuels on a global basis. And the important thing from this slide is to note, over the long term the IEA also does a very large role for renewables. Indeed, renewables are the fastest growing segment in the power sector, renewables starts for approach call as a primary source of global electricity by 2035 and the account for almost 1/3 of electricity output, and within technology solar grows more rapidly than any other renewable technology within the real scenario.

Next slide please.

But to realize this longer-term vision for renewables as well to realize the robust outlook that we presented over the medium-term, it's worth assessing some of the risks against this. And from our perspective, the number one risk to slowing renewable deployment or for renewables not meeting their goals is policy uncertainty and this slide here gives you two pictures of policy uncertainty and their effect on deployment both in terms of historical deployment but also in terms of what we're projecting over the medium-term. So you have one example in Spain where you have abrupt retroactive policy changes related to solar PV deployment which was too fast and too much in 2008 and the phase was very a generous incentive and then you have a very flat profile going forward because of many of these changes which occurred on the policy side. In the US, you have an example of Stop and Go policies where you have a volatile deployment pattern of onshore wind related to the branding uncertainty

over the production tax credit in the US for onshore wind and whether or not it'll be renewed.

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Some conclusion to realize this long-term vision for renewables and to see renewables to fulfill their long-term potential, we put together a couple conclusions for policy-makers and the first that they—many renewables no longer require high economic incentives as I showed earlier as renewables spread out to more countries and particular places where resources are better and as cost come down, it's becoming less and less necessary to support renewables with high level of economic incentives. But what they need is that they do need long-term policies that continue to provide a predictable and reliable market and regulatory framework that's compatible with societal goals. So a consistent policy framework in our minds is more important than the designation of a specific renewable incentive type as well as important for countries to reduce non-economic barriers but the competitiveness of renewables will ultimately depend on the market in which they operate which means that market design becomes very important. And from our perspective, having fair rules for upfront capital-intensive technologies and distributed generation will be keys and one example of this as we cite in the book is—one example to achieve this is having competition over long-term contracts. So renewables are capital in sense of technology. They benefit from having long-term remuneration available to them to reduce both their financing costs but also to increase investor certainty. And some of the competition of a long-term contracts that we've seen in Brazil and other places in Latin America is one way that we've studied and to ensure investments.

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So that concludes the presentation from my side and if you want further information, you can go on our website and yeah, I'll be turning over to the organizers now and be happy to take any questions.

Sean Esterly Yes. Thank you very, Michael and thank you Christine for the great presentations. We do have some questions that came in. I do just want to remind the audience that they can submit any questions they might have through the question pane in the GoToWebinar panel. The first question, I'd like to start with this one because your conclusion did cover it a little bit Michael but perhaps you and then Christine can expand upon it and that is, what can industrialized countries do to keep or what do they need to do to keep their renewable energy momentum going?

Michael It's a fairly broad question. I mean, there's a couple of ways of going out on this. I mean, from the IEA standpoint, it's important that to sustain and to support renewables as they transition to becoming more competitive, so even those renewables become more competitive and more situationed, there are still cases where renewables don't need financial incentives to

compete but at the same time, industrialized countries need to weigh the affordability with the deployment of issues. This is something that we're seeing in Germany in terms of the debate over how much policy support is needed and what can be afforded. So the government really need to put it in place and many government have done this schemes which are very long term in nature which are also flexible at the same time so that they're able to respond quite positively to move in from the renewable cost as renewables increase in competitiveness making them respond dynamically so as to minimize or to ease the burden in terms of the policy costs associated with it. For industrialized countries, it's really a tricky interplay between helping renewables transition towards competitiveness as the same time maintaining that support scheme to be affordable. The question can also differ depending on—the answer differs depending on what technology you're talking about too. For the more dynamic technologies like Onshore Wind and solar PV countries need to use a dynamic approach in order to reduce the incentives over time as policy or the system costs come down. But, with things like Offshore Wind and CSP, it may be necessary for governments to keep supporting these technologies for longer not just in terms of deployment incentives but also in terms of incentives for research and development. There's one last aspect to it which is related to the integration of variable renewables which in many countries, they can handle a large amount of variable renewable in the system from IEA work which is also coming out in January, the IEA's producing a study on the great integration of variable renewables and we see most electricity systems can handle about 20% of variable renewables as a percentage of electricity generation without very big changes. But as you get higher and higher penetration, countries need to think about market design issues and they need to think about how to incentivize flexibility and assistance, so flexibility being characterized by dispatchable generation, by interconnection, by demand-side management and by storage where it makes economic sense. So industrialized countries will have to deal with this issue as they get higher in terms of the penetration of variable renewable and so, they need to increasingly think about market design that incentivizes these flexibility mechanisms.

Christine

So if I can add to Michael's answer, I want to say that effectively, developing countries and the situation variables, they need additional, they need new capacity, they need to increase the energy generating capacity so their renewables—having these as a very interesting option because these are solutions and are often decentralized and available and actually can be beat up and dispatched quite quickly. So this is a great option tool to ensure that energy excellence in many parts of the world is relatively increasing in a sustainable way. In the industrial world, we have a situation on the one we had in Europe. We have agent power capacity so I think there's a great momentum to replace old capacity to sustainable capacity in the form of renewables and effectively, in all our different emission reduction scenarios we clearly see the need for decarbonizing the ad sector and this will be only possible with significantly increasing the

shares of renewables. As Michael said, an emphasis has to be put on operation but we do have lots of examples here, Denmark or Germany, where much higher issues even though if electricity puts us from renewables from wind and solar, it actually can be integrated into the system. I think what we need to do there is I think integrated solutions in Europe for example think often integrated policy system that do not make electrons action to stop at national boarders and with these, there will be the possibility of incorporating much higher shares of renewables that we currently have in the system.

Sean Thank you Christine and Michael for the answer. I'll move on to the next question which was presented based on Michael's presentation and the attendee noted that solar energy production is still less in percentage in biomass despite great increases in PV efficiency recently. Could you talk a little bit about the factors that contribute to that?

Michael Contribute to the increase in the solar PV efficiency or?

Sean No, to solar energy production still being less in percentage than biomass.

Michael Okay. I mean, solar deployment has been rapid to date but yeah, there still is a significant amount of bioenergy capacity and also generation that's already out there and I didn't emphasize so much bioenergy in the report but before talking about solar, it's also worth reiterating that bioenergy has been a in a general material a renewable technology and has been an important part of the renewable portfolio of many countries for a long time now. So bioenergy in a sense has been a more established and mature technology for a longer time than solar PV. So this is likely one reason why the generation was larger but also, bioenergy just tends to run. For a given capacity, it tends to run at higher capacity factors. Solar PV, it tends to run at lower capacity factors so a one-to-one increase in bioenergy or solar PV capacity would produce more generation on the bioenergy side than it would on the solar PV side. So today, I think those are the reasons why bioenergy is larger than solar PV but it continues to be the case that solar PV continues to increase at a quite rapid pace and we expect this to continue over the medium-term. In fact, solar PV is the area that we've revised up the most in our report this year and so, we've only done two forecasts but it seems that the forecast that we've made for the current year in terms of solar PV deployment has so far come out to be a bit conservative so solar PV continues its pride to the outside. A big reason for this is because of its cost reduction over the past few years but also because of its modularity and ability to scale up quite quickly and the adoption of supportive policy frameworks by an increasing number of governments around the world. So I mean over the medium-term, we see both growing quite strongly. I don't know offhand what the comparison is between 2018 where we see bioenergy in terms of the percentage versus solar PV, the total percentage, I don't know the numbers offhand but we see a growing role for both of them over the medium-term although the bioenergy sector tends to be a bit difficult to characterize in terms of just

saying bioenergy, there's many segments, there's increases in co-firing, there's conversions called to bioenergy conversions which are driving the forecast and also activity and smaller forms of bioenergy like biogas. So it tends to be a less uniformed sector than solar PV. So it makes it a bit difficult to make the comparison but I hope at least in Nat Sci. I answered the question.

Sean — Yes, I think so. And the next question has to do with incentives and PV cells. What do you see as the impact of the current incentives provided to solar PV cell manufacturers in China on the overall growth potential of the solar PV deployment across the globe? And the second part of that question is, should we expect a cost correction when the incentives expire or do you think that cost will continue to decline?

Michael — We don't really focus so much on the incentives given to the manufacturers. On our analysis, we focus more on the incentives on the deployment side. So I can't really comment on the really specific aspect of the question in terms of the durability of incentives given to Chinese manufacturers. What we are seeing in China is, we're seeing a much more attractive deployment environment for solar PV not just on utility scale but particularly on a small scale. So we see China emerging as a significant—China's domestic market emerging as a significant sort of absorber of some of the global PV access capacity that's been in the market in the past few years. There will still likely be a bit of excess capacity in terms of solar PV manufacturing capacity. This means the potential for us still continue consolidation in the industry over the next year or two or maybe even three but as China's deployment begins to step up and deployment steps up in other emerging markets, Japan I would know as being a strong source of deployment at least this year. It's likely that this excess supply in solar PV is likely to come down over time. This is one reason why solar module prices this year are relatively flatter, at least they're relatively stabilized but we don't give a specific outlook for solar module prices or solar stuff prices over the medium-term and we don't really comment on what we think the impact will be on the manufacturers. We're much more focused on just looking at the deployment that's likely to occur at the country level.

Sean — Great. Thank you, Michael. This next question is tied in a little bit to that. Could you talk a little bit about the bubble phenomenon that occurred in the PV technology sector and why it only occurred in that sector and why PVs were intensively relied upon—why they were relied upon financial incentives so strongly?

Michael — I think the bubble occurred in the PV sector because PV is a very easy and quick to deploy PV. The cost of PV came down very rapidly over the course of several years and deployment was concentrated or it used to be concentrated in just a few European countries sole countries like Spain, Germany, Czech Republic, they were offering very generous incentives at the beginning and often times these policy incentives were not coupled

with mechanisms that allow the incentives to be adjusted quickly enough or they were not coupled with caps on the amounts of capacity that could be deployed under these incentives. So I think these reasons explain why we had PV bubbles and why these bubbles have occurred in PV and more than in other technologies. I think in large parts, these policy lessons have been learned by many governments although we still consider Japan to be a bit of a dangerous spot in terms of a potential PV bubble just because of high levels of incentives that's still present there. The robust deployment they have and to date the absence of any strong adjustment to incentive levels even in the face of falling PV costs. So I hope that explains why we see PV as being distinct and as being a bit more prone to the bubbles and other technologies.

Christine — But I think—maybe if I can maybe add to what Michael said there I think we should also bear in mind that PV is actually a technology that cannot only be deployed by utilities, it also provides also technologies very close to customers where you can even be have the regulation in place in the country, people can actually have their own rooftop PV systems and which is just to see that that is a very, very large buying from many consumers all around the world and then interest in renewables and there was also actually, I think quite some development and I think we continue to see this of both large scale insulations but also small rooftop insulations on buildings.

Sean — All right. Thank you both. This next question is a new topic so can briefly explain the meaning of integrated resource planning and in your opinion, is it essential for all countries to have this as a pre-requisite to planning renewable energy targets?

Michael — Who do you want to tackle that one first?

Sean — Whoever would like to. I think that…

Christine — Do you want me to start or whatever you want.

Sean — Go ahead, Christine.

Christine — Well probably, I think for any target setting, planning is really important approach and effectively—I think that the fact that now 100 countries in the have new branch policies chose that these target setting approach is something that is absolutely spreading, of course, the policy has to rely on that and facts and figures and I think what also is important especially when the generation of penetration renewable increases, it is important to have well targeted and well planned systems because effectively we move away from mainly centrally dominated energy system who are much more decentralized one and required different planning techniques than a system that is actually based on conventional resources where the planning is just different.

Michael Yeah. I would agree with what Christine said and let me add that the government—It's a message I'm echoing from before but as variable renewables become a larger part of the electricity system in different countries, the government really need to consider market design measures that intensifies the deployment of flexibility. And flexibility is not just looking at different forms of generation but it's also looking at what can be done on the demand side planning for transmission and interconnection and also storage where it's relevant or economic. So it's not just a matter of looking at different energy sources and then energy mix but also looking at some of the infrastructures surrounding it but also looking at the—the IEA just released a report of energy efficiency where we characterize energy efficiency being a hidden fuel but this also needs to be taken into account energy efficiency and also demand side response measures when government or electricity in energy systems are doing their planning.

Sean Great. Next question asked that, in your analysis, if you look at indirect ways of supporting renewable energy like the removal of fossil fuel subsidies and what is the relation of these with direct policies for renewable energy development?

Michael We have looked at this. I mean in more of a kind of qualitative fashion. I would say we haven't necessarily tested because in a 5-year outlook, we tend to take the policy environment as given in terms of what we expect of the next five years. So the current policy environment plus whatever would have announced or whatever is expected to come to be being over the next five years, so in that respect, the outlook that we give for the medium-term report is similar to the new policy scenario in terms of the parameters. And so with that context, we don't really look at a major reduction in fossil fuel subsidy because we don't really try to test how they would affect the forecast because we don't see them as likely at least in the next five years or as in the longer term. You could have more changes because of that. Reductions in fossil fuels subsidies I think would certainly help the noble sector but it's also a bit like when you're talking about car and pricing perhaps raising a price of carbon could potentially disincentivize investments in conventional or fossil fuel generation but it may not necessarily be the key to incentivizing investments and renewable generations. So you'll also need—within the renewables, you'll need policy frameworks and market framework which allow renewable to have long-term remuneration so that can measure it with the fact that renewables are very capital intensive. So looking at the fossil fuel side of the equation and trying to stimulate renewables just by changing the price structure of fossil fuels or either by adding a carbon price or removing fossil fuel subsidies is certainly important but that in itself is probably not enough to continue to stimulate renewables on a large scale. And to continue to attract the finance to the sector, you'll really need to have frameworks in place that allow renewables which are capital intensive but

also low marginal costs to enjoy long-term remuneration either through power-purchase agreements of some kind of contractual arrangements.

Sean — Good. And you actually touched on something for the next question. I was hoping you and then Christine could expand us on the carbon market and their ability to pick up perhaps some of the room left by the lack of subsidy for renewable energy or what is their ability and what roles do they have to play and promote in renewable energy?

Michael — Right. I mean, for our timeframe the five year period while we discuss in the countries where carbon markets are present, we discussed the presents of them. We don't see them as being the major drivers of renewables over the medium term. The major drivers for us whether you're talking about Europe or whether you're talking about some other markets which may be introducing carbon pricing, the main drivers for us are more the renewable target for example the 20 targets in Europe, the incentives schemes that are put in place to support these target and the durability of both the target and the schemes in terms of giving investors a long-term signals. So for us, these are more of robust drivers on the policy side than the carbon markets are in. The policy drivers combine with the fact that many—the most dynamic renewables continue to decrease in terms of costs as their deployment increases. For us, these are the main factors driving renewable deployment over the medium term and we would not—for us, the carbon market are not the primary drivers.

Christine — I would agree with Michael especially when looking at a medium-term timeframe, over the next five years, so far, renewables cost has predominantly have been advised in policy frameworks. Of course, if there is any financial retirement agreement in place and if there is a way fashion being integrated in global market then this can potentially, of course, help develop renewables further as being very friendly technologies. However, there are many ifs in my sentence there and so, I think we still have some way to go until we release the carbon market driving the renewables department in many parts of the world.

Sean — Great. And I think for the next question we'll let Christine start off with this one and could you just touch on what some of the major drivers will be for a rapid ramp up in small-scale solar PV and small-scale wind?

Christine — What I think it's on the one hand—the hand the quick dispatchment possibility the fact that—and yet and these insulations can be set up quite quickly and generate electricity in developing countries while being integrated in microcripts. We have a situation where the large grids are not rolled out. The country's deployment can go quite quickly. I think we must go together. There are still a big number of people without essential electricity and so, we think these stable energy roll or checking of—ensuring access to energy fraud in a sustainable way by 2030 and we'll need to deploy renewables both centrally and also decentrally, however, to think it's there needs to be—to put more focus and effort on identifying

suitable business models for really attracting investors into the trade markets. There are some examples out there but I think it needs research instead of promotion on this sector needs to happen in order to really reach its potential and then when it comes, of course, to decentralized small scale solar PV on buildings there are people as instruments who exist. Let me think for example which allows or simplifies planning procedures which allow to set up the insulation and actually also give incentives to consumers to generate the part of their electricity use separately at this point of consumption.

Michael — I would just add to that we're observing a growing trend that solar PV for solar consumption is becoming increasingly economically attractive in some markets of the world. These are results of solar PV system prices coming down which is also reducing the levelized cost of electricity for solar PV at the same time when you set this against the retail price environment or at least the variable retail price environment that consumer faces. The economics of using solar PV for self-consumption can be quite attractive and we see them as being—I mean, one to say that solar PV is that socket parody or the economics are attractive in places like southern Germany already and southern Italy and approaching that in southern California. Of course, the attractiveness of this depends on a few factors. One, it depends on having the presence of a remuneration scheme for injecting excess electricity into the grid something in example with Christine mentioned having a net reader and scheme but also solar PV for self-consumption could also be attractive in the case where the consumer profile, demand profile matches up quite well with the solar PV output profile. So, in countries where you have afternoon peak related to air conditioning solar PV can actually be quite attractive in those places particularly during periods where peak power pricing occurs in the afternoon when you have the most not available. And also another thing that is helping spur this—as we see more financing model starting to come about, more business models and financing models such as third party leasing and particularly in the US but also in other places which are helping to facilitate and alleviate some of the upfront financing costs associated with spending money on solar PV where consumers are actually able to negotiate just to pay a monthly electricity price rather than investing in an entire system on their own. So I think a combination of these factors is starting to push solar PV decentralize small-scale sort of PV into a more rapid deployment and this is something that we expect to persist over the medium-term.

Sean — Great. Thank you. So we have two questions last in about five or six minutes to get to. This next question, you could probably spend quite a bit of time. So we'll just keep the answers brief as you can but which renewable energy technology would you consider already mature, commercially proven and safe to invest in?

Michael — Maybe I'll start—I mean, in terms of the technologies we see as being relatively mature so that means there's a significant amount of commercial

level of deployment and I'm focused on the electricity side here but I mean I could also talk about heat and biofuel as necessary but how your power, of course, Bioenergy, Onshore Winds, Geothermal is also a mature technology although geothermal presents the tone risks in terms of the associated expiration risk of drilling for wealth and also solar PV is continuing to emerge as a mature technology source and the ones we see as less mature at this point are CSP and Offshore Wind. In terms of the lack of commercial deployment and the lack of diffusion geographically although we see many large plants particularly in CSP coming online this year and large Offshore Wind arrays that have been coming on in Europe this year and over the previous few years but they were less mature in the sense that the costs haven't come down as rapidly in either areas as in other areas and also Ocean Technology remains relatively less mature where we see most developments at the demonstration side at this point.

Christine — I mean—No, I just want to add that it is important to really for reaching the objectives as what I've said out there in the management for example and deployment of all renewable sources will be crucial. I think the straws is not going to be just given that this time will be achieved, it will depend a lot also of course on how we do other demands but then it is about knowing all renewables in their different levels of development and naturally concentrate on just the cardinal sources because also I think we must bear in mind that developments can go in a direction that none of us had expected. If I may just look at the way on how we keep PV prices ready to come down, I don't think this is something that anybody would have expected a couple of years ago and really things can depend on many factors. So it is about considering them all in their different stages of development and improvement effectively.

Sean — Great. Thank you. And the last question from the audience today asked Michael if your forecast considered the impacts of research on new materials for PV modules and if so, how sensitive is that in per kilowatt hour cost of generation and per megawatt cost of installation would matter in large scale deployment of solar PV?

Michael — In terms of new materials, I would say we're largely not considering it within the next five years. So we're not—it doesn't mean it's not going to happen but just in terms of the way we do the forecasted, we do not take into account major technologies breakthroughs like that or something which is not already commercialized. So we haven't really done that sort of details and now it's on solar PV material, so that is a short answer.

Sean — Very good. And so, I just wanted to thank you both of you for the presentations in there and just for those questions and I just like to ask the audience if they could please take a moment to answer a very brief survey that we have. It just helps us to improve future webinars. Heather, can you display the first question please? And the next question is, do the webinar's presenters effective? And the final question is, overall, the webinar met my expectations. All right. Thank you for answering our

survey and on behalf of the Clean Energy Solution Center, I would like to extend a hearty thank you to Christine and Michael and also to our attendees for participating in today's webinar. We had a great audience and great questions and we appreciate your time. I invite our attendees to check the Solution Center website over the next few weeks if you would like to view the slides and also look into our recording of today's presentation as well as any previously held webinars. Additionally, you can find the information on upcoming webinars and other training events hosted by the Solution Center and we also invite you to inform your colleagues and those in your network about Solution Center Resources and Services including the no-cost policy support. I hope everyone has a great rest of your day and we hope to see you again at Future Clean Energy Solution Center events and this concludes our webinar.