

The State of Play of the Global Wind Industry and a Five-Year Projection

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Presenter

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Sean

Welcome to today's webinar, which is hosted by the Clean Energy Solutions Center and the Global Wind Energy Council. And today's webinar is focused on findings from the Global Wind Energy Council's recently released Global Wind Report, Annual Market Update 2013. 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 Solutions Center's resource library as one of many best practices resources reviewed and selected by technical editors. Before we begin, I just want to go over some of the webinar's features today. You have two options for audio. You may either listen through your computer or over your telephone, and if you choose to listen to your computer please select the mike and speakers option in the audio pane. Doing so just eliminates the possibility of feedback and echo. And if you choose to dial in by phone, please select the telephone option. Then a box on the right side will display the number and audio pin that you should use to dial in. And panellists, we ask you mute your audio device when you're not presenting. If anyone's having technical difficulties with the webinar platform, you can contact the number at the bottom of the slide that is the webinar's helpdesk at 888-259-3826. We encourage anyone from the audience to ask questions at any point during the webinar. To ask a question, simply go to the question pane and submit your question there. We receive them and then we will present them to the presenter during our question and answer session. If you're having difficulty viewing the materials through the

webinar portal, we have posted the pdf copies of the presentations at cleanenergysolutions.org/training, and you can follow along as the speakers present. We'll also be posting the audio recording of the webinar to that site.

So today's webinar agenda is centered around the presentation from our guest panellist, Mr. Steve Sawyer, and Steve has been kind enough to join us to present some of the report's key findings, as well as projections on where the global wind industry is heading. Steve will also share what the major challenges are, as well as insights into the emerging markets. Before our speakers begin their presentation, I just to provide a short, informative overview of the Clean Energy Solutions Center initiative, and then following the presentations we'll have a question and answer session where the panellists will address questions submitted by the audience, then some closing remarks and a very brief survey.

I'd like to provide 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 of U.N. Energy. It was launched in April of 2011 and primarily led by Australia, the U.S. and other CEM partners. So some outcomes of this unique partnership include support of developing countries through enhancement of resources and policies relating to energy access, no cost expert policy assistance, and computer learning and training tools such as the webinar you're attending today. There are four primary goals of the Solutions Center, serve as a clearing house of clean energy policy resources, also serves to share policy best practices, data and analysis tools specific to clean energy policies and programs, and also the Solutions Center delivers dynamic services that enable expert assistance, learning, and peer-to-peer sharing of experiences. Then lastly, the Center fosters dialog on emerging policy issues and innovation from around the globe. Our primary audience is typically energy policy makers and analysts from governments and technical organizations in all countries. But we do also strive to engage with the private sector, NGO's and civil societies.

So this slide provides a bit of background on one of the Solutions Center's marquee services, which is the expert policy assistance. This is known as "Ask an Expert." And we've established a broad team of over thirty experts from around the globe who are available to provide remote policy advice and analysis to all countries at no cost. So, for example, in the area of clean energy policy design and analysis, we're very pleased to have Terri Walters, President and Founder of Katevan Consulting serving as our expert. So if you have a need for assistance in clean energy policy, design and analysis, or any other clean energy sector, we encourage you to use this service. Again, it is provided free of charge. So to request assistance, you may submit your request by registering through our "Ask an Expert" feature at cleanenergysolutions.org/expert. And we also invite you to spread the word about this service to those in your networks and organizations. So in summary, we encourage you to explore and take

advantage of the Solutions Center resources and services, including expert policy assistance, the database of clean energy policy resources, subscribe to the newsletter and participate in webinars like this.

And now I'd like to provide a brief introduction for our distinguished panellist today. Mr. Steve Sawyer, the Secretary General at the Global Wind Energy Council, and at the Global Wind Energy Council he is focused on working with inter-governmental organizations to ensure that wind power takes its rightful place in future energy options and with opening new markets for the industry in Latin America, Africa and Asia. So now, please join me in welcoming Steve to the webinar.

Steve

Good afternoon. Hello?

Sean

Hi Steve. We can hear you just fine and see your screen.

Steve

Am I running the presentation, then, or are you putting it up?

Sean

I believe you are, but we can run it for you if you need it.

Steve

I can, just a sec. It'll take me half a sec. The last time I did one of these they did it for me, but you see my screen now?

Sean

Yes, we are.

Steve

All my junk in my inbox. OK, there we go. Good. OK. Well, thanks very much everyone for listening in. I see there are seventy of you out there now. As Sean said, my name is Steve Sawyer and I'm the Secretary General at the Global Wind Energy Council. We're a trade association. We represent some of the biggest companies in the sector, basically those that are involved in more than one or two continents, but also the major national and regional trade associations from the U.S. and Europe and North and South America and Asia. Our role, as Sean said, is to represent the sector with inter-governmental organizations like the UNF Triple C, ICCIEA and IRENA, but also to work on opening new markets, and I'll be talking about that a little later on in the webinar. What I'm going to talk about today are the results of the global market in 2013, draw some conclusions from that, also look at our short-term projections. We do a rolling 5-year projection every year, and augment that with a projection out to 2020 and 2030 every other year. We'll be publishing the next one of those this October in what we call the Global Wind Energy Outlook. I'll talk briefly about offshore wind and where it's got to and where we think it's going, and then about the new markets that we're actively engaged in and the ones that we have an eye on. Then a few observations about the state of the global energy transition or revolution or whatever, that's going on in various ways in various locations and its implications for our business, for climate change and for energy markets generally, and then draw some conclusions from all that. I'm planning to speak for about a

half hour, forty minutes, which should give us about an equal time as that for Q and A, so I'll get started here.

This is the global cumulative installed wind capacity developments over the last 16 or 17 years. As you can see, we've had an 18-year average growth rate of 26.2%. The growth in 2013 was a bit below that – whoops, don't want to do that, I'm just wondering how to send this to the back – I'm trying to get the dashboard off the screen so I can see what I'm talking about.

Sean

You might be able to minimize it.

Steve

OK, well, I switched it to the other side, that's all that did. I know what it says, OK, that's alright. So the cumulative installed capacity is now up over 318,000 megawatts, 318 gigawatts, which is an awful long way from where we were 15 or 20 years ago. If you look at the progression of annual markets, you see that for the first time in about 20 years the global wind market was down in 2013. Most of the world had modest growth. The EU market contracted slightly, but the big story here was of course the situation in the United States, where we went from 13 gigawatts of installation in 2012 to just over 1 gigawatt in 2013. That's the bad news. The good news is, of course, is that the U.S. industry is very much on the up at the moment, with more than 12,000 megawatts under construction in December, and an awful lot of that is going to be installed this year and next. The average annual growth rate of 23, 24% over the course of the last few years, but with a dramatic drop-off in 2013, primarily, as I mentioned, because of the situation in the United States.

If we look at the top ten cumulative markets, we see China installed firmly in first place, followed by the U.S., Germany, Spain and India. That's been pretty much constant over the past several years. India we would expect to pass Spain either in 2014 or 2015 and move into the fourth spot. The Spanish industry is stalled pretty much completely because of the economic situation in Spain, where there's no new demand of any kind for any kind of technology. The UK has now moved up over 10 gigawatts, and Italy and France may join them. The only new entrance that we would expect into the top ten for 2014 would be Brazil, which will almost certainly pass Denmark to take over the tenth spot at this time next year.

If we look in terms of annual markets, China recovered in 2013 from the drop-off in 2012, where they installed just under 13 gigawatts, which is down from the 16, 17, 18 gigawatts per year they had been installing on an annual basis for several years. But after that explosive growth in the Chinese market since 2006, it was to be expected that there needed to be a period of rationalization and weeding out and sorting out some of the transmission issues they've been facing. I won't say that they're all sold by any means, but they have been improved somewhat and the market is back in growth mode. It grew from 13 to 16,000 in 2013, and we would expect it to get up to 18 or so this year and then continue from there. The

Chinese government has now published a new target for the industry of 200 gigawatts total cumulative installed capacity, so in other words, more than doubling from the current total by the end of this decade. And if past experience is any indication, then they will at least meet and probably exceed that.

Germany had a very strong year. It's expected to continue to have several strong years, even with the rearrangement of the rules under the Energiewende which the new government has put in place. But it looks like that not only on-shore, but off-shore installations are going to maintain a strong feature in Germany and the U.K. India is somewhat stagnated over the last couple of years, but I just returned from there and there is much anticipation over the impact of the new government, which is expected to be elected. So, well, they have a very difficult election process with 850 million voters, so it takes about four, five weeks. We'll know the results on the 16th of May, but if the candidates who are expected to win do in fact come out on top, I think we can see a boost in the business sector in India generally, but also particularly in the development of wind.

Canada beat the U.S. in terms of its [inaudible] in 2013 for the first time ever, as far as I know. Again, that's not expected to continue. The U.S. is going to be back up probably in the number two spot this time next year. But an artefact of the strange, mysterious workings of the U.S. Congress in relation to the tax legislation. Brazil, as I said, is in a very strong position now. They would continue to be in the top four or five markets globally going forward. Poland, Sweden and Romania remain quite strong. The only change we would expect to that list in 2014 is that Mexico will probably be in there at number eight or number nine. If you look at how that breaks down by region, I used to be quite comfortable in saying that we have three relatively balanced major markets, one in Europe, one in North America, and one in Asia. But for the last four or five years, the last four years, anyway, the Asian market has dominated, and despite the little hiccup in 2012 has recovered strongly in 2013, and we expect that situation to continue for the foreseeable future.

Now what you can also see is the three little bumps on the right hand side of the chart, as I used to refer to them, Latin America in particular, but also the Middle East and Africa, are going to start making a difference in the not too distant future. Latin America would look bigger than it does at the moment, but since Mexico joined the OACD, in terms of energy statistics Mexico is lumped with North America. So you see the Mexican totals in that North American bunch. Otherwise, the Latin America would be about 50% higher than it is on this chart. And Africa now, after somewhat of a hiatus due to the Arab Spring and the markets, particularly in Morocco and Egypt, they are starting to recover. But the biggest development in that part of the world is South Africa, where there are 7 or 8 or 900 megawatts under construction, most of which will come on line during the course of calendar 2014, and we hope that's just the beginning.

Looking forward, this rather confusing looking chart is actually quite simple. What you see is the red line is the change in cumulative in annual market growth over the five year period between now and 2018, and the green line is the cumulative market growth, and the blue is the annual installed capacity and the green bar is the total cumulative installed capacity. As I said, after a substantial dip in the annual market in 2013, we expect a substantial recovery in 2014, again because we'll have most of our big guns, if you will, China and the United States, firing on all four cylinders or all six or all eight, depending on what kind of car you drive. And that combined with strong growth in some emerging markets and stability in Europe means that we would expect global installations in 2014 and this year of somewhere between 47 and 48 gigawatts. Now that could be conservative, depending again on what happens in China and the U.S. and Brazil, but we feel pretty safe that it's going to be pretty much in that range.

After 2014, growth will go back to the high single digits, or perhaps low double digits, depending on how things develop in some of those emerging markets. But the cumulative growth rate will level off at somewhere between 12 and 13% for most of the rest of the period, and we end up at the end of 2018 with just about 600 gigawatts of installed capacity, which is almost double what we have spinning today. So I believe this is a conservative projection, I think it's reasonably certain that we will get to these numbers at least. There are many things that could make those numbers larger, and many things that could make them smaller, but those would have to fall into the category of Donald Rumsfeld's "known unknowns." Lots of political volatility around the place, lots of economic vulnerability around the place, which could dramatically affect these figures one way or the other. But all things being equal, I think this is a pretty safe bet as to where we're going to end up at the end of 2018.

If you look at how the annual market breaks down by region, you can see the red bar, the Asian one, continues to dominate. But as I mentioned, as the period progresses, you see the yellow and the purple bars, Latin America and the Middle East and Africa, start to put up some significant numbers. And while they're not rivalling either of the three major markets, they do start to make a difference both in the annual totals and in terms of the pattern of investments in the sector. If you look at that in cumulative terms, then you see that while Europe has been the dominant market in terms of cumulative installed capacity since the beginning of the industry, or since very shortly after the beginning of the industry in the early 80's, it will be surpassed most likely by the end of this year by Asia, in terms of total cumulative installed capacity. It's a close thing, and it depends. The expectation of the European market to remain stable and basically contract a small amount, but again, it's significant political debates, still a bit of political, economic instability in the region. We've got European elections coming up, as well as a new commission coming in, so that could affect

investment patterns over the period. But the 2020 framework legislation, which requires Europe as a whole to get 20% of its final energy consumption from renewables, is a pretty strong and legally binding driver on all 28 member states.

Shifting for a minute to off-shore, off-shore gets an awful lot of ink and an awful lot of coverage and politicians like it, big pieces of equipment, big companies and billions of dollars getting invested, but it's still concentrated in just a few markets and it still makes up a relatively small percentage of the overall total of capacity of the wind sector, which I'll get to in a minute. But you can see the cumulative growth rates in the inset box, going to 4 to 5.4, now just over 7 gigawatts total installed. Just over half of that in the U.K. alone. Denmark is the number two market, they were the early movers, and Denmark currently gets about 33% of its electricity from wind. The plan is to get that to 50% by 2020, and most of that will be on the back of three large new off-shore projects. But after that, we can't expect an awful lot more out of Denmark. The two sleepers in the column, where we know there will be large development but it hasn't yet materialized, are China and Germany, both of which have supposedly more than a gigawatt under construction as we speak. China has a substantial target of 5 gigawatts by 2015, that's just by the end of next year, and if it were anyone other than China I'd say they have no hope of making it. I still don't think they will, but they may, in fact, come close. They're somewhere in the vicinity of almost 1500 megawatts under construction at the moment and new projects coming along. But like everywhere else, the development of off-shore in China has been slow and more complicated and more difficult and more expensive than anyone thought.

And Germany, the big delay has been primarily due to the interconnections, and getting the shore stations for dealing with all the power coming in off the North and the Baltic Sea into a part of the country which doesn't have a huge amount of demand in the north, and has an awful lot of wind power already. The northern states in Germany generally get somewhere in the vicinity of 50% of their electricity from wind already. So there's a substantial need for reinforcing transmission there, which has taken longer than people anticipated, but my German colleagues tell me there's more than 1,000 megawatts under construction and most of that will come on line in the course of this year.

There's some other, smaller European markets. I think the two to keep an eye on, really, outside of Europe are Japan, where because of the accident and the difficulty of installing wind capacity on shore there's been something of a boom in solar PV, but not much in wind. But there has been an awful lot of investment in off-shore, both the normal ground type and either a monopole or tripod foundation, but also Japan now has three floating turbines, and I'll talk a little bit more about that in a minute. But I think that they see an opportunity for them to become leaders in the floating market. And the new tie up between Mitsubishi and Vestas is

going to help facilitate that. The only one which doesn't appear on the chart yet, of course, or maybe it does – I just can't see it – yes, the U.S. It looks like there could be some substantial developments in the U.S. over the course of the next five or six years, but it's politically fraught and economically difficult. The strong push from the current administration, whether that will last beyond 2016 remains to be seen. But it looks like a gigawatt or two might be going into the water in the United States during the rest of this decade.

Korea will be a small but substantial market, but it will be for the Koreans and by the Koreans. In other words, Samsung and Hyundai and Nissan and Daiwo are the big conglomerates in that country. Just some overall statistics on the off-shore side. As I mentioned, there's an awful lot of talk and an awful lot of ink and lot of money going into the sector, but it still represents a bit less than 2.5% of the total installed wind power capacity globally. In the 2013 market, it was about 5% of the total market, which had 4 there, now it's 5. The major markets, as I mentioned, that we can expect in 2014 will be the U.K., Germany and China.

I'm going to move right on to the projections of where the sector may be going. There are some very optimistic projections out there. If you look at Europe, and according to the National Renewable Energy Action Plans filed by the member states, they should have 14 gigawatts in the water by the end of next year. You can say almost certainly that that's not going to happen. The industry projections are for somewhat less, and I don't think they'll meet those either, but they'll be closer, somewhere around nine or ten. But I think it's at least plausible to think that the target of 40 gigawatts by 2020 could be reached. Again, depending on what happens with the current round of political uncertainty associated with the establishment or not of renewable energy targets for the period after 2020, and the general investment climate for renewables in general. But we will keep an eye on that.

China, as I mentioned, has a very aggressive target for 2015 with 5 gigawatts. Will they make it? Probably not, but I would say that they are very likely to meet their 2020 target of 30 gigawatts. Once that offshore sector gets rolling, there's four or five Chinese manufacturers that have tooled up directly for offshore, and the position of the big five utilities in China, their balance sheets were in a bit of difficulty a couple of years ago, they have recovered somewhat now and most of the policy uncertainty and obscurity that was plaguing the development of offshore in terms of the Energy Department having to work with the spatial planning division, as well as the military and fisheries and all the rest of it, most of those issues have been worked through. So we would expect a large spurt in building offshore, particularly in the second half of this decade in China.

Japan, again, small numbers to start with. It could get big, but probably not until after 2020, same with Korea. U.S. is a wild card, and Taiwan is going to move ahead with an offshore program. It's financed by the

government, it's not going to be large. There's talk about putting turbines in the Great Lakes. One thing that I'm particularly keen on is India, where, as I mentioned, there's a potential of significant change in terms of the attitude of the governments in India toward renewables in general, and wind in particular. Energy is complicated, like everything else in India, because of an overlapping jurisdiction between the various Indian states and the central government, but we have now engaged in this 5-year project, which is sponsored primarily by the European Union, but in close cooperation with the Ministry of New and Renewable Energy in India, to actually help them design a roadmap for the development of offshore wind sector out to 2032. Focusing on the states of Tamil Nadu in the south, which has been the site of most of the early wind power development and still the largest state in terms of wind power development in India, but also in the state of Andhra Pradesh, which is in the west, which is the strongest state economically in India. So we're looking forward to getting some positive results on that as a result of the upcoming election in India, well, the current election, the ongoing one, which will have the results on the 16th of May. We think there will be an awful lot of investment and a lot of interest in that sector going forward.

New markets. There are lots and lots of them. I'm going to focus on three counts for the purpose of this presentation. First are the big three of the emerging markets, which occupies a very large percentage of our time. Mexico, Brazil and South Africa. Mexico, as you may know, just last December passed energy reform legislation and a constitutional amendment to overturn the provisions of the existing constitution, which prevented basically foreign companies from investing in or owning any significant portion of the Mexican energy system. Now this was motivated primarily because Pemex doesn't have the balance sheet or investment capital to exploit offshore, the deep water offshore the Gulf of Mexico. But for the electricity sector it's very good news, because it does two things. One is it allows foreign investment for the first time, and it creates actually an electricity market. In other words, the currently state-owned utility monopoly that runs the entire electricity sector is not going to be broken up, but on the generation side it's going to be one among equals. In other words, other generators will have access to selling electricity onto the grid, which has never been the case before. And there will be an independent regulator and most importantly, an independent system operator whose mandate is to insure equal access to the grid for all generators. So that, combined with the new Mexican government confirming the country's target of 35% of its electricity from renewable sources by 2024 means, in fact, that the government has issued a challenge to install something like two gigawatts a year for the next ten years. And I know my Mexican colleagues are very excited about that and think it's going to be a big opportunity. There's tremendous potential, growing demand, excellent wind resources, and a growing economy. I've been going around for the last six months or so saying that Mexico could be the new Brazil.

Brazil, I would say, is an emerging market but it's also emerging out of the new market in terms of being one of the main ones. They currently have a pipeline of more than 10 gigawatts to be installed in the next five years that's already contracted for in the Brazilian option system, so that will get built out. And in 2013 alone, the government contracted 4.7 gigawatts of new construction over that period, and there will be at least two options in the course of 2014 which will add to that 10 gigawatt total in terms of what we can expect over the next five years. And the expectations are that Brazil will get to somewhere in the vicinity of 20 gigawatts by the end of this decade, or perhaps a bit more.

South Africa is in the very early stages, as my South African friends like to say, the South African market has now reached lift-off after an extremely long countdown, which goes back to something around 2002. But as a result of the process of bidding and tendering that the government instituted first in 2008, and actually the first winning bids were announced at the climate conference in 2010 in Durbin, those projects are now under construction and will be built. There's about 1,100 megawatts that have already reached financial close and are in the process of construction or early stage, and another 700 megawatts or so which will reach financial close sometime this spring. There's also a recent announcement from the government that they are going to in fact allocate more megawatts from the round three, so there will be more megawatts of wind PV and ESP, we don't know exactly which technologies but we would expect that some of them would be wind, because what we have seen is that South Africa, the prices that they've come in for the wind, as in Brazil, as in Mexico, are cheaper than any other form of generation. So you may remember that the World Bank allocated \$4 billion a few years ago to build these giant new coal fired power stations in South Africa, but they are coming in at about 30% more expensive than the new wind farms that are going up. So I think the attractiveness and the economic competitiveness of the technology in those three markets is really going to drive major growth.

Elsewhere in Africa, we don't think about it so much, but six of the world's ten or twelve of the world's twenty fastest growing economies are in sub-Saharan Africa. Ethiopia, for instance, had the first commercial wind farm in sub-Saharan Africa, and they're building away, and they have tremendous wind resources, a growing economy, and a potential of a terawatt or more of development. Their master energy plan calls for about 7 gigawatts of that to be built out between now and 2030. Kenya, again, they've been growing at 5, 6, 7, 8% per year for the last decade. They need the power, they have some projects underway. There are more. Tanzania's first project will come on this year, and this is all being tied together now and attracting attention as the African continent begins to develop economically. In terms of connecting it together in electrical terms, in other words, building an African clean energy corridor is the working title, which was originally envisioned to go from Capetown to Addis Ababa in Ethiopia, but now is being extended up to Cairo as well.

There's another transmission line planned to get from Egypt across to Morocco, facilitate the export of – there's tremendous potential in Morocco, there's about a terawatt, they have nowhere to send it, least of all to Europe. The last thing Europe needs at the moment is more electricity. Where the electricity is needed, really, is in the rapidly growing economies in east and southern Africa, in particular.

Last but not least, of course, there's a lot of small markets developing elsewhere in Asia. Vietnam has a new project going underway, Thailand installed two last year, Pakistan installed one each of the last two years, Mongolia's first commercial project came on line last year, and there's another under construction as we speak. And the Korean market could be something substantial, depending upon how that country's green growth plans get translated into reality. So these are some of the growth markets that we're looking at going forward.

Just before I close, I want to make a few points in terms of what we're looking at in terms of the transformation of the global electricity market and the role that wind and other renewables are playing. This is a slide from the system operator in Denmark, Energynet. To get to a situation where they supply 50% of their electricity demand from wind only by 2020, not to mention other renewables which bring that total up to about 70%, they are doing a few things. One is breaking down the borders that traditionally have existed between the different parts of the energy sector, between electricity and transport, electricity and heating, as well as electricity and industry. And what we see, of course, is a much larger role for electricity in the overall energy sector, where electricity plays an increasing role in transport, an increasing role in heating, because in Denmark you often have a situation late at night in the winter when demand is very low and the wind is blowing like crazy, where Denmark will have 110 or 120% of its total electrical demand being met by wind. And they used to sell it on the world's most functional international electricity market, which is called the Nord Pool, between Denmark, Norway, Finland and Sweden. But they weren't the only ones, and it eventually came to the situation where the price was very close to zero or even negative on some occasions. So rather than giving the electricity away, they've decided to use it to heat up the boilers in their central heating units. So they can displace gas, reduce emissions, and make use of that electricity. So that and electric vehicles are the two big things at the moment, but there are other solutions going forward.

The other thing, if you look at our report, you'll see a guest piece from our friends at Siemens, Siemens Wind Energy, where they have developed something called "Society's Cost of Electricity," one of many attempts over time to quantify in useful ways externalities associated with different forms of energy generation. This is a comparative chart. I won't go into all the details, but it looks like the current levelized cost of energy, or levelized cost of electricity from existing technologies in Europe, projecting out to 2025, eliminating the subsidies from that, eliminating

transmission costs or adding transmission costs, and also incorporating costs associated with variability, then you get another set of numbers, which gives you the LCL plus the system costs. Then you add onto that social costs, in other words, dealing with NIMBYism and dealing with various other issues in relation to landscapes, etc., you look at its impact on employment, and then you look at its impacts on the geopolitical and macroeconomic risk associated with relying on imported fuels from parts of the world which are not really stable, and then you come out to a very different set of numbers running across the bottom, which is described as the projected societal cost of electricity. The U.K. is the example that has been used in 2025. And while you see onshore wind remains the cheapest, as it is today, it is in close competition with offshore wind, primarily because of the enormous employment effects and investment benefits from offshore wind. That's followed a distant third by gas and then coal and nuclear, basically priced out of the market. I encourage you to have a look at that study if you're interested, and there's more information on the Siemens website.

Finally, of course, we have to come back to the issue that just won't go away. I was in Berlin a couple weeks ago when the plenary session adopted the summary for policymakers of working group 3 reports, the IPCC Working Group 3 report on mitigation. I think while the alarm bells and the potential disasters associated with climate change that we can expect in the next few decades were outlined very clearly in the Working Group 1 and 2 reports, I think the Working Group 3 report on mitigation was particularly striking and a departure from past reports in a number of significant ways. First of all, it was a very clear statement that we have the technology to solve this problem, both in terms of the electricity sector, the power sector first, but also right across the energy sector, to get to the levels of emissions that we need to at least stand a fighting chance of keeping global mean temperature rise below 2 degrees, which of course is the target that the 192 governments that are signed up to the UNF triple C have set themselves. And secondly, on costs. The costs were able to be quantified, and primarily because of the dramatic reductions in the cost of solar, but also wind power over the course of the last few years, those numbers don't add up to be very much. It's something like 11% of GDP over the period to 2100, but translating that to an annual basis that's .06%. I'm sorry, I have three dots in there but it's not clear. It's not 6%, it's .06% of GDP. In other words, rather than having 2% growth in a given year, you would have 1.94% growth. And that doesn't include the savings from avoided fuel costs, nor does it include the savings from avoided climate impacts. So you could make a pretty strong case if you included those figures, you'd have an economic benefit. Then, of course, the other thing that comes through very clearly is that acting now is much cheaper and much more effective than acting later. That's not a new message, but it's one that bears repeating.

Looking ahead, 2013 was a tough year for the industry. Primarily because of the situation in the U.S., but also globally. Things are picking up at the moment. The Chinese market has recovered substantially and will continue to, as I mentioned earlier, in pursuit of that 2020 target of 200 gigawatts in the ground. And India, again, I've spoken about it and I think that it's substantial potential there. In Europe, it's a bit uncertain at the moment. Worst case scenario, the market will be flat for the next several years, or drop a little bit. There's a possibility for a rebound there and back to growth mode, but that will take some political changes. In Latin America, Brazil, as I mentioned, is a powerhouse and is going to be adding significantly to the global markets. There are some other markets in the region which are getting some new orders. Uruguay, Chile, small markets in Central America and the Caribbean, but it's not clear at what point there are going to be major new markets in Latin America outside of Brazil and Mexico, which I still think of as Latin America, even if they have joined the OECD. As has Chile, by the way. And finally, the South African market is starting to take off. That's good news. It's very long overdue. We would expect it to drive significant growth in southern and eastern Africa over the course of the next decade.

Overall, however, I think you saw in the projections rate of global growth, accumulated market growth of somewhere around 12, 13% over the next period. What would get it back up to the 20, 25% cumulative growth rates that we had in the previous decade would be one of the following. One would be that these new markets fill the gap by the lack of growth basically in Europe and North America overall. If the OECD economy recovers in such a way that demand growth takes off again, or there is new CO² related legislation. None of those we would expect to see any time soon, but I believe that's what it would take. And downward price pressure on the industry continues very much. We still have an oversupply of manufacturing capacity, particularly in China and in some countries in Europe, which is good for the consumer and good for developers because it drives down prices. But it makes it a tough time for manufacturers.

Cheap gas in the U.S. still makes the competition tough there, and consolidation in the sector continues. We've heard rumours just over the course of the past few days of G.E. thinking about trying to buy Alston. But at the same time that we have this consolidation, moving ahead we see new players emerging like the Mitsubishi-Vestas joint venture, like Vague in Brazil, like you see Hyundai and Samsung and some of the other big Korean players entering the market. So it's not clear that consolidation in the traditional sense is what we can expect. But some of the current players will be gobbled up by some of the larger current players. That doesn't mean we won't continue to see new market entrants.

For manufacturers to survive and for developers to survive the lesson of the past three or four tough years is that you only do that with market diversification, and you don't rely on one single market. I think those who have relied strictly on the U.S. market or strictly on the Spanish market

have learned a very difficult lesson over the course of the last few years. The vast majority of the growth that we're going to see is going to be outside of the OECD, and you need to be present in those markets, but you need to be present in the right ones, because you can't be in all of them.

So to wrap up, I just have a couple of final messages. One is that I continue to believe that a global climate agreement will be fundamental for wind energy and other renewables to reach their full potential. While the economics are working very much in our favour at the moment, energy security arguments are working very much in our favour at the moment, I think until there is a clear directional signal given by global governments of what they want their future energy systems to look like, then it's going to be a very difficult fight in each individual market. In emerging markets where there's a demand for growth and there's room for everybody to win some contracts, then it's much less tough. But we're going to see serious fights in Europe between renewables and the conventional power sector, basically because it's a net sum zero game, and every new megawatt of renewables that comes into the mix means X megawatts of conventional power needs to go out of it, or you end up with an oversupply situation like you have in Spain and in which everybody loses.

So I'm afraid we're in for a period of uncertainty, both in the international political landscape and the future of carbon markets, or whatever other means that might be used to price carbon in the power sector. These new climate related funds don't have any money in them yet, and I wouldn't expect they would any time soon. So in the meantime, our focus will of course be on national and regional legislation and individual markets, one by one by one across the globe. It's not the most efficient way of doing things, it would be nice to have a global price on carbon, but I'm afraid that we're going to be waiting a while for that. But all of the drivers which put wind energy in the position that it is today, they're all still in place, increasingly permanent. None of them are going away. Energy security, with the recent events in Ukraine, have driven the point home in Europe more emphatically than anything else could that Europe is extremely vulnerable to disruptions of supply, whereas renewables are home grown. Cost stability, we see the wholesale price of electricity go steadily down in markets where there is a high penetration of renewables. Obviously, the vulnerability that many countries feel is not only because of potential loss of supply from overseas, but also the uncontrolled and uncontrollable price bites, which can play havoc particularly with developing economies.

Economic development and job creation, by definition, renewables, most of that is at home, and of course in a place like China, the choking smog that you get when you walk out the door or when you wake up in the morning in Beijing or Shanghai or Chongqing or Wongjiong or any of the other major Chinese cities, which is a driver to get off of coal and onto renewables. And of course, there is climate change, which is the biggest one of all.

So all that stuff is still in place. I think the future is positive. How positive? I think there are a lot of unresolved questions which will need to work themselves out over the course of the rest of this decade, to see where we're going to be going in the long term.

So I'll end there. Thank you very much.

Sean

Great, thank you Steve, and thank you for the excellent presentation. And I do just want to remind you if you have questions for Steve, you can submit them through the question pane and we will present them to him to discuss there. So I'll start with some of the questions that we did receive from the audience. The first one I'd like to start with, Steve, is, which market could potentially surprise us in the next five years to come?

Well, if they were going to be a surprise to me then I wouldn't know the answer to the question. I suppose the biggest wildcards really are the two largest economies where there is no substantial renewables development to date. One of those is Russia. When Mr. Medvedev was president of Russia, there were some positive movements and some legislation passed and some early investment decisions made to begin to tap the absolutely enormous potential wind energy resources in Russia, as well as biomass, and believe it or not, quite a bit of solar in the southern part of the country. With Mr. Putin back in the saddle, there has been much less interest in that. There are five or six or 10,000 megawatts of wind energy projects ready to go, awaiting investors and awaiting clarity on the interconnections and of course, the Russians have put in an enormous local content requirement, so awaiting manufacturers who can actually build the stuff in Russia before any of that goes ahead. But the government is not really pursuing it with any enthusiasm at the moment. And given the situation in Ukraine at present, it seems that that's going to occupy their attention for some time. But there are a host of reasons why Russia would be well advised to invest in exploiting some of that enormous potential. But I think they have more immediate issues.

The other one, of course, is Saudi Arabia. Some smart people in Saudi Arabia a few years ago woke up and did the math, and they see an enormous growth in domestic demand, which is now currently consuming somewhere between 30 and 35% of their energy resources, just to fuel the domestic economy. And it's growing in double digit rates. It doesn't take a genius to figure out that if you have a country whose economy is dramatically dependent upon fossil fuel exports, it's consuming 30, then 50, then 70 or 80 or 90 or 100% of it domestically, then the economy stops functioning pretty quickly. So a couple of years ago, they announced the formation of the King Abdullah Center for Atomic and Renewable Energy, with an initial target of something like 50 gigawatts of renewables by 2030. We continue to watch that process. We're working with them. It's a very difficult environment to operate in, it's a very difficult investment environment. But assuming that they sort some of those issues

out, you could see explosive growth in winds, but also particularly in solar over the course of the next couple of decades.

There's a number of other smaller markets which, of course, could surprise us. But I think those are the remaining big ones where take-off doesn't look like it's going to happen any time soon, but it could, and if it did the consequences would be very large.

Sean

Great. Steve, with the sharp drop in solar prices, has that had any significant impact on wind deployment, or do you think it may in the coming years?

Well, it may. I don't think that there's any evidence to indicate that it has yet. Of course, I spend a lot of time, and my colleagues in the solar industry realize that we are much better off cooperating as much as possible, rather than competing directly with one another. The characteristics of the resources that make wind or solar economical where they are, are not the same. So you quite frequently find that they're complementary within an individual energy system, and plus a very large portion of the solar now is distributed, generation in the distribution system, where it makes an enormous amount of sense. There is only a couple of places on the planet where they are directly cost competitive at the moment, where in the same place it's cheaper to install solar than it is to install wind – not to install, but you get cheaper electricity – in the Atacama Desert, where you have just about perfect conditions for solar PV and the wind is only so-so. It's not bad, but it's not great. But I think obviously solar continues to increase in improvements in the efficiency of the technology and the prices keep coming down. I'm not sure how much farther they can come down, but they probably will. And the wind energy prices continue to come down, as well, and the efficiency of the technology continues to improve. So I think on the one hand this potential healthy competition will not—but I mean politically, in regulatory terms, the competition is from the conventional sources, from the incumbents. And we do our best and colleagues in the solar industry also do their best for us to work together and try to figure out the best way to proceed which benefits both of us, because in actual fact we should be and are allies, for the most part. And not directly in competition, the competition is someone else.

Sean

The next question I have from the audience, they were referring specifically to India, but you could also talk about it more generally. The question is, would competitive bidding based wind procurement for utilities help reduce prices, similar to what has been done successfully for solar PV?

Steve

OK, well, I will display my ignorance here, as I don't know, well, I guess there is competitive bidding for solar in India. It's a difficult question. I think there have been many attempts to do competitive bidding or tendering for wind energy around the world. Up until a few years ago, I

would have had to say that they were mostly failures. In China, in Canada, in the U.S. and elsewhere where it has been tried, they basically involved either speculators getting into the market and driving prices down and then dumping the projects when they turn out to be uneconomic, and all the rest of it. But there are two examples existing where I think they've been quite effective, the first and most well-known of course is Brazil, where the auction system has driven the price down to the point where last August the system operator had to exclude wind from one of the A3 options because it was too cheap, and they wanted to give the other generators a chance to win a few contracts. But wind has been the dominant technology that's been purchased in Brazil over the course of the last two or three years. And that is driven down by a situation where there is very good wind resource and very low prices for wind. But the reason that the option works is that there's a national system operator, there's a strong national grid, and there is very strong central planning of the electricity sector, so they know how much they need and when you sign a contract with them, you sign a 20-year PPA. That is not a negotiable contract. In other words, you sign that contract and you go through all the hoops to qualify for the option, you sign the contract, you are obliged to deliver that electricity to the government for a period of 20 years. And if you don't, you will have to pay to buy the electricity from somewhere else to give it to them, or your company will go broke. So they have effectively eliminated the speculators and the financial manipulators from that process, which have been the scourge of so many other attempts to develop bidding systems.

In a similar situation under very different political and economic circumstances is the case in South Africa. The Brazilian option is alive, a real time, on line thing that happens on a day and it's all over in a few hours. The bidding and evaluation process in South Africa goes on for weeks and months after the bids close, in terms of evaluating and coming up with winners. It's not purely on price. There are a number of other factors, social factors, investment factors, employment factors, etc. that are incorporated into the analysis of the different bids in South Africa to determine who will win an individual bid. But again, the stakes for entering the bids and for qualifying for it are high enough so it takes the speculators out, and at the end of the day you get a 20-year PPA guaranteed by the government. And again, it's a contract and you have to fulfil it.

So under those sorts of circumstances, I think at least in the initial phases, the first Brazilian options were in 2009, we can say that it works. It's not without its problems, but basically it works. And we can say a similar thing with a few more caveats for South Africa. In India, given the concurrence nature of the electricity system and the complicated overlapping regimes between the states and the central government, how it could work in India I have absolutely no idea. It almost seems to me it would have to be done on a state by state basis. And given the state of the system operators and the utilities in most of the Indian states, it would be

difficult for me to see how that would work. But maybe. And with the new offshore, I think the new development of offshore, as that comes to maturity in India over the course of the next few years, the indications are that they would go for some sort of a tendering system. But again, that would be tendering for specific locations to develop projects in competitive bidding of that sort. So if it's constructed correctly, it can work.

There are probably more examples of failed tendering systems than there are successful ones, but that doesn't mean they can't be made to work, as the examples in Brazil and South Africa have shown. Any system can be made to work with the right details and the right direction from the government and all the rest of it, and you win different things and you lose different things by doing it. There's been discussion of going to a tendering system in Germany, but I think there you would lose one of the great attributes of the German system, which is the opportunity for communities and individual investors and small players who like to participate in investments in the energy system, and which is why you have such overwhelming support for the Energiewende in the German public. So if you go to a tendering system where everybody is priced out of it except for the big utilities and the big players, you would lose all that. So it swings in roundabouts and there's no single system that will work best in every country. It needs to be designed to fit the economics and the culture and the politics of the country in question.

Sean

Next question I have for you references mature markets like Denmark, where the potential growth after 2020 is rather small. How much could be expected from repowering the older wind farms, so it is not new growth but could represent a considerable revenue stream for the industry?

Yes, it's I think substantial. An awful lot in Germany and Denmark in particular, an awful lot of the best wind sites are currently occupied by machines which now probably belong in a museum, from the late 80s and early 90s, small 250-kilowatt machines which are still working well and still. The nature of the early development of the machines, particularly in Denmark and Germany is that they were way, way overbuilt because so much was not understood about the stresses and whatever. So to be on the safe side, they just made them stronger and tougher than they absolutely needed to be. And a lot of those 20-year-old machines are still spinning away and doing the job just fine. But they are small machines, installed on relatively low heights, and we could replace ten or twenty 250-kilowatt machines with say five 3-megawatt machines and you'd get five times the power at a fraction of the price. That's starting to happen now, particularly in Germany. I think there is almost 500 megawatts repowering in 2013. In numerical terms, it's less in Denmark, but it will happen. But the other issue to overcome, of course, is that as a reward for the risk that the early investors took twenty years ago, 20-year PPA or whatever, 15-year PPA for a very, what in today's terms would be a very high price. And while the feed in tariff part of that is running out now, that paid off their

investments with minimal O&M cost for these valuable machines, they are still making pretty good money. So you have to figure out a way to get around that, as well. But I think for Denmark, that will continue for some time. For Germany, it will continue for a good year longer as significant drivers of the industry in those markets.

Sean

Referring to the slide where you presented a constant cumulative growth forecast for Europe, the U.S., Asia and some other markets, what makes the GWAC so confident that this constant growth in all markets will happen, while especially during 2013 it was proven differently with decreases in the U.S. and Europe? What are the market drivers?

First of all, you keep continued growth in cumulative terms unless you're annual installations are zero. So those are cumulative growth numbers. Annual market growth numbers go up and down, particularly in individual markets where there is political volatility. I think the confidence in the European market is as a result of the climate legislation out to 2020, where there are legally binding targets for renewable energy, which will continue to be respected unless the European governments agree to abandon them, but I don't think there's any significant likelihood of that. In the U.S. it's a bit more difficult. The U.S. is, of course, the most difficult market to predict. They're volatile, up and down. There are enough positive signals in the discussions and progress coming from both sides of the aisle at the moment, so I feel confident that beyond 2015 when the effects of the current iteration of the PTC have run their course, that there will be at least something else to take its place. There are a number of very positive proposals there, so I'm hoping for significant growth in the U.S., even after the direct visibility we have through the end of 2015. And we can say more or less the same thing with Canada. But my projections, at least, are much more muted than they would be otherwise, based on the potential demand and the tremendous resource in North America, because of the legislative uncertainty and because of the lack in both countries, U.S. and Canada, of any carbon price signal, beyond individual states and provinces having made their own. There is no national carbon price signal in either country. And if there was one, then I would think that the projections would be substantially larger than they are at the moment. Whereas, ironically, in Mexico we have both. The binding national renewable energy target and the carbon pricing on the market. But neither of those is present in the U.S. federally, or in Canada either.

Sean

Steve, we've had a number of attendees ask us about your work in India and projections for India. Could you just talk a little bit more about that, and will you be working with state governments or the center there? And how does this fit with existing targets in India?

Steve

Well, the existing targets under the current 5-year plan was for total additions of about 15 gigawatts. India runs 5-year plans and the current one I believe is 2013-2017, so March 1, 2013 through March 1, 2017. I would say that at the moment we are significant behind those targets. We

would hope that the industry could get a big boost later on this year. The nature of investment in the Indian market has changed substantially over the last couple of years, where there's a great deal more investment by independent power producers and less by individual tax investors, although they continue. And there's an argument that that's a good thing that they should continue, as well as the large investments from the large companies. So there's no question that the potential in the Indian market is enormous, and it can meet it. But whether or not it will is far more of a political, bureaucratic and regulatory question. Again, some of which we hope will get sorted out in the aftermath of the current election. For the offshore project, just as a highlight, you have many, many parts of the country that are still in a dramatic power deficit. Tamil Nadu in particular, ironically, given that it's the home to the most wind development. But the inefficiencies in the infrastructure there, it's only very recently become interconnected with the rest of the country at all. And those interconnectors were to be substantially boosted, as well as a number of others, if it's going to facilitate the growth of the sector. With the offshore project, of course, we're working closely with both the governments of Tamil Nadu and Gudua, as well as the central government, which is absolutely necessary, since in regulatory terms I think there are sixteen different federal agencies that would need to be involved in permitting offshore wind at one level or another, as well as a plethora of individual agencies within the specific states. So you don't do anything like that in India unless you're working both with the local and the national government.

Sean

Next question from one of our attendees. You didn't mention Argentina, the potential market in the future, and the fact that the country has utilization factors of almost 50% in wind farms and the recent discussions in congress about mandatory targets for 2015 to 2020. Do you think there will be any opportunity for OEM and developers in Argentina?

Steve

Argentina has arguably the best wind resources in Latin America. One estimate is that they could power the entire continent seven times over with their wind resources. But as a destination for investors after the nationalization of Petrobras a couple of years ago, to put it bluntly, all investors ran screaming from the room. The country risk is just considered too high. Now that was changing prior to that action by the Argentinian government, and we were seeing investors moving in, Chinese, European and others beginning to invest in projects. Their installation numbers started to go up. But they dropped again dramatically, and until and unless there's a very, very clear signal from the government that that sort of game is not going to be played again, and that there is a very clear investment climate which will facilitate the development of these resources, I don't think you're going to see much interest. It's a pity, it's a shame, and I hope it does change, but at the moment I would say it's terra nullius for us.

Sean

I'll try to reword this next question, it's a little confusing. But I'll read it and see if we can approach it. It says the main R&D forces, Seimens, GE,

Vestas, are using public funds. Do you opt, or should they be using their own patenting?

Steve I don't understand the question. If I do understand it, I think it's wrong. Because I think while neither Vestas or GE or Seimens are averse to receiving public funds for use in R&D, I would say in terms of their own R&D efforts, the vast majority of them are funded from within the company's resources.

Sean And whoever submitted that, if you want Steve to address it, reword the question, submit it again. I'll be happy to present it to Steve. The next question, Steve, is considering all the social costs and controversy, do you think the Cape Wind will ever happen?

Steve Well, that's a good question. My understanding is they have a PPA for 75% of the power that they would produce. They have all the necessary construction permits, they've got all the – I'm not sure, maybe there's another lawsuit or two standing in the way, there have been so many, I don't know. I believe now they have sufficient financing and my understanding is the construction is going to go ahead and start this year. Whether it will be successful or not, if I knew the answer to that question I'd probably be in another line of work. I'd probably be a local politician in New England somewhere, in Massachusetts. And I'm not. Even though I was born in Boston I don't follow with that level of detail. I think Jim Gordon & Co. deserve a medal for perseverance. Many others would have given up already. But I think their determination is to move ahead and it seems like it's much closer now to moving ahead than it has been at any point in the past. Whether it succeeds or not, we'll see. I don't know. I wish them the best of luck. And having sailed many times in Nantucket Sound I would love to see the turbines up there spinning.

Sean Next question. What are the best options regarding energy reserves for high loads in two systems?

Steve I have no idea what that means.

Sean We'll move on to the next one, that's alright. Could you talk a little bit, Steve about what are some current examples of state of the art wind generation technologies, maybe talk about size of turbines?

Steve Okay. The industry really goes through sort of phases. In the initial phase, everybody got up to around 250 kilowatts, and those machines became commoditized. And then they were somewhere between 500 and 750 kilowatts, and those were commoditized. And then we went to the megawatt scale machines, and then the multi-megawatts, and 2 to 3 megawatts was the majority of the machines being installed nowadays in sort of mature markets. The next round that now we're going through is the commoditization of the 5 and 6 megawatt machines for the first round. But the second round, if you will, of offshore wind development there are

8, 9 10 manufacturers with machines in those ranges now. Only a couple of them have any substantial numbers of them spinning, and they will have to produce hundreds of them before all the bugs are worked out and they are optimized in terms of what they can deliver. Next, of course, we have the Mitsubishi 7.4 megawatt, and of course the Vestas 8 megawatt machine. There are a number of others on the drawing board which are going to be sort of the next step, if you will. But they are in very early stages. But I think for onshore, the focus now is much more not so much bigger and bigger, but better and better. Other than sort of improving all the widgets inside the machines so they work better and more reliably and more cheaply, I think there are two developments which are worthy of note. One is the effect of modern turbines for not so much class 1 wind areas, but class 2 and 3. They tend to be put on taller towers with longer blades and smaller generators. You get higher load factors, you get lower cut in speeds, and you get much more effective utilization of the less than perfect wind resource, which you often find closer to load centers. So sort of this low generation of low wind speed turbines has proliferated over the course of the last several years in China, in India, in the United States, in various places in Europe, to good effect, both in terms of the balancing of the overall system, but also in terms of reducing the cost of energy.

Steve

Another exciting development, which I just think is really neat, is the use of lidar, lidar mounted on top of the cell of a turbine, which will allow it to read the wind, if you will, 400-500 meters out in front so that small adjustments in terms of the yaw and the pitch of the machines, and in particular with the yaw because it's the slowest moving one, the one which rotates the actual positioning of the entire cell so it faces into the wind, as well as the individual blade pitch. So that you can make anticipatory adjustments to both the yaw and pitch on the basis of reading that wind four or five hundred meters in front of you, which does two things. One is that it increases the efficiency by which you can extract energy from the wind, and secondly it reduces the wear and tear on the machine from the sort of sideways loads. In other words, the loads that are not designed to optimally generate energy, which will tend to wear out things like bearings and hydraulics and blades and that sort of thing. So I think you have a double benefit from that technology. It has, particularly in dusty places and places with lots of turbulence or with very high wind speeds, I think you can prolong the life, reduce the O&M costs and increase the efficiency of turbines through the use of this technology. And in very early stage now, but some of the early results we've seen have been very, very exciting. So I guess for onshore the lidar and the low wind speed turbines are the two most important innovations that are in the process of being introduced to the market at the moment, and offshore we continue to get bigger and bigger, and hopefully more reliable and more effective.

Sean

Thank you. Have we seen a reduction in subsidies in any country with growth of the wind industry?

Steve

Well, I guess there's two ways to interpret that question. One is there reduction in subsidies as a result of the growth of the industry, or do you mean growth of the industry in spite of reduction of subsidies? I have to think for a minute. Of course we have a number of markets where there are no subsidies of any kind where wind is doing quite well, and I would describe South Africa and Mexico and Brazil, New Zealand, Turkey, others where the industry is thriving without any subsidies at all of the type that we usually associate with different forms of renewable energy. The energy system, any producer of any energy system, depending of course on the individual system has certain advantages as a result of being an energy producer. I mean, access to the grids and access to financing, that sort of thing. But those are generally available in places like Brazil and Mexico and others to every technology. I believe, if I'm not mistaken, that the actual feed in tariffs for wind energy in Denmark have, in fact, consistently gone down over the last several years for onshore, and the industry continues to grow there. There's been a reduction in the rock, or at least a proposed reduction in the rock factor in the U.K., and the market continues to grow there. The situation in Spain, again growth is stopped in Spain not because of the feed in tariff price, but because of the economic collapse and the collapse in demand. The demand is back down to levels seen in 2005, so there's no need for any new generation capacity of any kind. So I hope that begins to answer the question. A feed in tariff, is it a subsidy or is it not? Under the legal definition of the WTO, the German feed in tariff is not a subsidy, simply because it's paid by the rate payers, not by the government. The Danish one, I don't know where it would fit in the WTO rules, but you get into some pretty arcane definitions of subsidies or not there. I hope I've answered that question, but this subsidy thing is obviously very complicated because all energy forms are subsidized to one degree or another, by definition. Fossil fuels are \$600-700 billion a year, nuclear, pick a number, depending upon how you would want to value the cost of insurance, which is in fact provided by the government, which cannot be bought on the open market. It's a complicated subject. But I think the answer is that has the technology matured and its relative costs come down to the point where it can compete more effectively with a lower level of support from the government or no support from the government? In fact, yes, but it's a very situation-specific question, and you'd have to look at individual markets to analyse it in detail.

Sean

That was the last question I have for you here for our question and answer session, we are running out of time as well. Before we move on to survey the audience, I just like to give you a chance for any closing remarks you might have, any last points or anything like that.

Steve

Well, I haven't prepared anything, but I'd just like to thank you and Penrell and the Clean Energy Solutions Center for this opportunity. I think you guys do good work and I support your efforts. I'm actually on your advisory board, recently formed, and continue to support your efforts.

Thanks for this opportunity. It's nice to do this sort of thing once a year, and I find the interaction with the audience, even moderated through text questions to be very useful to me in terms of figuring out how to pitch my arguments, and how to understand what questions are out there and how they can be most effectively addressed. So I've enjoyed this. I hope it's been equally useful to the audience, and I look forward to doing it again sometime in the not too distant future. So thanks very much.

Sean

Great, and thank you again Steve, for providing that great summary of the report, and also the great discussion afterwards and handling that range of questions. We appreciate that very much. And now I'd just like to ask our audience to take a quick minute to answer three questions that we have that will just help us to know what we are doing well and where we can improve for any future webinars. So Heather, if you could display that first question? And that question is, the webinar content provided me with useful information and insight. Thank you. And next question, Heather? The webinars presenters were effective. And the last question, Heather? Overall, the webinar met my expectations. Thank you, everyone, for answering our survey, and on behalf of the Clean Energy Solutions Center I would like to send a thank you to Steve and to our attendees for participating in today's webinar. We very much appreciate your time and the questions that were submitted for discussion, and invite everyone to check the Solutions Center website over the next few weeks if you'd like to view the slides again or listen to a recording of today's presentation. We'll be posting that recording within about a week of the broadcast. Additionally, you will find information on upcoming webinars and other training events, and we also invite you to inform your colleagues and those in your networks about Solutions Center resources and services, including the no-cost policy support through Ask an Expert. And we hope everyone has a great rest of your day, and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.