REN21 Renewables 2015 Global Status Report: Renewable Energy Integration

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Webinar Panelists

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Sven Teske Greenpeace

This Transcript

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Sean Esterly

Hello, everyone. I'm Sean Esterly with the National Renewable Energy Laboratory. And welcome to today's webinar, which is being hosted by the Clean Energy Solution Center in partnership with REN21. And today's webinar will provide highlights from REN21's flagship report 2015 global status report with a special focus on the findings related to renewable energy integration.

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

And I just want to go over some of the webinar features for you. You do have two options for the audio. You may either listen through your computer or over your telephone. If you do choose to listen through your computer, please select the mic and speakers option in the audio pane. Doing so will just eliminate any possibility of feedback and echo.

And if you choose to dial in by phone, please select the telephone option, and a box on the right side will display the telephone number and the audio PIN that you should use to dial in. And if anyone is having any technical difficulties with the webinar, you may contact the go to webinar's help desk at the number displayed at the bottom of the slide. That number is 888-259-3826. And they can help you out there.

And if you have any questions during the webinar, we ask that you use the questions pane, where you can submit it to us. And we do encourage anyone with questions to please utilize that tool. And if you're having any difficulty viewing the material through the [interruption in audio, 0:01:45], we'll be posting the .pdf copies. We have a couple of them up there already at cleanenergysolutions.org/training so you can follow along as the speakers present.

And also, an audio recording of today's webinar, along with these presentations, will be posted to the Solution Center training page within about a week of today's broadcast. And also, we're now adding the recordings to the Solution Center YouTube channel, where you'll also find other informative webinars, as well as video interviews with _____ leaders on varying clean energy policy topics.

Now, today's webinar agenda is centered around the presentations from our guest panelists, Laura Williamson and Sven Teske. Miss Williamson and Mr. Teske have been kind enough to join us to provide an overview of REN21's newly released renewables 2015 global status report and look at the status of integrated—integrating increased shares of renewables. And before the presentations begin, I just want to provide a short, informative overview of the Clean Energy Solution Center initiative. And then following the presentations, we will have a question answer session, where we can address the—any questions submitted by the audience. And then we'll finish up with a few closing remarks.

And this slide provides a bit of background in terms of how the Solution Center came to be formed. The Solution Center is one of 13 initiatives of the Clean Energy Ministerial that was launched in April of 2011 and is primarily led by Australia, the United States, and other STEM partners. And outcomes of this unique initiative include support of [interruption in audio, 0:03:22] countries and emerging economies through the enhancement of resources on policies relating to energy access, no-cost expert policy assistance, and peer-to-peer learning and training tools such as the webinar you're now attending.

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

Our primary audience are energy policy makers and analysts from governments and technical organizations in all countries. But then we also strive to engage with the private sector, NGOs, and also civil society. One of the marquee features that the Solution Center provides is the no-cost expert policy assistance, known as Ask an Expert. And the Ask an Expert program has established a broad team of over 30 experts from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost.

So for example, in the area of renewable energy policy, markets, and finance mechanisms, we're very pleased to have Camilla Ramos serving as one of our experts. So if you have a need for policy assistance in this area or any other clean energy sector, we do encourage you to use this valuable service. And again, it's provided to you free of charge. So if you have a question for our experts, please submit it through our simple online form at cleanenergysolutions.org/expert.

Or to find out how the Ask an Expert service can benefit your work, please feel free to contact me directly at sean.esterly@nrel.gov. That e-mail address is displayed on the slide. Or at my phone number at 303-384-7436. I'm happy to talk to you more about that program. We also invite you to spread the word about this service to those within your networks and also your organization.

And so now I'd like to provide brief introductions for our panelists today. Our first speaker is Laura Williamson. And Miss Williamson is the communication and outreach manager at REN21, the renewable policy network of the 21st Century, where she is responsible for promoting the efforts of REN21 to an international audience. And Laura's other activities include managing the production of specific reports and coordinating the bi-annual international renewable energy conference.

And then our second speaker today is Mr. Sven Teske. Mr. Teske recently completed a PhD thesis on good integration strategies and infrastructural planning requirements for 100 percent renewable energy systems. And he took his current position as the director for Greenpeace's renewable energy campaign in 2004. In this position, he led the work on the Energy Revolution at sustainable world energy outlook and specific good analysis reports for Europe and China. He was also lead author of—for the IPPT special report renewables.

And now, with those brief introductions, I'd like to welcome Laura Williamson to the webinar.

Laura Williamson

Thank you, Sean. I'm going to talk a little bit today about REN21's _____ status report [interruption in audio, 0:06:54]—mentioned on the interesting issue of grid integration with renewables, which is what Sven will talk about. So before I begin on sort of where we stand on renewables, just a quick word about who REN21 is for those of you who may not know.

REN21 is a multi-stakeholder network. We work with stakeholder groups across five key stakeholder areas. So NGOs, industry associations, science and academia, international organizations, and international governments. And it's through this international network that we produce the majority of our work. Our flagship publication is the global status report, and that's what I'm going to talk about today. And it's really thanks to this network of over 500 contributors that we're able to produce this annual report.

People contribute from their area of expertise, whether it be on technology, whether it be on policy, on finance. And collectively, this information is put together in the global status report. The global status report covers all energy—renewable energy technologies, the three sectors—power, heating, and cooling—and transport. And we're increasingly looking at energy efficiency, the interface between renewables and energy efficiency.

A quick word about how we put this report together. Each global status report uses formal and informal data so that we can provide the most up-to-date information available. The reason why we do this is we firmly believe that reliable, timely, and regularly updated data on renewables are—is essential for establishing baselines. This report this year is in its tenth year, so our tenth year of reporting. And the fact that it's grown from a 30-page report to now over a 200-page report really shows, I think, how much renewables have expanded and—in scope and in depth over the past ten years. And again, we're able to produce such a comprehensive report thanks to our network of experts.

With the increasing penetration of renewables, we're also starting now to look at regions, looking at—specifically at regions to be able to really dig down, to drill down and see how those regions are evolving. We've done reports for India and China, for the MENA region. Last year we launched a report for the ECOWAS, so the West Africa region. We will be launching our next report on the southern Africa, the SADC region, October 5th in South Africa. So that is the renewable energy development of renewables in that 15-country region. We have two other upcoming reports, one on the UNECE region, so looking at central and Eastern Europe, and a following report for east Africa will be coming out in early 216—2016.

Because of the data that we collect—we collect a lot of it—we include as much as we can that really—in each report. But we naturally have information that is remaining that's important, that's interesting information that doesn't make it into the report. All the data that we collect is available [interruption in audio, 0:10:42] our renewables interactive map. And I strongly recommend that for those of you who are looking for data, particularly at the country level, to really give a look at this map.

We have some currently—we've redone it. We've revamped it. So the interface is much easier to follow and more intuitive than our previous version. So let's get to the good stuff.

So what has happened over the past decade with regards to renewables? For those of you who are in the field, I don't think I need to tell you that it really has surpassed all expectations. Global installed capacity and production from all renewable technologies has _____ substantially. We have seen that most renewable energy technologies have witness or experienced significant cost reductions. And we've seen a spreading of support policies throughout the world.

And I think it's fair to say that despite the potential that we've known about renewables, that most mainstream projections that were done ten, even five years ago, were not able to predict the extraordinary expansion of renewables in today. So where do we stand in regards to renewables today, sort of specifically? Global final energy consumption has increased by about 1.5

percent annually in the recent years. And this is driven primarily by rising demand in developing countries.

Currently, renewable energy provides about—just over 19—19.1 percent of global final energy consumption. That was at the end of 2013. We've seen that the share of modern renewable energy—so that means modern biomass, not traditional biomass—has increased to about 10.1 percent, while the share of traditional biomass has stabilized at about nine percent. This is good news in the sense that if we are to meet the sustainable energy goals of doubling the share of renewables by 2030, we have to—in order to meet that, we have to substantially reduce the share of unsustainable or what is often called traditional biomass use in order to reach those numbers.

If we look at who the renewable energy champions are, if we look at it by investment—global investment, we have what I would say are our usual suspects. We see China, the US, Germany. However, I—a more interesting picture is if we look at investment relative to GDP. And this is where we get a completely different list of countries and again supports the statement of increasing penetration of renewables.

Looking at it by annual GDP, we see Burundi. We see Kenya. We see Uruguay. Which really highlights the [interruption in audio, 0:13:50] renewable energy in developing countries. If we look at the champions by total capacity, if—remove hydro from the equation, [interruption in audio, 0:14:06] Sweden and Spain and Portugal, all European countries that are leading with regards to total renewable capacity, excluding hydra, which is interesting to see.

If we look at the power sector, renewable energy currently comprises just under 28 percent of global power generation capacity. And just under 23 percent of global [interruption in audio, 0:14:41] demand was met from renewable energy. In 2014, renewables made up an estimated 59 percent of net additions to global power capacity and represented far higher shares—far higher than 59 percent of that capacity in several countries around the world.

We're starting to see variable renewables are achieving high levels of penetration in several countries. When I say variable, we're talking about predominantly wind and PV. So we saw that wind power met just over 39 percent of electricity demand in Demark, about 21 percent in Nicaragua. That's for wind. PV, we saw about just under eight percent met electricity demand in Italy, seven percent in Germany.

Heating and cooling grew in 2014, certainly not at the same levels as the power sector. What we are seeing is a growing interest in the use of advance collectors for district heating systems, solar cooling, and industrial applications. Energy use for heat, in general accounted for about half of the total world's final energy consumption. And within that, half of that, heating for buildings was provided by modern renewables. So we're starting to really see a penetration to modern renewables in the heating sector, particularly in the building-heating sector.

We did see a slowing of solar thermal technologies in 2014. This was primarily due to declining markets in Europe and China. [Coughs] Excuse me. [Coughs] Growth is slow in the heating and cooling sector, but it's starting to pick up. But it is clear that this is definitely a sector where there needs to be greater development of policy supports for renewables in the sector.

For transport, also grew, again, not as much as the power sector and slower than what we saw in the heating and cooling sectors. Over the last six years, we've seen about 1.5 percent growth of renewables in the transport sector from about two percent to 3.5 percent. The good news is that trends in the development of gaseous fuels and electricity have continued to create pathways for the integration of renewables into transportation.

There have been some advances in new markets and new applications for biofuels, particularly compressed natural gas and fueling stations—this is for biofuels—have expanded in 2014. We're starting to see limited but growing quantities of bio methane that are fueling cars and buses in several EU countries, predominantly German, Finland, and Sweden.

Now, if we look at renewables by technology, we start to see a little bit more clearly where this growth has been occurring. Though one sector saw more than 51 gigawatts of power capacity added in 2014, this is just under—it's about a 44 percent increase over the 2013 markets. So we're now at a total of just over 370 gigawatts that is being—of total capacity being provided by wind. By the end of 2014, at least 85 countries had commercial wind activity in place.

And we're starting to see an increase in offshore wind installations. By the end of 2014, offshore wind was an estimated 1.7 gigawatts of grid-connected capacity. And so now we're at about 8.5 gigawatts of offshore, grid-connected capacity. What we are seeing is that the off-shore wind industry is also starting to move further and further off-shore into deeper waters, which in turn is driving new designs for foundations and requiring more sophisticated vessels to actually go out and put those installations in place.

On solar PV, another record year for this sector, with about 40 gigawatts of capacity added, now standing at a total of 177 gigawatts. There was still strong market development in 2014 despite substantial decline in new installations in the European Union and slower than expected emergence of promising new markets. More than 60 percent of all PV capacity in operation worldwide at the end of 2014 was added over the past three years. Asia continues to eclipse all other markets, and they accounted for about 60 percent of global additions.

Bioenergy, total primary energy demand from biomass in 2014 was approximately 16,250 terawatt hours. The bioenergy share in the total global primary energy consumption has remained steady since before 2000, so at about ten percent. Approximately nine thermal gigawatts of modern biomass heat capacity was added in 2014, which increased the total global capacity to just about 305 thermal gigawatts. Biopower capacity increased by an estimated five gigawatts in 2014, bringing the global total to approximately 93 gigawatts.

Solar thermal heating and cooling also increased. We can see a steady increase there. And we're starting to see an increased focused on glazed water collectors. And we're starting to see China developing its commercial market in this sector.

With regards to jobs, good news on the job front, as well. Steadily increasing contribution of the renewable energy sector to the jobs market. According to an analysis from IRENA, the International Renewable Energy Agency, globally an estimated 7.7 million people worked directly or indirectly in the renewable energy sector. This is up from about three million from ten years ago; so pretty good growth in the sector.

Solar PV is still the largest employer, with about 2.5 million jobs. We've really seen growth in this particular sector, particularly in Japan, the US, and Bangladesh. Global wind power had about a million jobs in 2014.

Global investment over the past years has increased and decreased, as you can see on this graph. Investment in global—investment, excuse me—in renewable energy globally increased in 2014. It was about a 1.17 percent rise compared to the previous year and was really the first increase—the first substantial increase in investment for the first time in three years. What's nice to notice here is that renewables outpaced fossil fuels for the fifth year running in terms of net investment in power capacity additions.

This first increase in three years in investment was due in part to a boom in solar power installations in Japan and China, as well as to record investments in offshore wind projects in Europe. Solar power and wind are still the leading technologies in terms of dollars committed. We saw that solar power accounted for more than 55 percent of new [interruption in audio, 0:23:41] in the renewable power and fuel sector. And wind power was responsible for 36.8 percent.

Let me just preface this by saying that these numbers are not including hydro greater than 50 megawatts. So if we're looking at investments in renewables not including hydro that's over 50 megawatts, we have solar and wind being the leaders. Overall in 2014, more than a quarter of new investments in renewable energy went to small-scale projects. So those are small-scale renewable energy projects predominantly in solar PV.

Here you can see investment by region. Investment in developing countries was up 36 percent from the previous year to about 131.3 billion. This investment came the closest ever to surpassing the investment total for industrialized or developed economies. So we're starting to get an evening out in the investment area between industrialized or developed countries and emerging and developing countries.

We saw a spread—investment spread to new markets in 2014. We saw good market development in Chile, in Indonesia, Kenya, Mexico, South Africa, and

Turkey. So each of them investing more than $1 billion USD. Policy landscape continues to increase, supporting the deployment of renewable energies. What we're seeing is yes, we're getting a spreading of policy mechanisms, but they're also becoming differentiated according to technology.

A continuing evolution of feed-in policies in many countries, moving more towards premium payments in the power sector. And they're starting to be better adapted to support the heating sector. We're also starting to see an increasing shares of renewable energy being integrated into existing power systems. And this is something that Sven will look at more closely in his presentation.

If we start to break down the policies by category, we're starting to see that feed-in tariffs and renewable portfolio standards are still the most popular instruments. An increase in the use of public, competitive bidding, or tendering. We saw in 2014 that policymakers focused their attention on adapting existing policies to keep pace with the rapidly changing cost and circumstances of renewables. And we're starting to see a growing linkage between the electricity, heat, and transport sectors and the development of innovative mechanisms to account for that penetration.

And so here you can see a little bit more clearly the bundling or the energy policy landscape by year, we get a mix of regulatory policies, fiscal incentives, public financing mechanisms all continued to be adopted. The power sector has been the main focus over the past five years. FITs, feed-in tariffs, were the most popular type of policy. Net metering or net billing policies were enforced and are starting to increase. There's been about a 220 percent increase from early in 2010 to 2015. So that is encouraging.

Distributed renewables are still a bit of a challenge. Now, part of this is that it's very difficult to track the uptake of renewables in distributed form. A lot of very small home systems being implemented by a wide range of actors. The data collection process on distributed renewables is not as developed and as sophisticated as grid-based renewables. So our window into how this sector is developing is not as clear.

It is—what is clear is that we are starting to get more and more distributed renewable energy systems being implemented. As I noted at the beginning, over a quarter of new growth was in the sector, but actually being able to see clearly how that is divided up is still a bit of a challenge. So with—and what we're also seeing is that we're getting distributed renewable generation, but we're still having a big lack in some areas.

So for example, with installed—renewable installed capacity of about roughly 147 gigawatt, all of Africa has less power generation capacity than Germany. So there really is a key role for distributed renewables in many parts of the world. Tracking that penetration is ongoing, and we're still grappling with how best to monitor that. The good news is that DRE systems are continuing to attract investment, particularly in the form of venture capitalists, but also commercial banks are now entering into this area, as are companies.

Historically, we've seen that governments and international organizations that have really taken lead on advancing energy access, but we're now starting to see an evolution from the sort of centralized, public-led approach to a more of a public, private partnerships and private ventures. As I mentioned, DRE is still attracting—is starting to attract investment from venture capitalists, commercial banks, and companies. We're also starting to see certain companies—certain countries take a lead. So for example, Brazil, China, India, and South Africa have really started to take the lead in developing large-scale, off-grid renewable energy programs, and that's really helping to address the duel challenge of energy access and sustainability.

So that was sort of a very quick overview of where we stand in the world today with regards to renewables. In conclusion, it's unquestionable that renewable energy growth continues to grow, particularly in developing countries. Seeing a [interruption in audio, 0:31:00] even and increasing uptake even with a dramatic decline in oil prices during the second half of 2014. We did see global carbon emissions associated with energy consumption remain stable in 2014 while the global economy grew. Part of the stabilization has been attributed to the increased penetration of renewables, as well as to improvements in energy efficiency.

We definitely have—the wheels have been set in motion for a global transition to renewables, but we still need a concerted and sustained efforts to really get renewables—get us to the point of 100 percent renewables or increased shares of renewables in the global energy mix. We need to establish and strengthen institutional, financial, and legal frameworks. We need to keep pushing to build awareness about the challenges posed by the lack of access to sustainable energy sources and the role that distributed renewables can play in that.

We need to ensure that we have long-term and differentiated policy frameworks—the differentiated part is very important—to be able to bring in the contribution of renewables to the three energy sectors—power, heating and cooling, and transport—particularly in the last two, where we really need to work on increasing penetration. And we need to see those three sectors come together and look at how grid integration can play a role.

So that's it from me. This is just a very quick overview of the products that we produced, as well as links. And one last quick plug. Sean had mentioned at the beginning that one of the things that I'm responsible for is for the international renewable energy conferences. For those of you in sub-Saharan Africa, we have our South African international renewable energy conference. That will be at the beginning of October.

For those of you who are interested, we will be tweeting on it. There will be information on our website. It is a renewable energy conference dedicated solely to renewables that are held every two years. This is the first time on the African continent. And there's going to be some very interesting discussions coming out of that, so I encourage you, if you're interested, to please follow along via our website and our tweets. Thank you very much.

Sean Esterly Great. Thank you very much, Laura, for the excellent presentation. And now we will turn our attention to Sven for his portion.

Sven Teske Okay. Hang on a second. I can't see my presentation. Oh, here. So do you see my presentation now?

Sean Esterly Yes we do, Sven. And –

Sven Teske Okay.

Sean Esterly Yep. Perfect.

Sven Teske Okay. Good. So before I go into more details, I would like to go into the situation, how it evolved in countries where there is a large share of flexible renewable energy power generation, solar and wind. Mainly wind first and then solar later on. In the beginning, the flexible regeneration cuts into the normal profile. And if there is a share of less than 20 or 25 percent, depending on, of course, of the volume and of the grid—the country, it does not really interfere with base load, and integration is usually possible without large storage infrastructure or enormous expansion of grids.

So that's the starting phase. So we keep saying—we keep hearing that renewable energy requires a different infrastructure. But in fact, for the first, let's say, uptake of five to ten years, you usually don't need to change the infrastructure—the power grid infrastructure in the country. So you don't need to wait. But you have to prepare the infrastructural changes while the market is growing.

When the power generation exceeds 25, 40, 50 percent—again, depending on the infrastructure and the strengths of the grid—and you do accept base load, then the wind and solar peaks cut out of the load curve, and there is either—you either need to dispatch, you have to store it, or you need to curtail it, which is not very good way of handling renewable energy generation. So you cannot accept a base load if the share of renewables is larger. In case there is a priority access into priority dispatch for renewables, the power generation cuts into the base load. And this is basically the situation right now in my home country, Germany, where the install capacity of solar PV and wind together is about 80 gigawatts, while the demand of the country is between 60 and 80.

So in sunny and windy days, Germany has up to 80 percent. That happened last end July, 78 percent of renewables for a few hours. That also means that the base load power plants have to reduce output. And that leads to economic losses and clashes in energy policy. So what you see in Germany and in some parts of Spain and Denmark since many years, you see that renewables go directly against base load power plants.

So I think the first message we have in terms of integration—renewable grid integration is we don't need base load. We can't actually afford base load power plants. While there is a base load, there is no need for a base generation. And I think this is a very specific and very clear message. While we cannot be completely open what technology we add to the grid.

So the logic—and this is the way how Denmark is organizing that right now—is you build up—you have the base generation is wind and solar. And you put this on top of each other. And everything between—sort of residual load between solar and wind and the load curve is provided by dispatchable power. So that could be bioenergy, hydro, in some cases it's possible to have concentrated solar power, geothermal. In the transition phase will be, certainly, gas, but also maybe even parts of coal.

In—again, back in Germany, the situation is that the surplus coal gets exported into the neighboring countries. And that leads to quite a lot of argue around the energy policy. The eastern neighbors of Germany, Poland and Czechia, Poland is heavily based on coal; Czechia is heavily based on nuclear. They have phase shifters already. That means they block imports of cheap wind electricity into their electricity _____.

We also see that demand site management can ease the problem a bit, but not very much, depending on what kind of mechanisms you have, what kind of equipment you have. There could be a low, double-digit percentage range of shifting the load, but it is not enough in order to really accommodate the entire solar wind share. So the evolution of a smart grid—and I actually have to say I actually don't like the expression smart grid because right now the grids—most of the power grids are actually not stupid. It's just that we add Internet information about production, decentralized production, which is not available right now for the grid operator, to the existing grid.

So smart grid always sounds like we have to rip off the cables, the existing cables, and have to replace them with other cables. This is usually not the case. We basically merge the existing power with the Internet. And therefore—and this is an example here from Denmark, which tries to build clusters, clusters of isolated micro and mini-grids. And that, we're talking about communities. We're talking about small cities up to 100,000 people.

And those cities have their own power generation mix. They have solar PV. They have wind. They have co-generation, mainly based on biomass. They do have limited storage capacity, so they actually can operate almost 100 percent independent from the transmission grid for a number of hours or maybe even days. So the idea is that once there is a lot of wind in the electricity grid in Denmark—and we're talking about 30 percent wind electricity share right now in Denmark—then the storage facilities in those areas, in those clusters, get charged.

So the demand-side management is done both by consumption, also by electrical heating, in order to provide heat and store the heat in tanks, as well as batteries to a smaller extent, or charge other pump storage hydro, which is not really widespread in Denmark because Denmark is quite flat. So you can charge the existing batteries in the clusters. Once there is low wind generation, the grid operator has the possibility to cut off clusters entirely from the national grid. So this is the demand-side management with entire cities getting off the grid, and there's—that's the possibility of also choosing different sizes of clusters to do demand site management in a larger scale.

What we have seen in analysis is that integrating private consumers in demand site management is problematic. There was a research done in—of the _____ _____ in south Germany, where they monitor—they basically had a project—demonstration project which has [interruption in audio, 0:42:52]—contributes actively at demand site management. So if the stock market prices, electricity price is high, try to save demand—to decrease the demand. If the stock market price is low, consume more.

The problem is that it's not only one household seeing that but maybe a thousand or maybe 10,000 or maybe even 100,000. And that means that the fluctuations of actively engaging households are so large that you lose control over the entire system. So the lessons learned is that there must be one grid operator who has the control over demand site management, both in the distribution and in the transmission grid. Otherwise, you give away your control to the consumers, but you can't really control the system anymore. So there is a mix of consumer-led demand site management and grid operator-led demand site management.

We have done a very specific study for Europe, and I'll just give you a few—a glimpse of what we have done in order to show in what direction grid integration issues go and in—why we have done it. The European network—the transmission and system operator network, _____, is working on ten-year development plan for cables for the power grid across Europe. And basically, it is a summary of the national—of the 20 national grid operators. And they try to make a European grid out of it.

Obviously, all the 28, or almost 30, countries who have their own energy policy need different demands for the grid. In order to influence the debate and to influence the grid expansion in favor of renewables, Greenpeace has done two—or actually three studies now and developed its own European-wide network plan. And we simulate three cases. The reference case, which is based on current policy scenarios from the IEA; then we have our own renewable energy scenario with 27 percent renewable electricity by 2030, broken down by 30 countries; and a conflict case, where this is right now actually quite unfortunately the reality.

France, Czech Republic _____ keep inflexible coal, lignite, and nuclear power plants alive. And the renewable _____ have an uptake in most all other European countries. And that means we have specific, very different install capacities for the entire EU. So the range for renewables in the EU is between 620 gigawatts to 1200 gigawatts of renewable capacity in 2030. The later one would lead to 77 percent renewable electricity share.

We have methodologies for different electricity shares from different countries. This is probably not very visible, but you can download the presentation so you see the big difference of shares over time for each country. And in order to show the model how we do an analysis of grid integration and the uptake of the renewable energy market, what Laura just showed to you, is we have a network model of 200—more than 200 nodes—grid nodes representing the major loads and generation sites. Also we have 400 AC lines for major transmission corridors with capacities. And all exist in HVDC lines in both capacities.

The main—the—or the basics of that model also take into account the ten-year network development plan which was published in 2012. Right now there is a new plan under discussion, which will be published next year. The methodology of those analyses is that the initial network topology is as shown. We have different install capacity always for each grid node in terms of power plant technologies but also yearly electrical load for each countries and for the scenario—for the different scenarios. And the engineering company we're working with is called Energynautics. They have a distribution key for how the technologies are distributed in each country. And that depends also on the resource assessment in terms of wind and solar.

We have time _____ for the weather year of 2011, which we feed in. We have variable renewables, wind and solar. And we have the load profiles for each country, which has been supplied by _____ itself. The outputs is basically the necessary network extension and the costs that dispatch nodes of technology, including curtailment, and the load factors for the controllable generators.

What does that mean? We have—we calculate how many cable—additional cables we need. Those subsea underground overhead lines for DC and AC. And we assume the costs estimated by ENTSO-E. So ENTSO-E estimates about $57 billion for the next ten years investment in the grid. And we have to identify, which is very important also for future energy policy, what are the technical assumptions for different renewables.

We have variable renewables, which is wind, on-shore, offshore, and PV. We have flexible “controllables,” which means biomass, hydro, gas, oil, geothermal, and CSP. We have inflexible controllables, which is nuclear, lignite, and coal. That means they cannot really follow the load. We have pumped hydro as one storage technology. And we have PV batteries.

What are we doing if we have inflexible generation? And I—this is an example. Inflexible generation means that we have the range of 20 percent flexibility, which to the upper pink band. So that means if there's 80 percent—20 percent flexibility, a nuclear react can has a maximum output of, let's say, 1000 megawatt. You can go down to 800. If you have to go below 800, you have to switch them off because you can't follow any further. This was always the line of the nuclear industry until recently. Now they claim they are more flexible, but we don't know if this is also safe.

We also have the assumption for flexible generation for solar _____. So we capping—we basically cap the PV peak and moved it—move it into the evening or night. And we have run different models with different percentages and with a cost assumption, which is maybe too high if we now see the announcement of Tesla and other battery companies. But being conservative, 10 percent of the capacity—of the PV capacity with battery seems to be right now, or we have calculated last year, the best difference—the best storage share.

This visualizes a system conflict in the grid—France versus Germany in the summer. So we have the yellow line is peak of German wind and solar. And also have the inflexible power generation from France. And in some cases, for example, in the—between the 16th and the 17th of July, we have a huge clash where, in theory, a lot of solar and wind electricity would cross the border to France, while at the same time France would have a very high output on nuclear. And that would lead to a direct system conflict.

If we go into more detail what that means, and if we say—we take the technical reality into account, then the only power generation which have to—can jump in and—or shut down relatively quickly is gas. And that means that the gas will be in the conflict case always the loser by having very, very low capacity factor. So that means gas is not economic. But also coal, for example, in the conflict case between France and Germany, coal would have a capacity factor of only 34 or 43 percent in 2030. Capacity factors below 65 percent or 60 percent are not really economic to operate those power plants. That means they lead to uneconomic capacity factors.

Again, we need to have the load coverage and the load factors by each technologies and the imports and exports under different scenarios in order to evaluate where are—is the country still an import country? Is it an export country? What is the curtailment rate? What is the gas load factor? What are the other load factors? And only a total concept in terms of renewable power generation and conventional power draws the structure of future energy policy.

Again, an example from Germany. Germany is currently working on a new power market design. They call it power market 2.0. And they decided very clearly on energy only market and against capacity market because capacity markets—capacity tariffs will lead to indirect and direct subsidies of coal and nuclear capacity. And also the problem is that you will have to decide which power plant is system relevant and which power plant is not system relevant.

And therefore, that will be very difficult, so the energy only market seems to be the way to go. But that also means that the entire power market system and the way how to reach the set needs to change when we have very large shares of renewables. And we see that this will be in the very near future the main bottleneck of high shares of solar PV and wind. It's the policy, and also the lack of infrastructure.

Coming to an end from the grid analysis point of view and what do we actually need and—as grid expansion until 2020 in Europe and then later on until 2030 is that we need a few corridors to move away the wind electricity from the coast to the center of the continent or to move solar energy from south to north and some interconnections. We also have integrated this large DC lines. You see one from Scotland down to the south of England and then to the north of France. This is a particularly important corridor, as well as the one in Germany going from the north all the way to the south—the center of Europe.

And we go for DC lines because you avoid loop flows. Loop flows appear if, let's say, wind in the north Germany gets feed into the grid in the transmission line—in the AC transmission line. But there is no demand in—there is no—not enough demand for the electricity. And that will lead to a loop flow that—that means that the electricity will not flow across Germany but across the Netherlands and Belgium back to the south part of Germany.

I would like to conclude for our analysis in terms of the load coverage. That means what is the percentage of renewable energy which contributes to the load 24/7 across the entire year? And we see that there we have some export countries like Denmark, like even Croatia. Croatia is a corridor. Also Sweden. And we have a number of countries which are import countries.

That brings us to another problem because technically optimized renewable energy mix does not necessarily mean that every country has 100 percent of self-supply. But we move around electricity in the most economic way. That means we use more wind in from areas where there's actually wind—or more wind rather than producing in very low wind speed area. But this is a—technically speaking, this is the best concept. Politically speaking, I admit that this might not be the preferred version.

I conclude with the cost estimate. What we are able to do with this strategy in terms of dispatch ranking in terms of demand site management and the mix of demand site management and grid expansion and storage is that we can integrate twice as much renewable power generation capacity into the European grid with the same investment. We have done a specific study for the Gansu province in China.

We just published it in July. We published just a week ago a scientific paper about that research. And this follows the same line. And we have found that also the Gansu province in China can integrate far more wind and solar than they currently do without any curtailment.

And I would like to end here. And as a last slide, I would like to highlight—and I'm pretty sure that those of you that know the German situation, and I see that in the registration there were a few Germans—the German audience probably knows that, but here's the European change platform. You see on this Internet, the on—in time, real time production of German renewable and conventional power generation.

So for example, you see right now that at between 10:00 and 11:00 this morning, we had 10.8 gigawatts of solar and 8.1 gigawatts of wind. And we had conventional of 47.4 gigawatts. In some days when we have very sunny, windy days, as I mentioned before, we go up to 80 percent renewables between 11:00 and, let's say, 3:00 or 4:00 PM.

And with that, I would like to close and be open for question. Thank you.

Sean Esterly

Great. Thank you so very much, Sven. And we'll leave your last slide up there for just a minute in case anyone wants to copy down your contact details. So if you can just leave that up for a moment, that would be great. And then I'll show my slide again in just a second here.

Just a reminder to the audience, if you have any questions for either of our panelists today, please feel free to submit those through the question pane. And we can ask them directly to them right now as we're starting the question and answer session.

And so first question that came in—this one's actually for Laura. And it just asks if you've seen any impact on the renewable energy market from natural gas development recently, particularly liquid natural gas.

Laura Williamson

Okay. Can you hear me now?

Sean Esterly

Yes, we can.

Laura Williamson

Okay. Excuse me. We haven't seen any impact—negative impact on the market so far. We're—the data we were collecting, although it's a 2015 report, was on 2014. I—what we did see was the fact that renewable uptake was not affected negatively by falling oil and gas prices. So renewables in and of themselves are a market that is evolving and developing well and currently are less sensitive to those market fluctuations.

Sven might have a bit more detail on that 'cause I know that he sometimes looks at that for some of his work. Sven, do you have anything to add on that one?

Sven Teske

No. Not really. We have done a lot of survey if we have a negative influence of low gas and oil prices on the renewable energy market. And up until now, we haven't seen any proof. I know that there is conflict, especially in a political conflict, renewables versus LNG in the US and Mexico. But it is very hard to verify if that has direct impact on the renewable energy market. I couldn't see any sort of solid proofs. It's more indirect feeling that this could affect—could be affected negative the renewable energy market.

Sean Esterly

Great. Thank you both. We'll move on to the next question. This one's for Sven. It asks, "What is a realistic timeline for European integration? What is needed to drive it? And how can the EU experience be applied to developing countries to increase energy assets?" I'm happy to repeat that if you need, Sven.

Sven Teske

Yeah, I know. It's—[laughs] well, I don't have a crystal ball. I would love to know that myself. I know that the—in the EU we have this ten-year network development plan. And this is led by the—by ENTSO-E, the European Network for Transmission and System Operators. And they move to fairly high shares of renewables right now and—renewable electricity. There's also the regulation or the agreement every country—every EU member state needs to have 10 percent of its capacity for cross-border trading.

That means—as an example, Germany needs about 80 gigawatts capacity. That means the cross-border trading capacity to the neighbors must be eight gigawatts. The—there is—this is an agreement which is not entirely legal binding, but it helps to—for grid expansion issues. But the grid expansion itself is fairly slow. Also, because there's resistance for new overhead lines. So what happens is that the existing overhead lines get a second line—a second cable, which is technically possible.

There is also the possibility of doing temperature measurements of the line itself and use—and put higher capacities through the line. That's possible so that we can actually integrate a bit more than theoretically. So with the theoretical safety margin is slimmer. And I see that the—in the medium term, that storage technology market could ease a bit the pressure of the grid expansion.

But I see that the majority of new power plants in the EU are renewables. More and more old, coal power plants go offline. Nuclear goes offline. They're all 20, 30, 40 years old. Gas is not really being built new because there is no specific incentive right now. And renewables are booming just because it is cheapest to build wind and solar.

The problem we have in the EU is more—not more the new build but the existing capacity. We do have established and written off power plant fleet across Europe. And you can't really compete against written off power plants. And that's the main bottleneck to get those power plants off the grid. So we don't have [interruption in audio, 1:05:53] like in developing countries that new fossil fuel power plants are being built. That's not really the case.

In Germany, there were a proposal of 15 new coal power plants, and only five have been built—five or six. So that's not the main problem. The main problem is really to get them off the grid, the old one. However, to conclude, I would think that in the next ten years, we can easily double the share of renewable electricity. And this is simply economic, and more and more countries are in favor of renewables. Europe is basically divided. Half of the countries are very supportive of renewables, where the other half is not.

Sean Esterly Great. Thank you, Sven. This next question, if you happen to have it handy, we can address it. If not, we can follow up offline after the webinar with the attendee. But they were wondering if you know currently what the percentage of renewable energy in Germany is?

Sven Teske Electricity is 28 percent, sort of our annual average. Last year it was 28 percent.

Sean Esterly Great. Thanks again, Sven. This next question points out that gas power plants produce the lowest greenhouse gas emissions compared to other fossil fuels. They were wondering if you think gas power plants can be a transitional option in developing countries such as Nigeria while developing their renewable energy share?

Sven Teske Depends on where the infrastructure is. If there is no infrastructure for gas in place, then I don't think it makes sense to build up infrastructure to scrap it 20 years later. If there is gas infrastructure in place, then this might be a possibility. But I think we also have to keep in mind that renewables, mainly wind, are just cheaper than gas right now. So for economic reason, it really doesn't [interruption in audio, 1:07:59]—not necessary of that African countries, for example, wait.

It is the least cost option. The main problem in those countries is sometimes the lack of the infrastructure itself. So power grids are not there or in very bad states, so that's more the problem. So I'd rather go for implementing best infrastructure power grids and start with renewables right away, rather than going for gas and building up a gas infrastructure and then scrap it 20 years later. I think that's not economic.

Sean Esterly Great. Thanks, Sven. This next question has to do with energy storage. And they're wondering if you've ever studied biogas as storage, both the actual technology and H2 enhanced, as opposed to using battery source?

Sven Teske Yes. The Greenpeace in Germany actually has its own utility called Greenpeace Energy. And Greenpeace Energy provides electricity to 120,000 households. And Greenpeace Energy also sells gas for heating. But this is a specific gas sort of tariff, which mixes hydrogen and gas.

So we produce with—this is a very small project; up until now it's only one winter—but produced as hydrogen and feeds that into the gas pipeline. And that means that we have—we call it wind gas, the product. So what we study is how do we—how can we produce gas ourselves with electricity, with _____? Either use only hydrogen and use the gas infrastructure or add carbon to it from—for example, from biomass?

And then we have renewable methane. Renewable methane is probably better than hydrogen because you can handle it the same way like natural gas. It is chemically the same as natural gas. So you can actually use also the power plants. So this is something where we—especially in countries where there is a gas infrastructure, we're very much in favor of that.

Germany, for example, could store 500 terawatt hours of electricity into the existing gas pipeline system, which is equal to the annual demand of the entire country. So that's a huge option. And in fact, if you see the storage development technologies in Germany, gas, sort of renewable methane, hydrogen, or other gases, or biogas are more of in favor—or more developed than batteries.

Sean Esterly Great. Thank you. And this question is for both of you. It asks if, "Does the global status report cover projections into the future for renewable energy? And do you have any insights on what the future for renewable energy in India looks like, particularly out to 2030?"

Laura Williamson I'll start with the easy answer to that question. No. We do not. The global status report is status. It's where we currently stand now. The reason being is we have to know what the baseline is in order to make good decisions.

Sven might be able, because of the Energy Revolution work, to speak more specifically to the potential for India. From what we've seen currently, the movement of India across the past ten years, huge, huge potential for India to move rapidly to renewables.

Sven Teske Yes. Thanks, Laura. I—we just published our fifth edition of the Energy Revolution, which is an alternative to the IEA's world energy outlook. And we used the same IEA regions, and we used the same GDP development and population development input data and even the same oil and gas price estimations and GDP, as we don't do it ourselves. But we develop a different alternative scenario. And obviously, we have one for India, which has been published only three days ago, until 2050.

So we have three scenarios in that publication. If you go to the Greenpeace homepage, http://www.greenpeace.org, and look for the Energy Revolution 2015, you can download this. If you want to have further information, you can drop me an e-mail. But I think that's all in there. And we see huge potential for India, but we also see a lot of announcements.

In the real world, the UK installed three times more solar PV in 2014 than the entire country of India. I would say India could do better. And we see that the—with the development of the rooftop policy in Delhi and other states that the renewable policy is increasing—is better. So we hope that it finally takes off. But what we have heard from India up until now, very good announcements but little action. And we very, very much hope that this turns now into real markets.

Sean Esterly Great. Thank you. And we just had a few more questions come in. One attendee notes that you mentioned that [interruption in audio, 1:13:36]—so your opinion when compared with the REICPPP of South Africa?

Sven Teske Laura, do you want to start? Laura? Okay, well then I can give it a try. The scheme in South Africa—I know that—I was sort of a little bit involved in the beginning when the feeding tariff was agreed, actually, first. And then just five minutes before it should've started, they changed the system to that. I think it works in terms of wind, the—this policy. But the problem is that the public participation possibilities are not very high. And if sort of small and medium enterprises are not able to benefit from that system, so to win the bidding, for example, and small companies can't really compete with large companies in the bidding process, then the public acceptance goes down.

And one of the reasons why Germany was able to build so much wind with very little resistance is that communities and small, medium enterprises and private people actually benefitted from it because they could invest their own money into one—or one wind turbine or wind farm or solar generator. So if you have a broad range of ownership structures, if—the acceptance is much higher. So it's not just the amount of how many cent per kilowatt-hours do I pay or do I get? It's also who gets it? And who can contribute?

And I think a good mechanism should mirror the broad range of stakeholders involved in the energy transition. And therefore, I very much favor feed-in tariff policies over bidding systems because of the possibilities that even farmer or a small, medium enterprise can actually take part. Germany will move away from that, which I personally think is a huge mistake. But this is what the government decided, and let's see if that actually works because it has not been done yet.

Wind tendering system will start in Germany in 2016 with a test phase, same with solar PV. And let's see if that works. One of the reasons why the wind market in Germany right now is so huge with four gigawatts last year on land was the—was old panic installations to complete that before the new system was in place.

Sean Esterly Great. Thank you, Sven. And we had another question that goes back to the renewable energy and natural gas issue. They asked, similar to the last question, if you see an opportunity of natural gas to support the uptake of renewable energy in Europe. So from a developing country to a developed region. And if so, what are the key steps of policy that could be adopted by governments?

Sven Teske Unfortunately, I can't—I don't have a single example where gas was helpful for the uptake of renewables. In theory, the gas industry and the renewable industry should be strategic partners. In practice, they fight each other. That's the problem. In Spain, for example, the gas industry was very aggressive—aggressively going straight against the renewable industry. And so unfortunately I don't have a good example.

Sean Esterly That's fine. Thank you, Sven. Laura, do you have anything to add?

Laura Williamson No. I was going to agree with Sven. [Laughs] We haven't—we really haven't seen anything.

Sean Esterly Great. Thank you. So moving on to the next one, it asks, "In your studies, what is your view on nuclear energy? And is it a viable option for India and other developing countries?"

Sven Teske Well, clear answer, no. Apart from the environmental argumentations about the _____ nuclear waste problem, security issues, and all the rest of it, proliferation for military purposes, the nuclear power plants are simply the most expensive power generation technology you can have. If you look for the current two reactors, which are sort of—they try—I really have to say we tried to be built in Europe, one in France and one in Finland—is that they current cost around 6000 Euros per kilowatt, compared to 600 Euro of gas, compared to 800 Euro to 1000 Euro of coal, between 800 Euro and 1200 Euro for solar PV, and around 1000 Euro for wind.

Nuclear is really, by far, the most expensive technology. And it is certainly not the right technology for new build, certainly not the right technology for developing countries because it takes ten to 12 years. The average construction time from all existing nuclear power plants worldwide is 12 years. So the demand—the rapidly rising demand of developing countries cannot be met.

So if you even start to—if you decided to have a nuclear power plant, it takes 12 years or 15 years till you have the first kilowatt-hour. And that means you have 15 years where you wait for new electricity you urgently need actually today. So it's not the—besides that, you have seen the grid integration slides. You can't really use it as a flexible power generation technology to integrate high shares of renewables. That means you have a system conflict from the very beginning.

Sean Esterly Great. Thanks, Sven.

Laura Williamson I think also one thing to add—maybe this isn't the case—well, it will be the case in certain parts of India. The problem also with nuclear as with other power generation technologies is it's grid-based. And if we're really looking at energy access for all, we also have to consider that last mile, getting energy resources, getting electricity, other energy sources to that last mile. And nuclear certainly does not contribute to that.

Sean Esterly Thank you both. And do either of you have any advice for small island developing states, such as Ireland and the Caribbean, to transition faster to 100 percent renewable when taking into consideration that the RE potentials are very huge on those islands?

Sven Teske There are some very good example. For example, Barbados is currently developing a 100 percent renewable energy scheme. [Laughs] I know that just by accident because my professor, my—which I—he was my—Dr. Farber, he is currently working in Barbados for that 100 percent renewable energy concept. So I would say islands per se are the next booming regions for the renewable industry because it is simply economic. The only problem or the only sort of the missing link right now is the knowhow of grid management from flexible power generation, solar and wind, on islands. But this is a know how problem, not an economic problem, and therefore, I think, from my personal point of view, islands are the next big thing for the renewable industry.

Laura Williamson There's been also a lot of—there are lots of very interesting initiatives with regards to islands. You have IRENA, which has its SIDS Lighthouse, which you might want to look into. There's also the 100 RE campaign that is documenting communities that are going 100 percent renewable, and I know that they have some island examples in there that might be of use.

Sean Esterly Great. Thank you. And we have time for about one more question. And that question is, "What is your opinion on the current status of licensing requirements of off-shore renewable energy? Should there be stricter regulations, for example, on prior environmental impact assessments only where a technology has reached maturity? Or should we opt for applying the precautionary principle?"

Sven Teske

I think that's a question for me, right? I would—Greenpeace is working in favor of offshore wind since the very beginning since 2000. In fact, we pushed the Danish offshore wind program. Even in the 90s, we did a joint press conference with the former German—sorry, Danish environmental minister, _____ _____, and the former environmental minister from the UK, on the Greenpeace shift to expand off-short wind. And since then, we are promoting actively offshore wind.

That doesn't mean that we give a free ride in terms of environmental impact. But we have studied offshore wind construction and planning and operation over the last 15 years now. There's a lot of knowledge in place. And with this knowledge, you can actually start working and planning offshore wind. There is right now—in the North Sea area, there's—there are large parts of new projects now, which show that we have very little environmental impact problems. Of course, you need to have a good mapping where you put them and where you don't put them.

Obviously, natural parks are off-limits. Also shipping lines are not suitable for offshore wind. But then with a good spatial planning, we are very much in favor of offshore wind. And with the current knowledge and know how gathered internationally also in terms of sound, of noise, of migration birds, and all those environment impacts, I think we believe it's safe to say you can go ahead with off-shore wind when you take all the knowledge gathered in the last 20 years into account.

Sean Esterly

Great. Thank you once again, Sven. And thank you, Laura, for answering those questions and addressing the—some of the audience's concerns and questions. And with that, we are near the end of the time, so I'll go ahead and wrap up the webinar.

And just on behalf of the Clean Energy Solution Center, I would like to thank each of our panelists again and also our attendees for participating in today's webinar. We very much appreciate everyone's time, and I do invite you to check the Solution Center website if you'd like to view the slides, which will be posted very shortly, and also looking to a recording of today's presentations, which will be posted in about a week after today's broadcast.

Additionally, on the website you'll find information on upcoming webinars and other training events. And just a reminder, we're now posting the webinar recordings to the Clean Energy Solution Center YouTube channel, which has a variety of other very informative clean energy videos. And just a reminder, please also invite you to inform your colleagues and those in your networks about Solution Center resources and services in the no-cost Ask An Expert policy support.

And so with that, 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.