CLEAN ENERGY SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

Planning for Energy Access: Assessing Electrification Options

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For more information, see the clean energy policy trainings offered by the Solutions Center.

Webinar Presenter

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Sean Esterly Hello, everyone. I'm Sean Esterly with the National Renewable Energy Laboratory. Welcome to today's webinar, which is hosted by the Clean Energy Solutions Center in partnership with the Club of National Agencies and Structures in Charge of Rural Electrification, also known as CLUB-ER. Today's webinar is focused on planning for energy access, assessing electrification options. One important note of mention before the webinar begins 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 experts. I just want to go over some of the webinar features. You do have two options for audio. You may either listen over and through your computer or over the telephone. If you choose to listen through your computer, please select the Mic and Speakers option in the audio pane to help eliminate any feedback and echo. If you are dialing in by phone, please select the telephone option and a box on the right side will display the telephone number and also the audio pin that you need to use to dial in. If anyone is having any technical difficulties with the webinar, you may contact the GoToWebinar's help desk at the number displayed at the bottom of the slide. That number is 888-259-3826.

We do encourage anyone from the audience to ask questions at any point during the webinar. If you have any questions for our panelists, please just type them into the question pane. We'll receive them through there and present them during the question and answer session. If you're having difficultly viewing the materials through the webinar portal, we've posted PDF copies of the presentations at cleanenergysolutions.org/training. You can follow along as the speaker presents. Also an audio recording of the

presentations will be posted to the Solutions Center training page within about a week of today's broadcast. We're also now adding the recordings to the Solutions Center's YouTube channel, where you're find a large library of informative webinars as well as video interviews with thought leaders on clean energy policy topics.

We have an exciting agenda prepared for you today, which is centered about the presentation from our guest panelist, Dr. David Jacobs. Dr. Jacobs has been kind enough to join us to discuss critical points in decision making for planning electrification strategies. Important parameters that will be discussed include the usage of GIS or Geographic Information Systems for renewable energy resource assessments, load density, cost of grid extension, cost of distributed generation technologies, and the willingness to pay in rural communities. Before the main presentation, I just want to give a quick informative overview of the Clean Energy Solutions Center initiative. Following the presentations is when we'll have the question and answer session where Dr. Jacobs will address questions submitted by you, the attendees. Finally, we'll wrap up the webinar with a very brief survey for attendees.

This slide provides a bit of an overview on how the Solutions Center came to be formed. The Solutions Center is one of 13 initiatives that the Clean Energy _____ launched in April 2011. It was primarily led by Australia, the United States, and other CEM partners. Some outcomes of this unique initiative include support of developing countries and emerging economies to 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. The Solutions Center has four primary goals. The first goal is to serve as a clearinghouse of clean energy policy resources. Second, is to share policy best practices, data, and analysis tools specific to clean energy policies and programs. Third goal is to deliver dynamic services that enable expert assistance, learning, and peer-to-peer sharing of experiences. Lastly, the final and fourth goal is the center strives to foster dialogue on emerging policy issues and innovation from around the globe. The primary audience of the Solutions Center is typically made up of energy policy makers and analysts from governments and technical organizations in all countries. We also strive to engage with the private sector, NGOs, and also civil society.

This slide provides an overview of one of our marquis features that the Solutions Center provides, and that is its' no cost expert policy assistance known as Ask an Expert. The Ask an Expert program has established a broad team of over 30 experts from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost to the requestor. For example, in the area of energy access we're very pleased to have Ellen Morris, president and founder of Sustainable Energy Solutions serving as one of our experts. If you have a need for policy assistance in energy access or any other clean energy sector, we do encourage you to use this valuable service. Again, it's provided to you completely free of charge. If you have a question for one of our experts, go ahead and feel free to submit it

through our simple online form at cleanenergysolutions.org/expert. We also invite you and encourage you to spread the word about this service to those in your networks and organizations so that they may also take advantage of it.

Now, we'd like to provide a brief introduction for today's distinguished panelist, Dr. David Jacobs. Dr. Jacobs is founder and director of International Energy Transition Consulting, also known as IET consulting. He also holds the position of research associate and lecturer at the Environmental Policy Research Center at the Free University in Berlin, Germany. His research focuses on financing, policies, and framework conditions for renewable energy sources. In previous years, he worked as a researcher and policy consultant for several government and international organizations. He is also the author of several books and book chapters and a large number of articles on sustainable energy policy design in the developing and developed world. With that introduction, I'd now like to welcome Dr. David Jacobs to the webinar.

David, we see your slides perfectly. I think you are still muted though.

David Jacobs

All right. Thank you very much for this very kind introduction. It's a great honor for me to present here today. I think it's a great advantage for us to live in the 21st century that we all have this technology at hand that we can connect with each other all over the globe to discuss such important topics as how to electrify the villages around the world which are not yet electrified in the next one and a half decades. You all know that by 2030, we want to have energy access for all. This is really just a brief overview today of how we could potentially get there. I just want to discuss some steps with you – which are very useful for you if you work in the electrification agencies – to follow in order to come up with a consistent and comprehensive strategy for your electrification plans. Here's a very short agenda for the next hour. First of all, we're going to look at some of the important definitions and background regarding energy access. Then I would like to walk you through a step-by-step approach, first of all looking at the use of ____ information systems in order to get a first assessment of electrifications options for your country. Then as a second step, looking at some of the parameters that you have to analyze in order to make more detailed decisions within specific regions of your country where it's not as clear-cut whether you go for off-grid or on-grid or grid extension options. The third step, discussing some of the technology options that you have at hand for off-grid electrifications, mainly mini grids solar home systems, but also hybrid systems because, of course, you also need to make a decision to which of these technology options to use. Then we'll summarize, conclude, and hopefully still have half an hour for questions and discussion. That is the agenda for today. I'll jump right into it.

By looking at some of the definitions and background – because as you all know, there's a lot of international organizations working in this field. They are using ____. I'm just trying to raise your awareness that there's no clear-cut definition for modern energy access on a universal scale. There are some definitions which we are going to look at right now. For example, the UN Secretary General Advisor Group on Energy and Climate was defining

modern energy access as some sort of minimum threshold of modern energy services. This would also need to be reliable, affordable, sustainable, and low carbon. This is already a useful and broad definition of how energy access should look like by 2030. It is slightly more precise when you actually look at the International Energy Agency definition or methodology which they used in the World Energy Outlook. They are using the following definition. They say a household having reliable and affordable access to a minimum level of electricity consumption, which is increasing over time. It is more than just the first supply to either the electricity grid or to any off-grid option. They actually define certain minimum levels, and those are different for rural and urban areas. In the case of rural areas, the minimum level in order to account for having energy access is 250 kilowatt-hours per year per household. In the urban areas, it is actually double. That's important to know when you look at the statistics from the International Energy Agency. It's not just about being connected or having any sort of access to solar home systems. It actually requires a certain minimum amount.

We also have important definitions regarding energy access and electrification rates. Some also call it cover rate. This is actually the percentage of the population which has access to electricity. In a few minutes, we will actually get there and see that these energy access rates and electrification rates actually differ quite largely even when you just look at the African continent. This is actually one of my favorite pictures when it comes to energy access and electrification. It does not only show the beauty of our planet at night, it also gives you a very visual impression of the problem that we're facing that we have 1.2 billion people around the globe – so 17 percent of the global population – which do not have access to electricity. On this picture, you might even search for Africa because it is almost completely dark at night. That shows you the challenge that we're facing in the next 15 years if we really want to electrify all inhabitants of the African continent in the next 15 years.

We also have to keep in mind that the electricity demand in the coming 15 years is actually expected to double, with the highest increases in developing countries. We all know that we have a severe climate problem in this world, and therefore renewable energies will have to play a major part in electrifying the not yet electrified areas around the world. It is also an important puzzle in not only fostering development in this area, but also in combating climate change. Here are some of the figures from the Africa Energy Outlook from the IEA. You probably know about most of this already. We have been quite successful already in the last 15 years, so 140 million people in sub-Saharan Africa have already gained electricity access. The number of – the electrification rate was actually increased on average from 23 percent to 32 percent. We have large differences, as I said before, within the African continent, starting with South Africa all the way to 85 percent of your population having access to electricity whereas the percentage is lower than ten percent in six countries on this continent including ____ and Central African Republic, Congo, Liberia, _____, and South Sudan.

The severe problem that we're also facing is of course that electrification of rural population is much more difficult, which is shown by the last figures on this slide. We had different successes, also, over the last decades. For instance, Morocco and [Inaudible Poor Connection] we managed to reach almost full electrification of the country within the last 20 years – from '99 to 2010, they have managed to increase electrification rate from 50 percent to now 100 percent. You also see that other Sub-Saharan countries like Senegal have been very successful of increasing energy access. Also Ghana. However, the average in Sub-Sahara Africa remains very slow, so we have a lot of work to do. This work is, of course, also fostered by the Sustainable Energy for all Initiative. We currently have action plans being developed for all the countries and investment companions afterwards. There are now plans being formed in order to electrify all of these countries 100 percent by 2030.

Here's another introductory slide from the International Energy Agency from the Africa Energy Outlook, which is giving us an impression of which next steps we need to take. These are actually the options that will be used or that are likely to be used to electrify the remaining 1.3 billion people on this planet. You see that about 43 percent of them will probably be connected via grid connection solutions, so we're simply expanding the existing grid. However, more than half of all of the not yet electrified population will actually have to be electrified by off-grid solutions, 35 percent by mini grids, and the rest of them probably via solar home systems or other off-grid solutions. This is just giving you an impression of where the journey might go to. In the next half an hour, we will look into some more detail why you want to choose any of these three solutions and what are the cost structures behind those?

First of all, as a first step, I always recommend to make use of existing maps and of geographic information systems. Once again, we are on the lucky side to live in the 21st century because our satellite technologies have improved considerably. We can now do resource mapping and other activities with these modern satellites and get a very good idea already about resources that we have in the different countries without having to do on-ground measurement, at least in the first stage where we just want to get an overview. When you use these geographic information systems, it of course makes sense to layer certain maps over each other so that you can actually see them in combination. First of all, as I said before, it is important to assess the resource quality of your renewable energy technologies – wind energy, solar PV. On the other end, it is of course important to have a map of your electricity grid so that you know where you can use the resources and where you might have to expand the grid. The population density also needs to be included in these maps. It is also useful to have a map of the road network within your country because you know when you're planning a wind park, especially, you have to get the equipment there. When there's no roads available, this might increase the overall cost of installing this wind plant. You normally have those. It is also useful to have the terrain – the slope – because when you have a mountain, of course it is more difficult to transport and to construct either the transmission lines, or the solar parks, or wind parks that you want to deploy in this area.

When you move to the very end of the presentation after I finalize, you will also find some additional information about some of the countries that have established these very beautiful overlaying maps. I have included an example from Saudi Arabia, who has established a very interesting resource map where you can actually play around with these features and see how these different maps overlap. ___ they give project developers a first indication of where they might go, but also the electrification experts within the country have a good idea of which options they can use.

I was actually in the lucky position to assist Irena in the last couple of years of doing some trainings on their global atlas. You might have heard about this project already. Actually, Irena did a great job in the last couple of years of creating a common platform – this is a global atlas – where they combined all the resources available worldwide in a single platform. They were not doing additional resource assessments on their own. They were just working together with all the international organizations and all the stakeholders around the world in order to get all the resource maps that are available on one platform. For instance, if you are now from Senegal and you want to know about your solar PV potential within your country, then you can simply go to the global atlas website and you can then type in Senegal and then you find all the resource maps that are available for your country for wind, for solar PV. This is already a very good starting point for you to do the first assessment. I encourage you to go to this website because it has a lot of useful information and also a lot of explanations of how to use this website. Below here, you can actually find the links, first of all, to the website and then also to the explanatory documents for how to use this resource assessment _____.

We are in the lucky position that all of this is already gathered in one location. I wanted to walk you through one of the maps which is available on the global atlas. That is actually a resource map for the _____ region, which shows opportunity areas for grid connected, and off-grid PV, and also wind energy in the _____, which illustrates – at least on a very _____ level – which expansion and in which areas you might want to choose off-grid solutions. On the right-hand side of the slide here, you see the legend. You see that they're actually working with certain percentages. If it is very conventional for you to go for off-grid solutions, it is in a reddish color. When it's very convenient for you to go for grid expansion and grid connected solutions, then it's in a greenish color as you will see in the next slides. They were actually using a lot of the parameters that I've already shown you a couple of slides earlier – the global yearly irradiations, the grid distance, the slope, the population density – also the protected areas because you won't be able to build any wind park in an environmental protected area. This is just to give you a first glimpse of how you can potentially work with these geographic information systems when you do energy access planning.

On this slide, for instance, you see parts of the _____ region. As you can see here on the left-hand side, you can actually change the distance from the grid that you should use off-grid applications. That reflects your ambition of expanding the grid or of the budget that you have available nationally for expanding the grid. You can either say, "Okay, in the next 10, 15 years we'll

be able to expand the grid by this much – let's say another 20 kilometers from the existing grid, or we can actually expand it a lot further – 150 kilometers from the existing grid." Depending on this, you can then see in how far these green areas, where you can very good see right now the existing grids. These green lines that you see especially in the southern part of the map, how they actually get bigger when you move to 75 kilometers distance from the grid and then to 150 kilometers along the grid. Of course, the cost for expanding the grid – and we will discuss this in a few minutes – is very crucial for which options you will actually choose.

Once again, you can go to the global atlas and study this map in a little bit more detail. There's also some more documents explaining the approach that they have used, which I think is quite useful for any electrification agency to use these sort of instruments to at least get a first idea.

That was the first step. Of course, once we have done this we need to have a more detailed analysis because we have some of the areas where it is not quite clear whether we should go for grid expansion or off-grid solutions. In this area, for coming to a decision with this areas, we of course need more information. We've already talked a little bit about the resource assessment on the upper part of this graph. Just to mention, of course when you do the resource assessment for having a new power plant, for having a renewable energies plant, the geographic information systems that I've just shown you before can only be the very first step. Once you really want to build a project, then of course, you also need on-site measurements. In the case of a wind park, the banks, the finances, normally want to see wind data of at least one year in order to get an idea of the quality of the site. When you do solar PV projects, then the banks normally want to see measurements for at least six months depending on whether you have strong seasonal variations and solar _____, this might also be a year or even longer.