CLEAN ENERGY SOLUTIONS CENTER
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From Low-cost Procurement to High Value Renewable Energy

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Webinar Presenter

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David Jacobs Hello and welcome, everyone around the world, to this new session of the International Solar Alliance Expert Training Course. I'm Dr. David Jacobs speaking here from Berlin, Germany. I have the privilege to present to you today Session 11 where we will, again, discuss auction design for solar PV and other renewable energy technologies.

If you haven't done so, there's also Session 10 on option design—basic auction design parameters—which I highly recommend watching before this one. In this session, we are going to talk about some advanced features of renewable energy auctions—meaning combining solar PV option design with policy objectives other than just low-cost procurement of solar PV.

As you already know, this is combined effort of the International Solar Alliance and the Clean Energy Solutions Center, which in cooperation, are hosting this expert training series.

I'm David Jacobs, founder and director of the consulting firm IET—International Energy Transition—with more than a decade of experience in advising more than 35 countries around the world on solar PV policies and renewable energy policies in general. Very pleased to be here with you.

This is part of our Module 2, where we deal with policies for large-scale solar PV. As I mentioned before, there are related training units. If you're brand new to support mechanisms for renewable electricity, I suggest that you start watching Session Two, which is the introduction to solar policies, including an overview of net metering, net billing, NET-FIT, feed-in tariffs, and auctions. And if you're new to auction design for solar PV, I also recommend watching Session 10, which deals with basic auction design and parameters that help you to procure low-cost solar PV with auctions.

Just a quick overview of this training session. First of all, we will look at the learning objective of this one-hour seminar. Then, we have a quick summary of the first session on auction design—Session 10, which I already mentioned before. We will then try to understand different renewable energy policy objectives and how they can be integrated in the auction design. We will also look at potential combinations of auctions with feed-in tariffs because many policy makers around the world are interested in supporting different actors, different market segments with different support mechanisms.

And, eventually, we'll get some further reading and, as always, some simple knowledge checks at the end of this webinar so you can test whether you fully understood everything that was discussed.

So, let's look at the learning objectives.

First of all, understanding the different policy objectives related to renewable energy auctions, as I mentioned before, is key of this webinar and how you actually build them into your auction design. So, we all know about different renewable energy policy objectives—increasing security of supply, [Inaudible] carbon emissions, creating jobs, et cetera—but the main question was this—where we'd ask, "Really, how do you actually manage to build them into your auction design and what are your options here?" And we're primarily dealing with two types of renewable energy objectives. One of them is location specific deployment of renewables—so, location specific auctions, because in many countries around the world, we already see some grid constraints, so, it no longer make sense to build solar PV anywhere around the country, but you actually want to steer project developers to an area where you still have available grid capacity to avoid curtailment of renewable energies and to also reduce grid expansion costs.

And secondly, we look at socioeconomic criteria, socioeconomic benefits that can be built into renewable energy policies and auction design such as job creation—creating a local industry via local content requirements, et cetera. And last, but not least, we will discuss the potential combination of auctions with feed-in tariffs.

So, just a quick summary from the last webinar—Session 10—where we primarily discussed policy frameworks and design options for lowest cost procurement of renewable energies.

I had shown you, already, this enabling environment pyramid just to make clear, again, that the decision whether you opt for feed-in tariff or an auction-based support mechanism is not as important as many analysts try to suggest. I'm more of the opinion that there's other factors in this case—contractual, regulatory, and market factors—which are much more important when you really want to procure low-cost renewables. And if you put these three factors into place, if you design everything right, then, the eventual decision of whether you go with a feed-in tariff or auctions is actually secondary. So, let's look at some of them again, important—well, first of all, at the bottom of the pyramid, we see the resource and technology factors. Policy makers have

very little influence on these factors, of course, 'cause you cannot really influence how much solar radiation you have in your country.

Policy makers also have very little influence on the cost decline of solar PV. That was different when we were still talking about a very young solar PV market. I remember back, for instance, in 2002-2003-2004, German and Japanese policy makers were actually able to influence, on their own, the cost evolution of solar PV, because each doubling of the installed capacity would lead to further cost increases. Now, we're talking more of a global market and much higher procurement levels—annual procurement levels of solar PV—so, a single country no longer has this direct influence on technology learning in the case of solar PV. But you have a very strong influence on market factors, regulatory and contractual factors, just to mention a few of them.

Market factors depend, for instance, on the amount of renewable energies you want to procure on the outlook that you can give to the industry—how many auctions you will run every year, how many auctions you will run within the next 10 years. So, this can—the considerable size of your national market will also attract more interest from international project developers, will spear competition, and thus, also reduce procurement costs. Regulatory factors are rather straightforward. A stable, regulatory environment streamline _____ procedures, streamline grid access procedures, easy availability to land, et cetera. All of these will also help you to drive down the cost of solar PV in your country.

And most important are contractual factors, which are usually built in to standardize power approaches agreements. And here, what you want to look at is longer payment durations—15 to 25 years—establishing a credit-worthy off-taker, mitigating currency risk and inflation risk, also mitigating exposure to market prices. And with these factors in place, you will probably be able to achieve low-cost procurement of solar PV in the range of $0.03 to $0.08 per kilowatt hour US. So, this is just a quick summary of last session, so, if you want to understand some more details, please go to Session 10.

What we also discussed in Session 10 were the 6 basic design features of auctions. The procurement schedule—how much do you procure and how many auctions per year? How many auctions in 10 years? Et cetera. What payment will winners receive, the payment modalities?

Also, the price finding mechanism—what kind of price determination do you have? Do you have pay as bid or do you use marginal cost pricing? We discussed, in depth, penalties on non-compliance. What do you put in place in order to ensure that projects will actually get built? And bidders don't have an incentive to bid too low, which with offering projects that they eventually cannot realize anymore.

Who can participate in the auction prequalification requirements? We discussed this in depth with material and financial prequalifications and in-depth analysis, also, of bid bonds, which are really crucial, also, when it comes to penalties for non-compliance. And last, but not least—and this is kind of leading over to this session—are the selection criteria. So, once you

have received, hopefully, many hundred bids from different project developers, how do you actually select, then, on which basis? Is it just the price—as it was done in many countries in auctions up to now—or do you also build in other policy objectives—for instance, job creation—for instance, localization of manufacturing, and also, rate or rank the proposals—the project bids—that you get according to these additional selection criteria.

So, this is leading us to what I call "Solar Auction Design 2.0"—balancing risk cost procurement with other policy objectives.

And in this session, we're going to look at five different aspects. First of all—three socioeconomic benefits which are frequently associated with renewable energy deployment. So, one of them is local content and how to establish a domestic industry so that you create an innovative industry in your country; that you create the associated job effect, for instance, and that you also maybe create spillover effects to other industries around your country. And related to this is also the question of ownership and actor diversity. So, what type of investors do you actually want to have in your country?

Do you want to create a national industry with national project developers as well or do you just want to have the least cost procurement with international project developers? And related to this, also, do you want to have more large-scale projects to be built in your country or do you also carve out a certain fraction of the market for smaller scale—like, just such as community, solar projects, and more distributed solar PV projects? Second, we will look at locational steering and objectives related to system integration. So, what are the requirements for optimal system integration? Maybe you also have some technology preferences—maybe an optimal mix of solar PV with other renewable energy technologies such as wind energy.

You might also want to require a mix of solar PV with battery storage, which is happening in more and more jurisdictions around the world as well. And then, looking at locational steering—yes, also quite a lot of design options available to you as a policy maker in how far you can actually steer project developers to a certain location in your country to avoid grid congestions and curtailment costs.

So, this is an overview of what we will discuss today. Once again, we're discussing the move from policy—auction policy design 1.0 to 2.0 where you're now trying to balance least cost procurement with other policy objectives.

And the reason for more and more countries now opting for auction design 2.0 is pretty straightforward. Actually, solar PV has become the least cost procurement option in many countries around the world, so, the initial objective to really procure least cost solar PV is no longer as paramount as maybe five years ago, because you're normally undercutting the cost of any other technology anyway. And since we're now at this stage of solar PV technology development, policy makers also say, "Hey, it doesn't really matter to me whether I can procure solar PV for $0.04 or $0.06. I rather want to build in some additional policy objectives. And if my procurement gets a

little bit more expensive by doing so, this is no longer my major concern, because solar PV is going to be 30 percent less expensive than a new gas-fired power plant or coal-fired power plant anyway." So, this is why we're now discussing these more advanced design features of auctions.

So, first of all, let's take a look at some of the socioeconomic benefits which are related to renewable energies.

As I mentioned before, we will look at local content and domestic industry, job creation and other socioeconomic benefits, and then, last, but not least, ownership structure and potential objective driver in a diverse field of actors which are able to invest in solar PV in your country.

Talking about local content, the objective is rather clear. Many countries around the world have realized that renewable energies—and solar PV in particular—is a technology of the future and this is not going to be something which will just be around for a couple of years or decades. That will probably stay with us for hundreds of years. And therefore, having a foot in the door of this emerging or already quite well-established technology makes a lot of sense for countries around the world, and therefore, they have also developed quite aggressive industry policies to re-attract solar PV manufacturing or other parts of the value chain to that country. What are the typical lessons learned on local content requirement with regards to solar PV?

So, when you want to establish these requirements, then the initial local content requirements should not be too high. So, you should try to strike balance, as the policy makers, between the wish for creating local value and then, also, the need for competition. Because when you create very high local content requirements right from the start, you might, in the worst case, run into a situation where no one is actually able to fulfill these very high requirements because, for instance, you don't even have any solar PV module production within your country, so, you have to wait two years until this module manufacturing capacity is available in your country. But you might also run into a situation where the output of your manufacturing units is very limited, and this will then, of course, also limit the amount of bidders in your auction and this will, again, limit the competition and potentially increase prices. So, therefore, it is usually recommended to start with relatively low shares of local content requirement so that you do not only look at the hardware that you need for solar PV systems—such as inverters and modules—but you also look at other components along the value chain.

So, for instance, when you take everything into account along the value chain, then you can already reach relatively low local content requirements—let's say 20-30 percent—by installing the solar PV system and doing all the installation work and operational maintenance work nationally. And then, you can increase these local content requirements over time in case you really see that national industry is emerging and also, the manufacturing sector is willing to move to your country. I want to stress, right from the start, that when we discuss local content with policy makers around the world, most people think about attracting PV module manufacturing to their country. And I think that this is probably the one component along the value chain where it

makes least sense to have these components localized because the module manufacturing really depends on economies of scale and we have now a very large module manufacturing capacity based in China with multi-gigawatt factories. And if you really want to out-compete them on a global market, then you'll probably need to look at an annual solar PV market within your country of 5 to 10 gigawatt—and there's not so many countries around the world that actually have this size of markets.

So, my recommendation is always—when you want to localize parts of the solar PV value chain, probably focus on something else than PV modules. But this is just a comment on the side. This also refers to the next bullet points—that you should really do, first of all, an assessment along with the entire solar PV value chain and really analyze which of the components—what makes sense for you to manufacture or to build together locally, and maybe you also come up with the decision, "Hey, I actually want to benefit from low-cost prices on the international market and what I really want to benefit from locally is more the installation business of solar PV and the whole operational maintenance jobs which are related and which are normally up to 70 percent of all jobs created along the PV value chain." When you go into a solar PV manufacturing plant today, you actually don't see so many people around anymore as you might have seen maybe at the early 2000s, 'cause a lot of the production has already been mechanized and employment generation or creation, for instance, it's very limited. And, as mentioned before, local content requirements should also be part of a broader industry policy.

So, simply by putting it into your auction design will probably not do the job and you will not be able to create, really, a solid local industry. So, you should have some additional enhancing mechanisms—for instance, creating some special economic zones for solar PV companies or other parts which are normally parts of broader industry policies. So, you cannot just assume that by writing these local content requirements into your auction design will actually help you to become a major player in the global solar PV market.

Here are just a few examples—one from Morocco where they actually started with relatively low shares of local content requirements, which were then part of the prequalification requirements. These were discussed in depth in Session 10 of this webinar series, and, as mentioned before, these were relatively low shares of local content were already able to be achieved through operational maintenance and installation of the systems alone. So, that was a rather wise approach for Morocco chosen there. Other countries—here, an example from onshore wind energy in China—were more aggressive, setting up 50 percent local content requirement in 2003 and increasing it further to 70 percent in 2005. But you really have to keep in mind that this was not only being implemented in the auction design, but it was also enhanced with a wider industry policy implemented by the Chinese government already in the early 2000s for wind energy and a couple of years later also for solar PV.

Let's now look at some of the advantages and disadvantages of local content requirements. First of all, disadvantages. As I mentioned before, by incorporating these other renewable energy policy objectives—like local content—into your auction design, you normally have to face slightly higher costs because you're in restricted access, in this case, to some of the commodities. There was an interesting study recently published by Probst et al—you'll also find this in the further reading list—where they analyzed local content requirements implemented in India in 2012 to 2016. They came with interesting figures showing that the procurement of renewables of solar PV in this case was five to seven percent higher than it would have been without any local content requirement.

So, this is already giving you an interesting indication of what type of price increases you can expect by implementing some of the local content requirements. Of course, this depends largely, also, on the share of local content that you are expecting to be realized, but, as an initial indication, I think this is a quite useful number. There's also, then, of course, higher total system cost and higher cost for rate payers, depending on how the electricity rate design is actually managed. So, you will need to explain this to your electricity consumers—that they have to pay slightly higher prices for the reason of establishing a national industry. And, as mentioned before, there's also less competition within auctions, which could result in the worst case and higher prices again.

The major advantages—and this is probably very important for many policy makers around the world—is that you get more political buy-in but also public buy-in. So, when you're able to say, "Hey, we're not just going to build solar PV in our country, but we're also establishing new industry which will eventually enable us to create more jobs"—this is normally a very compelling argument, especially in countries where you see high unemployment rates. Local manufacturing and supply chain creation is, of course, the desired side effect of this and, in the best case, you also see some technological innovations—some technological spillover to other industries, job creation—which could somehow justify this slightly higher cost that you will have to face.

Now, let's look at another policy objective which is part of, well, renewable energy policies in an increasing number of countries as well. And this is an intention to have not only large-scale project developers coming to your country investing in solar, but also giving your local communities—community-owned solar, community-owned wind—the opportunity to invest in renewable energies themselves. So, the easy—the straightforward story here is that small-scale actors like community-owned solar PV project developers are normally more risk averse. And when you compare the risk between a feed-in tariff, for instance, and an auction, you actually see that there's slightly higher risk for the project developers and therefore, these smaller scale actors might not be able to participate.

So, some countries have actually taken this into account, and they have created special auction designs in order to also allow smaller scale actors to

participate. And the easiest way is to have some special prequalifications for them. A straightforward way is to, for instance, reduce the financial prequalifications. For instance, reduce the bid bonds or not require any bid bonds, as we have learned, in Session 10, you—once you want to participate in an auction you, first of all, need to sign either construction or completion bid bonds—let's say $5.00 US per kilowatt installed, which you will have to deposit at a bank. And in case you're not realizing this project, you are not going to get that money back.

So, this can easily amount in quite a high total sum of bid bond payments that is required and, community-owner project—developers might not have this money readily available, and therefore, reducing or even cancelling out this financial prequalification is one option. Also, in some cases, you could reduce material prequalifications. For instance, there have been some cases where the decision-making process was, in community-owned projects, sometimes slower because you, first of all, need to get 50 people from your community on board and then, you have to discuss and you have to come up with a common solution. And this is sometimes not in line with general deadlines that you have within auction design and, therefore, some of the material prequalifications—having certain permits or already securing land or grid connections—might also be canceled or reduced for these type of community-owned projects. Another option is differentiate price rules or you can also say, "Hey, we want to have a procurement of 200 megawatt of solar PV, but we actually going to carve out 50 megawatt of this and we're just going to give it to small scale actors and they can then compete either in an auction for this or they might even receive a fixed price which is somehow related to the auctioneer’s ask that you figure out from the auction that you have for the larger scale actors."

So, there's various options for you within the renewable energy auctions to make life easier for community-owned solar PV projects or other small-scale actors, and there's also some further reading on this in the further reading material at the end of this webinar.

I also wanted to take a closer look with you at the case of South Africa because they have been really one of the leading case studies when it comes to building in other socioeconomic benefits into their auction design. South Africa wanted to establish a feed-in tariff in 2009 but then, decided not to do it because there was some issues that it might actually be unconstitutional because you need to have competitive procurement when a government agency wants to procure anything in South Africa. Therefore, they decided to implement auctions in 2011 with 5 big auction rounds—a total procurement of more than 6 gigawatts. And, as you can see from the last bullet point, they're not only looking at the price that is proposed to them by the different project developers but actually, 30 percent of the assessment of the different bonds depends on the various social impact and the economic development factors, and this really reflects, also, the overall socioeconomic agenda within South Africa—meaning strengthening the national industry, empowering local communities, and also, advancing gender and racial equality. So, in the

next slide, you can actually see how these economic development scoring categories are built up.

So, first of all, some points when assessing the bids are given to job creation. So, you need to show, in your bid, to what extent you actually want to create jobs for South Africa citizens in particular—black citizens, because they are normally the most marginalized community within the South African community—and also, creating jobs in local communities. So, it's a rather specific, rather detailed requirement with what kind of jobs you're expected to create for what type of citizens in which communities. An additional—let's keep the local content aside, because we already discussed this with other countries. There's also the question of ownership.

Here, again, the financial shareholding of black citizens and local communities is strongly incentivized or actually required, so, you always have some minimum requirements that you have to fulfill. And if you go above these minimum requirements—I think it's 40 percent financial shareholding of black citizens, so, you need to fulfill this requirement, and if you go above them, you get additional points in the rating systems of your procurement. Management control is also important. Top management positions—how many of them are actually held by black citizens. Preferential procurement—the share of procurement of goods and services from small and medium-sized companies or for woman and black-held enterprises, and then, last, but not least, you have ED and SED.

So, Enterprise Development and Socioeconomic Development—that's a very specific feature of the South African auction design where actually part of your overall investment of a solar PV project will go into a sort of community fund and then, the community can decide what to do with this money to use it for creating a new health center or a new school or for developing enterprises within the community, et cetera, et cetera. So, this is just an example to show you how detailed and how complex the requirements for additional policy objectives can actually become.

And South Africa has proven to be very successful with their auction design and also their additional policy objectives that they have built into that. Most of targets were surpassed—for instance, in the case of employment, also, in the case of ownership and top black management. Only the share spend of woman-owned vendors has not yet reached the target, but there's now initiatives to further strengths in the policy design to also reach this policy objectives within South African auction program.

So, secondly, I wanted to look with you at locational incentives.

And here, we have two—well, we're primarily going to look at locational steering for system integration and look less at different technology preferences, because they really depend on an overall assessment of the electricity system to really understand what type of technology mix would enable least cost for the system as a whole. So, what I wanted to look with you is really at different design options for locational steering.

And the reason for locational incentives are primarily related to system integration. So, you'll want to re-dispatch cost or curtailment costs. So, you do not want to curtail or turn down your solar PV system in a certain area with frequent grid congestions and rather move the solar PV systems to areas with enough grid capacity. So, these grid constraints can be overcome, but there's also some political decision, sometimes, to have renewable energy spread out over a large area of the country and not create hotspots which might also create public opposition. I remember, for instance, that this was built into the French policy where a lot of procurement was taking part—of solar procurement—was taking place in the southern part of France where you already had quite a dense—population density, but also, competition with the agricultural sector.

So, therefore, the French government decided to have locational incentives to also move solar PV to the northern part of the country where you have less sunlight, but you have more space available for developing solar PV. And sometimes, there's even regional competition for these socioeconomic benefits, because policy makers know that if they are able to attract a lot of solar PV projects to their region, that will probably create more jobs, and therefore, policy makers at the national level sometimes also have to make sure that the benefits associated with renewable energies are evenly spread in the country and that not a certain region get preferential treatment just because they have the best solar resources.

So, this is an overview of different design options for locational steering. First of all, you can decide to have no locational incentives at all—as you can see on the very less—so, you're not building any locational incentives within the auction design. You might have them in other part of the electricity design. Then, there's the case of Mexico where you have some financial incentives or disincentives, depending on which region you want to build your solar PV project. Then, I also want to show you the example of South Africa where they have established certain solar PV renewable energy development zones.

And last, but not least, the most, well, aggressive, in a way, policy for locational steering is a pre-development of sites so that policy makers actually take control over the site, pre-develop it, and then, run an auction on these pre-developed sites. So, let's look at this for types now.

So, the easiest way, from an auction design standpoint, is, of course, to not introduce any locational incentives into your auction design, but that does not necessarily mean that you do not have any locational incentives. It is more the question of—do you really want to build these incentives into your auction design, or do you actually want to make them part of your overall electricity market design? For instance, you can have differentiated price zones—some zonal pricing and nodal pricing—as part of your electricity system. So, not only the renewable energy producers within your system will get the incentives, but actually, all power producers will get the incentive to build their generation units in certain regions. And what is also one options of how to steer or introduce locational steering in your renewable energy policies is the cost-sharing methodology for grid connection.

So, as you probably know, there's two major types of cost-sharing methodology—the shallow connection charging approach and the deep connection charging approach. And the shallow connection charging approach would mean that you only have to pay the grid connection to the next or the existing grid connection point whereas, under the deep connection charging approach, you would not only have to pay this new connection line, but you might also have to pay for the upgrade of the already existing grid. So, in other words, by adopting the deep connection charging approach, you actually give project developers quite a clear financial incentive to develop the project in areas where they don't have to pay for the upgrade of the already existing transmission grid. So, by having this cost-sharing methodology for grid connection in place, you can already have some locational steering without implementing any such type of design features into your auction design.

So, the general question is really there might be the risk of overloading the auction or the solar PV auction design—that you tried to correct each and every mistake that is actually part of your electricity systems by designing your solar PV auctions. And some analysts say, "Hey, instead of having an auction which is increasingly complex where project developers need to go through 400 pages of bidding documents to really understand all of this, why don't you tackle the problem at its very source and try to design your electricity market in the way that you have locational incentives like as you see here, the nodal pricing market that you have in the ERCOT system in Texas?"

Secondly, let's look at the Mexican case where you have some incentives and disincentives built into the auction design, in this case. So, a bonus-malus system—so, you actually have an incentive to build—or you had an incentive in the first auction round in Mexico—to build solar PV projects in areas with relatively high electricity prices. So, this informs you, as well—the bonuses or maluses that were applied were actually informed by long-term system simulation and then, also, to understand where congestions within the grid will take place and where this might also lead to higher prices because of a lack of transmission grid. So, this is why this first auction in Mexico was normally termed "Yucatan Auction"—Southern part of Mexico where you had a lot of grid connections—because, as you can see here from the graph, you actually got quite interesting bonuses—in the second row from the right—for building projects in this area and this, then, would really help you to win the project in the first place.

Last, but not least, let's look at some locational incentives based on renewable energy development zones. IRENA was trying to promote these type of development zones across the African continent but also in other parts of the world. And the basic idea is that you look at the existing transmission grid within a country or within a continent, and then, you say, "Hey, when you build close to this strong transmission lines, then you're actually benefiting the whole system because you avoid further cost for expanding the distribution grid, for instance." And therefore, in South Africa, you have some certain advantages for building projects within these areas which help

you to better coordinate transmission planning and renewable energy deployment targets. So, for instance, in the case of South Africa, there was already a strategic environmental assessment performed for you in these areas—meaning that new projects that wanted to build in these locations would actually only have to do a simplified environmental impact assessment, which would then, of course, reduce the project development cost and would give them an advantage in competitive auction rounds.

Last, but not least—and probably the most straightforward, but also the most complex approach—is to pre-develop sites by government agencies. And the idea is really to say either you have a plot of government land that you can use, or you say, "This is an especially good area for solar PV development because we have the grid connection, we've got solar resources, and so on." And by having these sites pre-developed, you can actually shorten the private sector project development lead times and thus speed up also the deployment of solar PV. And what these pre-development sites actually enabled also was very low procurement costs within auctions, because you were actually shifting some of the costs—which are normally part of a private project developers' project development cost—you were shifting those already to some public agency who has taken on task, which normally a private project developer would need to take care of. So, this pre-development of sites is usually executed by some specialized government agency, so, if you're in a country where this has not yet happened, you would probably create a new unit within the responsible ministry or responsible agency, and this unit would then spend, well, probably a couple of years to develop certain sites and then, to run auctions on these very specific sites.

So, the pre-developed sites frequently—what does it actually include? What is this government agency doing? So, they are securing the land—so, they're buying this land. Normally, it is already in the hand of the government, so, this is quite an easy task for a government organization and they're also securing the grid access and they're already building the distribution line or even expanding the transmission line to get access for the solar PV project in this area. What they typically do is also an assessment of the resource quality.

So, for instance, having solar radiation measurements for at least a year, up to two years, to really make these projects bankable right from the start. What is sometimes also executed is some of environmental impact assessment. So, this no longer needs to be done by the private project developers and also, other permitting and administrative procedures are then taken on by them. So, you can really go to this plot as a project developer and not only build and later operate the project without having to take care of a lot of the administrative handlings that I mentioned in this slide.

So, there's, of course, certain advantages and disadvantages, again, of pre-developed sites. There is the major advantages of having lower cost of procurement. And, as I write it here, the renewables appear to be less expensive because some of the cost actually shifted from the private project developers to some government agency. So, if this is very important for you to have—to communicate to the public, "We are actually procuring solar PV

for only $0.02 per kilowatt hour", a good way to do this is to pre-develop some sites. Because many of the least cost procurement of solar PV in the last couple of years in India, for instance, was actually based on pre-developed sites.

Some people say that this is the most contested issue—is that you might have faster deployment of solar PV. As they're saying—if you have a specialized agency within the government, they will be able to get through all the government agencies which you're normally involved in to get the grid connection to buy the land. They might actually—to do this faster because there might also be less bribery involved, because no one is trying to—would want to take money from a government agency, whereas corruption might be more predominant when private project developers try to develop a site. Here's, of course, an important part of de-risking the investment. Lower cost of capital are the consequence of this.

As mentioned before, this can be very beneficial in markets with high risk of corruption. And pre-develop of sites normally works good in countries where the government already owns the land. So, this is sometimes the case for onshore land, but this is also why these pre-developed sites are also taking place quite a lot in the case of offshore wind energy, because the land rites' offshore, not only within the government ownership, and therefore, pre-developing these sites makes a lot of sense for these technologies. But also, in other countries like Vietnam and Saudi Arabia. Large part of available land—or part of available land—actually belongs to the government and therefore, pre-development is quite easy and feasible.

There are also some substantial disadvantages. First of all, you have to keep in mind that pre-developing these sites takes quite a lot of work force and specialized governments, and this might be a challenge for governments which have budget constraints, or which have general lack of workforce anyway. So, establishing a new unit with 10-15 new employees—or even more—might not be feasible for many governments. Therefore, you really have to analyze how much work force you would need for doing this task and how much money you actually have available. And some people say that it actually delays the procurement of solar PV when you have pre-development of sites because government agencies are normally slower to develop project.

It makes much more sense to have hundred private project development firms running around your country and developing sites in parallel than having one specialized government agency with 10 to 15 employees with just developing one plot after another. So, this is a valuable argument for probably many countries around the world. And what might also be difficult is that in the case you're just implementing the pre-developed sites in the next couple of years but you already had some development of other renewable energy or several PV projects before, these privately developed sites—or pre-developed sites—can no longer be used, or you might have two parallel auctions—one for pre-developed sites and one for note yet developed sites.

So, this was just an overview of the typical policy objectives—additional policy objectives that you can put into auctions. I hope this was helpful. Last,

but not least, I wanted to take a quick look with you at potential combinations of auctions and feed-in tariffs because this is also linked to the questions with what actors you actually want to enable to invest in solar PV in your country. Is it only going to be large-scale project developers or do you also want to have certain market segments for small scale actors and community-owned projects? So, let's take a look at these questions.

So, what is actually the major difference between an auction and a feed-in tariff? Just to recapitulize this—so, with the major difference is really the price finding mechanism. In the case of the feed-in tariff, you have administratively fixed prices done by government based on some market research, some government agency. And in the case of an auction, you are actually not undertaking this task, but you're rather asked industry—other emerging industries in your country—what prices they can actually offer. But unless the feed-in tariff and the auctions are not so much different, they both normally result in the fixed payment per kilowatt hour, either on top of the wholesale market price or independent of that. So, from an investor security point of view, they both provide a relatively high level of investment security.

So, should you go for feed-in tariffs or auctions? What are some of the questions you should ask yourself? First of all, calculating feed-in tariffs is not an easy task, so, if you have not done this and if you have a lack of information on how to do this, it might be quite challenging, especially in young markets where you have very limited on-site data, where you have very limited past projects in solar PV. It can be quit challenging of fixing a feed-in tariff. So, therefore, you should also think, "To what extent does my government actually have a tradition or experience in determining prices administratively?" That's maybe a good first question.

Then, you should also ask yourself, "Is there actually sufficient interest in investing in solar PV in my country? Will there be enough competition?" Because we saw—especially in some so-called least-developed countries—that by having a very small overall market size, maybe only procurement of 50 megawatt or 20 megawatt per year. You were sometimes not able to attract enough investment from—or enough interest from—international project developers, and therefore, you didn't have enough competition within the auctions and then, you needed to face rather high prices. So, this is then related to the last question.

Is the market big enough to create competition? What is the size of my auctions? How many auctions do I want to run every year? How many auctions to I want to run in the next 5 to 10 years? And if you say, "Hey, I have a relatively small market or it's relatively small competition", maybe you rather want to opt for a feed-in tariff instead of an auction.

Additional questions on what type of actors should invest. Only the large-scale international project developers—also, smaller scale national actors. We discussed this already—that smaller scale actors are normally more risk averse and therefore, they're normally more comfortable with a feed-in tariff or with some special auction design for them, which takes away some of the administrative burden in preparing the auctions, which reduce material and

financial prequalifications as discussed before. And last, but not least, the question—which type of actors should actually invest? Do I want to have national or international project developers?

Because this is frequently something not quite well understood by policy makers. When you run an auction and you don't have any national industry and you didn't have any other support mechanism before to establish a national industry like a feed-in tariff for a number of years or some other investment incentives, the international project developers will probably outcompete the national project developers not only because they can develop the project in a more cost-efficient way, but primarily because they have access to international capital markets. So, having access to reduced interest rates actually allows them to develop the projects or to submit bids which are considerably lower compared to a project developer who might only have access to national banks which have higher interest rates and also shorter payback terms, and therefore, the question of you want to have national or international project developers should be on the table when you start discussing which policy mechanism you want to utilize.

So, following this discussion of the main questions of how to maybe come to a decision of whether to use feed-in tariffs and auctions, I also wanted to highlight that there's different ways of combining feed-in tariffs and auctions. So, there have been some countries that move from feed-in tariff to auctions—for instance, Brazil—because they were not really able to set the feed-in tariff and there were quite a lot of windfall profits because they didn't have much experience in determining prices administratively. They moved to auctions and this way, were able to reduce prices quite a bit. We also had the reverse. We actually had—in China, for instance, they were running auctions for solar PV in the early 2000s because they said, "We don't have enough information on their actual prices of solar PV within our country, so, we're just going to run a number of auctions for a couple of years, and with these auctions, we actually get some real-word projects on the ground, some real-world data, some real world cost data that we can put into our feed-in tariff calculation model."

And once they had enough data collected, they were able to establish feed-in tariff prices based on the previously held auctions. There's also the case where countries are actually using auctions for emerging technologies and feed-in tariffs for more mature technologies, which is also linked to the data availability. Because, for emerging technologies—for instance, floating solar PV—there's very little cost data available currently, and therefore, you could say, "Hey, for this type of technology, we actually want to run a number of auctions to get some cost data and then, we can fix the feed-in tariff later based on these data." Whereas, for normal ground-mounted solar PV, we already have enough data. We know how to watch what the costs are more or less and we're able to fix the feed-in tariff.

And what most countries are doing is what I depicted in the last bullet point—is to use auctions for larger-scale projects and then feed-in tariffs for smaller scale projects. They're doing this in Taiwan, but they're also doing it

in many other countries around the world, including most European countries. And the reason for this is related to what we've discussed before—that some of the smaller scale projects do not want to handle all the administrative burden, administrative costs, that are related to an auction and therefore, they are much more comfortable, also, from a risk perspective with the feed-in tariff, whereas larger scale project developers—say, above 10 megawatt or sometimes above 1 megawatt; sometimes above 40 megawatt—can actually deal with all the requirements of an auction and compete with other project developers within this competitive procurement framework.

Auction design for small-scale actors—we discussed some of this before. Here's some more design features that you can actually implement. The Canadian—I think Ontario—case is quite interesting—where they said, "Hey, small-scale actors have a difficult time participating in auctions because of all of the requirements in the project development stage." So, they were actually establishing a fund—a national fund—where small-scale community-based projects could access to help them to develop the bidding documents, but also, to develop—to pre-develop the projects with, for instance, environmental impact assessment and so on. So, they were quite conscious of these costs and that especially during the project development stage within an auction, you're facing the risk of whether you're actually going to be selected or not, which then results in higher finance costs.

So, taking all of this into account, they were saying, "Hey, we actually need some financial support for these community-owned projects." We already discussed lower prequalification criterias and we already also discussed the options that you might just want to look at the auction results for large scale results and say, "We covered a certain market segment and the small scale project will get the same price as the large-scale project plus 10 percent or whatever it is", and therefore, they can then benefit from a feed-in tariff type price, which is based on the auctions held for large scale projects.

So, last, but not least, some further reading. You've already seen some of them in Session 10. I added a further reading list here which is discussing mostly the aspects discussed in this webinar.

Thank you very much for listening. It was a great pleasure, once again. Thanks again to the International Solar Alliance and to Clean Energy Solutions Center for making this happen.

And, as always, there are now a few easy knowledge checks—some easy multiple-choice questions for you to see whether you've actually understood everything. Well, thanks for listening and hope to see you in the next session.