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Combining FITs and Net Metering: The NET-FITs Concept

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Toby Couture Good morning everyone. Welcome to this International Solar Alliance Expert Training Course. This is session seven of this Expert Training Course series, focusing on Solar PV Policy, in particular on relatively new and innovative policy called NET-FITs. This policy has emerged in recent years as a bit of a hybrid between classic feed-in tariffs and net metering policies that traditionally focus on rooftop solar. As we'll see in this short presentation today, NET-FITs are emerging as an increasingly popular way to encourage rooftop solar investment and avoid some of the downsides both of feed-in tariffs as well as net metering policies.

This webinar series is supported jointly by the International Solar Alliance and the Clean Energy Solutions Center. The International Solar Alliance is a network of solar resource-rich countries from around the world focusing on scaling up solar power worldwide. The Clean Energy Solutions Center is one of the leading institutions providing capacity building and training and technical assistance support for clean energy policy around the world. This training is part of module one and focuses specifically on the issue of NET-FITs.

Now, let's have a quick look at the presentation. So, first, we'll look at the learning objective. We'll go over the core components of the presentation, overview of the policy, how it works, look at some examples from some of the leading jurisdictions, and then wrap everything up. At the end, you will have a knowledge test to check whether you've been paying attention and gauge your grasp of the net metering or the NEFIT policy.

So, first, learning objective. Understanding how the policy works, understanding how NET-FITs have emerged and how they differ from traditional net metering and traditional feed-in tariff policy, understand where they're currently being used. We'll look at a few cases with a particular focus on Australia and Senegal, and to understand the advantages and challenges of NET-FIT policy, some of the pros and cons. So, let's dive in.

NET-FITs first emerged in Australia in the 2000s as a part of an effort to scale up solar power in Australia. They contrast with what are sometimes called classic or German-style feed-in tariffs in that the payment that's offered is only offered for the net excess generation. In other words, the classic German-style fit was what is called or what can be called a gross feed-in tariff. In other words, the solar system output is purchased 100 per cent. There's no consumption onsite. So, under Germany's fit, if you drive through parts of Germany, you see rooftop solar. In many different—in most cases, that rooftop solar is not being consumed onsite, at least for the systems that were installed before, say, 2014, 2015. Most of them are 100 per cent grid export systems. In other words, they're not wired in to enable the house to self-consume that power.

Australia structured its policy differently. They offered a payment for the net generation, not for the gross generation. So, that means, in Australia, households were consuming as much power as they could from their onsite solar system onsite and only injecting the net excess. So, payment, in that sense, is only based on that—on what is injected. Everything else is simply used to offset the power bill. So, if you were paying, obviously, quite high power bill, then you're offsetting that on a per kilowatt hour basis for everything you consume. The NET-FIT determine, essentially, what you get for your surplus.

Now, previously, in the 2000s, because solar PV was more expensive and because Australia was keen to support the technology, much like Germany and Spain and other jurisdictions around the world, they paid more than the retail price for that generation, as we'll see. Now, what's started to happen and what is rapidly transforming this policy landscape is that solar is now increasing below the retail price that customers pay. That means that we're essentially beyond grid parity. In many cases, we are even—we are beyond socket parity, beyond the price you get from your utility. We are in a landscape where it actually can still be attractive for the customer to receive a NET-FIT payment that's below the retail price and still make their project profitable.

Now, in that case, if, let's say, you pay a retail price of $0.15 per kilowatt hour and you're getting a NET-FIT of, say, $0.07 per kilowatt hour, then, obviously, you have an incentive to try to self-consume as much as possible because you're getting more value, so to speak, from self-consumption and you're only getting $0.07 then, in this case, for everything you inject. Under policies like that, given how cheap solar has become in recent years and how sophisticated some of the business models and delivery models for solar have become, it's actually possible to make that an attractive proposition. That's really where NET-FITs are emerging as an exciting and potentially path-breaking new way for countries around the world to strike the balance between the desire to encourage more solar while also limiting the need for subsidies or direct supports in that sense.

The NET-FIT rate can be set at a rate that is below the retail rate, which means there's no subsidy and it can actually lead to benefits both for rate payers and for the utility that's purchasing the power. So, there's an opportunity here that's emerging of which the NET-FIT, in a way, is an embodiment of this opportunity for a win/win between solar customers and the utility and the rest of electricity rate payers. So, there is an opportunity here and we're going to explore that in this short presentation and try to look, as well, at some of the—on the one hand, yes, some of the advantages, but also look at some of the challenges and what needs to be taken into consideration.

So, the formula for a NET-FIT, essentially, is a specific cash payment structured in dollars per kilowatt hour, typically determined by the utility or the regulator. Now, in many cases, in many countries, this is, obviously—it's a government regulation or a government regulatory body that sets the law. But in some cases, particularly in Australia, the utility is actually the one who is determining what that NET-FIT rate should be. So, in Australia, you have a very diverse tapestry of different NET-FIT rates, depending on which utility and which region you're in as well as different methodologies for determining what that NET-FIT rate should be. We'll get into that in the discussion in the slides to come. So, in that sense, a customer receives both a bill and a check from the utility at the end of the month.

So, taking a step back and if we look—you may recall this from session six, where we looked at both net metering and net billing policies. In this session, session seven, we're focusing specifically on NET-FITs. The net metering policies, as you can see here, did not offer the possibility of a cash payment nor, typically, did net billing policies. They're essentially primarily based on the principle that you get a bill credit and you can then offset your future consumption. But you're not getting, in most cases, a check at the end of the month. NET-FITs differ. NET-FITs provide a cash payment for that net excess generation. So, you are, essentially, a small power producer and you are getting remunerated. You're getting paid for your contribution to the power system, in that sense.

Again, in most cases now, NET-FITs—in fact, virtually all cases, the NET-FIT is structured below the retail rate. This differs from a classic feed-in tariff which we see here. At the bottom, where the actual purchase rate is not related to the retail rate at all, it is set, based on the LCOE or the Levelized Cost of Energy of each technology and even in some cases by project, size, and location. So, NET-FITs, in that sense, you can see here are, in many ways, a hybrid policy between net billing and—or net metering policies and feed-in tariff policies.

Now a key question is always, "How do we set the rate and what is the right price?" We'll start to unpack that a little bit here. So, I've laid out five core options. These represent the main options that are being used in different jurisdictions around the world for calculating the NET-FIT.

The first, and in some ways the easiest, not necessarily the most effective but easiest rate is simply to appeal to the wholesale market rate in jurisdictions that have a functioning wholesale market. The advantage there is that for the net excess, you essentially look at what the retail or what the wholesale market price was and potentially take an average of that, which is commonly done. Monthly average. It could be a weekly average. It could even be a daily average. You would compensate the customer for their net injection based on some average wholesale market rate for a given period and pay them in cash. The idea there being that that reflects the value, so to speak, of that solar electricity to the grid.

Now, a second option that moves in a similar direction is the approach of using a time-of-use rate. There are a number of customers in different utility systems around the world that pay time-of-use tariffs. For those customers, it can be made available as an option to also participate and get a NET-FIT that is linked to a time-of-use adjustment. So, basically, you would get less for each kilowatt hour produced between, say, 9:00 AM and 3:00 PM and you would get more for kilowatt hours produced, let's say, between 3:00 PM in the afternoon and 9:00 PM at night. In order to incentivize supply that corresponds with the system's peak demand.

So, time-of-use rates can be one way of encouraging a little bit more market orientation and also giving the utility supply when it needs supply most. We'll get into some of the behavioral changes that can be triggered by that. For example, under a time-of-use rate structure, a customer might have the incentive, for example, to not install their solar system facing, say, south or north, depending on whether you're in Australia or in South Africa versus the northern hemisphere but rather facing west so that you're producing more solar power in the afternoon hours and less in the morning hours when that power is compensated at a lower rate.

A third approach here is the avoided cost rate. This, as we'll see, has been used, is being used as a mechanism to determine the NET-FIT rate. The idea there being the avoided cost rate is essentially the cost that the utility would incur to supply that power itself via other means. So, if it's a, for example, in an island-based context where diesel is the primary supply source, then the avoided cost rate would be based on the cost of diesel generation in the system. The idea there would be that that would be a fair price because it affects the "value" of solar to the system based on the avoided cost that the utility would otherwise pay. This approach is being used in certain parts of Australia as well as in certain parts of the U.S. to settle the net excess generation.

There are, however, some challenges. I'll go through a few challenges on each of these in a moment. But for the avoided cost rate, one clear issue here is that if you're paying an avoided cost-based rate and, say, fuel prices go up—and then let's pick up our island case example—that means you are essentially exposed to a double whammy. You are paying both more for your fuel rate for your—to run your diesel generators and, at the same time, you have to pay more for all of the solar participants, solar suppliers on the network. So, there's no protection against rising prices because if prices go up, they go up across the board. For many utilities, that may not be—in the short term, that may seem an attractive option, but it may actually prove less attractive if fuel prices or energy prices, more broadly, go up. So, there are some important risks there.

The fourth is the value of solar rate. This is emerged in the U.S. as part of a discussion around what the value of solar is to the power grid and not just the value in terms of electricity but also the value in terms of the environmental, emissions related benefits, the social cost of carbon, savings from solar power. In some states, they even want to include reduced line losses and other distribution system level benefits for the value of solar. All of those other different values have been stacked together to create a rate.

Then, the idea is that that rate reflects the value of solar to the system. Beyond the methodological complexities and even legal complexities of setting an appropriate value of solar rate, there is, of course, always the risk that the rate is either too high or significantly too low depending on the methodology that's used. In the U.S., indeed, we've seen some states put forward value of solar rates that are extremely high, proposing rates sort of in the 18 to 20—over $0.20 per kilowatt hour. In other states, they've calculated far lower rates, sort of under $0.05 a kilowatt hour.

So, you see a very wide disparity in the values corded. That is, again, fundamentally a function of the methodological assumptions made, and the input parameters used. So, value of solar rate faces a number of challenges despite the fact that it may be intuitive in theory to set the rate based on what the value of solar is to the system. Who can be opposed to that?

One challenge with all of these, the first four, is that all of them are dynamic benchmarks. So, they would change over the time. Then, the question becomes, "Does the rate, then, for each customer also constantly change over time and what risks does that have for the investor or for the system owner, the household, or business that is investing in solar?" So, to the extent that these are dynamic benchmarks, the customer is carrying more risk than a rate that's simply set as a floor price or as a minimum price, which is closer to number five listed here.

In other words, in many cases, NET-FITs are set at some essential—so essentially a floor price level that guarantees that the customer will get that for their net excess generation. So, a calculation is made based on a methodology. There's a number of different ways of structuring this. A NET-FIT rate is agreed and set as a floor price for that net excess supply. In that case, the NET-FIT rate would be bundled into the mini power purchase agreement, if we can call it that, with the customer. So, the rate would then be set over the duration of the contract.

NET-FIT contracts can be as short as a couple years or as long as 20, depending on the case. So, the fifth option here, arguably, can provide more investment certainty, but it also increases the risk, of course, that the prices—it fails to tap into some of the potential benefits of having a more dynamic price benchmark. So, for example, if the customer is under a time-of-use rate structure that can be adjusted over time, they will be getting paid more for that evening supply. But the value of that evening supply may go up or down and the needs of the system may go up or down—may change over the course of the contract, which means that a customer may, over the course of the solar installation's life because able to respond behaviorally to different changes to the pricing signals.

So, for example, if the rate offered for net excess generation, the NET-FIT rate goes down significantly. Then the customer can say, "Well, I'm going to increase my self-consumption. I'm going to engage more in demand response and trying to turn on my air conditioning unit or my heating unit or my washer or dryer or my dishwasher to correspond with daytime solar supply and maximize my self-consumption and therefore reduce the amount of power I'm actually injecting into the grid." So, the potential for having—I guess the advantage of having a bit more of a dynamic pricing environment is that it keeps the customer vigilant and on their toes, whereas by setting the rate, essentially, you can set it and, so to speak, forget it. So, there are some pros and cons there that we'll get into a little bit more later in the presentation.

Now, depending on how the NET-FIT rate is set, it may result in cost savings or cost impact for the utility and its customers. As we saw in most cases, NET-FITs are now below retail, but in Australia, in the 2000s, the NET-FIT was set well above retail prices in order to catalyze the growth of the market. I choose one example here where they were offering $0.44 per kilowatt—Australian cents per kilowatt hour, in Queensland. So, $0.44/Australian is somewhere around $0.32, $0.33/U.S. per kilowatt hour. Gives you an idea, at the time, this was then a subsidy rate to try to encourage, again, the growth of the market. But since then, the rate has been dropped. In most cases, outside of Victoria, which adopted time-of-use pricing, as we'll see in a moment, to somewhere between $0.07 and $0.12 per kilowatt hour and it differs by state and by utility.

Another factor here is that retail prices in Australia have been going up, as we'll see. That has also helped improve the economics of investing in solar in places like Australia. So, this table provides a quick overview of some of the key jurisdictions that have invested or that have developed NET-FIT policies. You can see here, Victoria, the first state listed, offering two options. One of them a flat minimum rate at $0.099 and a second option, which you can opt into of a time-varying rate that ranges between $0.07 and $0.29 per kilowatt hour.

Now we'll get into the time-varying NET-FITs in a moment, but you can see here, also of note, is that all of these policies have various forms of size caps. So, they're, in some cases, quite restrictive; 100 kilowatts or less. This signals in many ways that the Australian solar market is much more focused on smaller residential and small business installations in contrast to, for example, the German or, even in many cases, the U.S. distributed solar market where it's common to see rooftop systems or certainly commercial-scale rooftop systems in the megawatt range.

Another important point about this table, you can see on the far right, that the rate depends ultimately on the retailer. So, customers in a given area can actually shop around. They can go on the websites of different utilities and lock in their rate with a different retailer. So, there is competition on the retail end for NET-FIT compensation levels, which makes Australia, in many ways, one of the most dynamic and fascinating markets for distributed solar policy at the moment. Australia has also been undergoing a fairly rapid growth in recent years. 2018, now coming to an end, is already poised to be, by some margin, the best year that solar has had in Australia, already beating the 2017 record installed capacity that was achieved last year.

So, 2018 is—if 2018 is a sign of things to come, Australia is definitely—the momentum is there, and the market fundamentals are quite strong as, in particular, retail prices remain fairly high and as solar costs continue to come down and also combined with just growing awareness among both residential and business customers of the potential savings that solar can offer. So, in Australia, in many ways, we're beyond a conversation around subsidies and supporting solar with rate payer money or with government money. It's very much in a dynamic where PV is actually providing cost savings. We'll get into that in a little bit more detail in a moment.

Now, as we pointed out, NET-FIT prices have come down in Australia, which remains the largest NET-FIT market in the world. In 2011, a five-kilowatt system would cost between 17 and 25,000 dollars, Australian, after rebates. Today, the same system would cost between four and eight without rebates. So, a very significant cost evolution, which we've seen in markets around the world. But in the—at the same time, further reinforcing in a way these declines of solar prices is the fact that retail prices have increased which has made self-consumption and investing in your own solar system much more financially attractive.

If you look here, you can see, quickly, what this looks like in practice. You see here, on the right, the electricity price index baselined to 1990. You can see fairly modest growth over the 1990s and into the 2000s. But then, starting around 2007, prices really start to go upward. Although they've come down a notch since, prices in Australia remain quite high, as we'll see in the next slide. Again, on the left here, you see the declining solar PV costs against that backdrop. So, as PV has gotten cheaper, retail prices have gone up, really creating, in many ways, a perfect storm for the uptick of solar power.

This graph shows the actual retail prices against the left axis in Australian cents per kilowatt hour. You can see there at the bottom, one Australian dollar is around $0.72/U.S. So, about three-quarters. This gives you a sense, roughly, or where the rates are. We've seen an uptick in 2017 but, basically, rates remain broadly in the range between $0.24 and up to even $.48 in certain parts per kilowatt hour. So, at those levels, solar is very attractive, indeed. Payback rates in Australia are estimated to range from two to five years.

So, if you're in Southern Australian paying extremely high, it's the top purple line. Paying extremely high retail prices. The rooftop solar system can be installed at a levelized cost of somewhere between, say, \$0.08 and \$0.10 per kilowatt hour. The payback times are very, very attractive. That's partly why we're also seeing more interest in certain parts of Australia in investing in residential storage.

Partly, again, because the retail prices are quite high, the incentive to self-consume more of your supply from the PV system is quite high. There's also an increasingly dynamic storage market unfolding. So, in that sense, Australia is really blazing a very interesting path forward, again, where the market fundamentals supporting solar are increasingly strong and where policy, supported broadly by the existence of NET-FITs remains in place making that investment, making that growth possible.

Now, you can see here, just a quick analysis of the return on investment, the ROI. The first line on the top shows the ROI of different solar systems and the range for systems without a battery. So, you see there, battery size zero on the left axis, this means that it's still more attractive in Australia to invest in a pure solar only system. If you invest in storage, your return is going to be less, still. But it gives you a sense of the range as well, that in some cases it's still fairly attractive to also invest in storage. You see ROIs here between 9 and 12 per cent which, arguably, isn't that bad. Certainly, the economics are going to get better as battery costs continue to come down. So, again, although it remains more attractive to invest in a solar only system, that may well change in the years ahead.

Now, as I mentioned at the outset or early on in the presentation, Australia also offers location-specific NET-FITs based on the utility's avoided cost in that specific region. So, in Western Australia, different NET-FIT rates are offered, depending on the avoided cost in different regions of the grid. The range is quite large. So, you can see here, the NET-FIT rates will range by location from \$0.07/Australian, up to \$0.50 per kilowatt hour, again, depending on what the utility uses to supply power to that region. So, if you're in a more remote region of Western Australia and paying the higher, in most cases, diesel-based supply rate at around \$0.50 per kilowatt hour, investing in your own or getting, rather, these NET-FIT rates in the range of \$0.50 per kilowatt hour, investing in your own solar can be very attractive, indeed.

I think that's where these location-specific feed-in tariffs or NET-FITs are particularly interesting where they can actually help the utility save fuel costs and still allow customers to participate and customers to actually contribute to creating and maintaining a more sustainable power supply in remote regions. So, you're seeing here a fairly wide spread, based on avoided costs. This represents one way of structuring NET-FIT policies. Certainly not the only way, but this gives you an idea of some of the policy—one of the policy design options that is available.

Another policy option is the use of time-of-use pricing, which we also discussed briefly a moment ago. The State of Victoria has recently introduced a series of time varying rates for the NET-FIT. You can see here the distinction between off-peak, shoulder, and on-peak times. So, from off-peak is during the evening hours. Shoulder is, as seen there, 7:00 to 3:00 PM. Then, 9:00 to 10:00. Then, the on-peak is from 3:00 to 9:00. Whether it applies, weekends or weekdays. Then, finally, the NET-FIT rates.

So, you can see here that for weekdays between 3:00 and 9:00 PM, the system peak—that is the on-peak hour or the on-peak hours. NET-FIT rate there offered is $0.29 per kilowatt hour. So, if you can supply power in Victoria between 3:00 and 9:00 PM to the grid from your solar system, you will get paid $0.29 per kilowatt hour for doing so. So, this creates a significant incentive, as highlighted briefly earlier, for customers to start orienting their systems westward so that they capitalize on that late afternoon sunshine. Again, this is one way of encouraging a behavioral change that actually has positive system-wide benefits, positive both for the utility as well as for the operation of the power system, and potentially even for power reliability as it helps contribute to the critical peak hours.

This kind of a pricing approach, although, clearly has its critics. Some argue that the peak rates are too generous. They may be over-compensating solar. On the other hand, dealing with these evening peak hours is one of the most critical challenges of power systems around the world. It doesn't matter whether you're in Latin America, South Africa, or Sub-Saharan Africa, West Africa, throughout the Pacific region, the Asia-Pacific region, India. Dealing with the evening peak is a massive challenge.

One criticism that's often raised to solar is that just as the evening peak is starting to occur, solar is dropping off the system because the sun is setting. So, there is significant interest in trying to get more systems, more PV systems to supply power into the early evening, into the late afternoon and early evening hours. One way of doing that, again, is to structure the compensation mechanism accordingly so that people get paid a little bit more for orienting their systems westward or for other adjustments to their behavior within the household, as we'll see in a moment.

Customers in Victoria are provided with a choice. They can remain at a fixed, set-it-and-forget-it rate of $0.099 per kilowatt hour or they can adopt the time-of-use pricing at the rates agreed below. So, nobody is forced, at this stage, to adopt the time of use rates, but the incentive is sort of made there.

Now, some of the aims or some of the rationales for some of these time-varying fits. The aim of the policy at the most basic level is to drive some kind of behavioral change. That behavioral change can take place in a number of different ways. One is load shifting. So, customers may be given an incentive because they're paying more to the grid or getting less for the net excess generation, to shift their behavior and, for example, run their swimming pool pumps or their heating and cooling systems or their dishwasher or clothes washer and dryer at different hours of the day so it coincides with the best pricing.

So, it encourages people to be a bit smarter about their electricity use. One might think, "Well, this is fairly household specific and you're never going to get significant system-wide impacts from individual decisions," research suggests, in fact, precisely the opposite. If you look at the major issues around peak, so peak demand in the evening hours, these are fundamentally systemic challenges that are born of millions of individual decisions that are not system aware.

Now, if we can shift the logic and get people to be a bit more system aware by giving them price signals, the logic there is that people will start to respond by shifting loads around. If one or two households shift their loads around, that is unlikely to register. But if you get a few million people shifting their loads around, even occasionally from time to time, then the system-wide benefits can be quite significant, indeed. I think that's the potential and the hope, certainly, of getting these pricing approaches to create the right incentives.

Second, clearly as I mentioned, orienting your solar panels to the west can generate more electricity later in the day. That can have a number of different benefits. Finally, installing battery storage can also be one additional policy or one additional decision or behavioral change that's induced. So, if, for example, you're paying a very high evening rate for electricity, say between 6:00 PM and 10:00 PM, it may be smart to invest in a storage system that can help you stay off-grid in a way for those evening hours so that you're not paying the utility the very high evening rate. So, again, there's a number of possibilities here and I think we're just at the beginning of this potential revolution in more behaviorally aware, more system aware energy use. NET-FITs, obviously, aren't the only way to start triggering these types of behavioral changes for households and businesses with solar systems, they certainly offer the possibility of doing so in a more sophisticated way than under, for example, pure net metering or pure net billing.

Utilities in Victoria are even thinking now of taking this a step further and even introducing critical peak tariffs that would pay even more. Instead of $0.29 per kilowatt hour, some of the numbers that have been bandied about are somewhere around $3.00 per kilowatt hour. So, like a factor of ten more than the current peak rate, recognizing again that there are very significant, critical shortages during certain hours of the year in extreme circumstances. The utility is prepared to pay for that for supply during those hours. So, again, I really think we're just at the beginning of experimenting with some of these approaches and it's going to be very exciting to see how some of this plays out and, also, what other jurisdictions around the world from Bangalore to Dhaka to Abuja and Rio de Janeiro can learn from these kinds of approaches. Because, again, these challenges are common to many utility systems around the world.

Another important distinction here is between the residential and the commercial customer segment. Now, residential customers typically only self-consume a small share, typically between, say, 20 and 40 per cent of their actual consumption or actual supply whereas commercial customers typically self-consume more. This ultimately depends on the system sizing. So, how big is your system? How big is your roof? How big is your onsite load? But the basic logic is there. This has significant impacts on what's possible and what the incentives suggest for these different customer types.

So, for a commercial customer, the majority of economics under this particular case here would be driven by avoiding utility consumption, not so much by the NET-FIT rate. So, they may be less responsive to critical peak or, say, peak pricing approaches because, ultimately, they're only injecting, say, 10 or 15 or 20 per cent of their total output. It may not be really a big driver. Whereas, for residential customers who are much more exposed to the NET-FIT rate may be even more responsive. Now that's somewhat counterintuitive because normally we would think that commercial customers would have more sensitivity to pricing or more—would be more savvy about energy use and would be prepared to try to save money wherever they could. Experience thus far has not broadly supported that contention.

Commercial customers often just treat energy as a pass-through cost. It's simply a cost of doing business. It's only in certain cases that commercial customers have really taken a keener and more active interest in optimizing their energy use. There are some promising examples. There are some supermarket chains and some hotel chains, for example, that are really starting to get on board with this and starting to get a lot smarter by having dedicated staff that focus on energy issues and try to optimize. I think we're likely to see more of that and more demand for that as, again, the landscape continues to change in the years ahead.

Now, we've talked a lot about Australia. Let's take another look at another jurisdiction that's recently adopted a NET-FIT policy in West Africa. For those of you who don't much about Senegal, a few quick facts. Approximately 15, almost 16 million inhabitants. Annual generation of just under three terawatt hours. Installed capacity of about 1,000 megawatts. Recently, they just locked in a few contracts for 100 megawatts of solar PV.

Peak demand of around 560 megawatts and electricity tariffs that range between $0.15 and $0.23 per kilowatt hour, depending on the customer class and consumption. So, against that backdrop, given that Senegal is a very sunny country, not far from the equator, benefits from tremendous solar resource, the—and has among the highest electricity tariffs in West Africa, largely because it's a primarily oil or diesel-based power system, the business case now for investing in rooftop solar for customers is growing. Within launch of the NET-FIT, Senegal is poised to become one of the most interesting markets in West Africa, certainly, and potentially even in Africa as a whole for rooftop solar development.

Now let's look at some of the rates that they have recently introduced. You can see here on the left that it's differentiated somewhat differently than in the Australian cases that we saw. It's differentiated by customer class, which is essentially also a proxy for project size. So, smaller households are likely to install smaller systems and larger households, larger systems.

Senegal also introduces a cap in its law that says that residential customers can only install systems that are 120 per cent of the peak demand of the household, whereas commercial customers can only install 110 per cent of their peak demand in solar on their roof. So, this essentially caps the system and means these different customer classes are also implicitly project-size caps. The NET-FIT rates are shown there, and they range from about $0.087 up to $0.13/U.S. per kilowatt hour. When you combine that with the retail prices we saw on the previous page, the economics are, again, increasingly attractive for rooftop solar in Senegal.

The other interesting thing is that, in Senegal, it's not only limited to solar technologies but Senegal has also enabled it for biogas and the list of technologies has also included wind power and tidal power and wave power and other technologies that are unlikely to be economically viable at these NET-FIT rates, but at least it shows a willingness to broaden the envelope and really open the market to a wider range of renewable technologies. Biogas technologies will receive the lowest NET-FIT at around 50 Franc CFA per kilowatt hour. So, $0.087 per kilowatt hour. At that rate, that's the rate that applies for all medium-voltage-connected customers. At that rate, the IRRs for bio gas technologies are very robust. They're sort of between the 13 and 17 per cent range. For solar systems, the range is a bit wider, but most systems are between 12 and 15 per cent.

Now as installed costs for solar continue to decline and as the market in Senegal continues to mature, these IRRs are likely to continue to improve so long as the NET-FIT rates remain as they are. The regulator has committed to adjusting the rates every couple of years. At the current prices and under current trends, it's already quite attractive. I think the potential, again, for a fairly—for Senegal to emerge as one of the most interesting markets in distributed solar in Africa is significant. This is very exciting. Senegal is the first country in Africa to have adopted a NET-FIT at the national level. It will be interesting to see—to watch this unfold in the months and years ahead.

There is a recognition that the NET-FIT is critical to unlocking financing, particularly in countries like Senegal where banks are often reluctant to lend to net metering projects or to pure self-consumption projects because they're fundamentally linked to the credit worthiness of the proponent, whether it's at a hotel or a shopping center, a supermarket. Most of it is done on balance sheet without bank financing. So, there's a real challenge in getting banks to invest in these kinds of projects when there isn't a clear NET-FIT-type rate that provides a floor price on the purchase of electricity. We'll get into a little bit more of that here in the advantages.

So, let's take a step back, covering everything that we've seen so far about NET-FITs and look at some of the advantages and disadvantages. So, on the one hand, NET-FITs are a recognition that the cost of rooftop solar is increasingly below the retail price the customers pay because the rate is increasingly set below the retail price. This means that it can be both a win/win for utilities as well as for customers.

For a utility, let's say if customers are paying $0.15 per kilowatt hour and the NET-FIT rate is $0.07 per kilowatt hour, to pick up on our earlier example, this means that the utility on the distribution wires can buy that $0.07 net excess generation from customer A and wheel it down the grid and sell it to customer B for the full retail price at $0.15 essentially earning a markup on that distribution generation and avoiding line losses that they would have incurred from supplying that power from further upstream in the power system. So, the potential there for the utility to actually gain directly from a NET-FIT policy like this, in a host of different ways, is quite significant. That was really a critical factor in getting in the utility, Senelec, in Senegal, onboard.

NET-FITs are more bankable than either net metering or net billing because they provide the possibility of a cash payment, which provides a floor price, essentially. It enables banks to model a worst-case scenario. So, if the person in the house moves out or if the business goes out of business, the solar system can continue to produce power and can continue to export generation and get the NET-FIT rate. So, it means that the bank is assured that even in the worst-case scenario, they will be able to recover their loan. So, the potential here is significant to really helping unlock more bank-based lending, bank capital to support the growth of the solar market, which has, so far, been extremely difficult particularly in parts of Sub-Saharan Africa, Latin America, and parts of the Asia-Pacific region. So, the need here to really unlock financing is critical and NET-FITs can be an important instrument or an important tool in helping enable that.

Further advantages of the NET-FIT rate can be differentiated by project size, location, time of day, as we saw, and even by customer class. So, the potential for more carefully adapted NET-FIT rates is significant to make sure that there isn't over-compensation on the one hand, but also to ensure that different customers in different regions or in different project sizes are still getting a fair price.

A few further advantages, the NET-FIT rate, as we saw at the beginning, can be linked to independent benchmarks like wholesale market prices or utility-avoided costs which can remove the need for so-called subsidies. The independent benchmarks may have issues of their own, as we saw earlier, but the basic logic of linking it to some wholesale market price removes the criticism that solar is receiving any preferential treatment. If the retail prices are high enough, which they are in a growing number of jurisdictions in the world, the potential for making an attractive business case on the back of even fairly low wholesale market prices is significant. That may be where the market moves in the years, if not decades, ahead. So, stay tuned on that.

Another advantage here is that there are fewer issues of cross-subsidization between customer classes, which has been one of the big criticisms of net metering policies. Finally, it's easier to adjust the compensation rate because the NET-FIT is not linked to the retail price. So, it can be adjusted independently.

Now, a few challenges. Under NET-FITs, customers may even be unfairly or insufficiently compensated for their net excess generation. In other words, the NET-FIT rate may be too low and distributed generation, like solar, may be worth more than the rate that the utility is prepared to pay. This may encourage customers to shop around for another customer willing to pay more. This is certainly the case in Australia where retail customers, individual households, can choose their supplier and can shop around for the best NET-FIT rate.

There's also the issue here that if the utility sets the NET-FIT rate too low, it may actually have the unintended consequence of encouraging the emergence of what are called peer-to-peer power sharing business models where households and businesses can actually share power with themselves directly using, for instance, block chain technologies where they can directly be compensated and have a financial kind of relationship, not with the utility but with other customers in the network to essentially exchange kilowatt hours in real time. That may mean that customers may actually be more willing, in some cases, to pay a better rate than what the utility is paying and could really be an accelerator for the emergence of a more decentralized power system in the years ahead. So, again, lots of exciting issues to unpack there.

I think that's really—it's too early to say exactly how that's going to unfold, but clearly, I think the logic stands that if the utility is not compensating customers sufficiently, is not paying enough for the NET-FIT or is being too restrictive in other ways, that customers, in this new landscape, will start to shop around and will start to explore other ways of marketing their power that could even be more disruptive to the traditional utility business model than just paying them a fair NET-FIT rate. So, again, very interesting times.

Another disadvantage or challenge here that's often cited is the administrative burden. Issuing small cash payments for sums under $50.00 may be considered administratively burdensome, especially if the processes are not sufficiently automated. So, there's certainly a risk there. That said, utilities have no difficulties billing customers for small amounts when the customers owe them small amounts. So, by the same logic, there's no reason why utilities shouldn't be able to also write checks for small amounts to their own customers. So, again, some debate there around what the actual administrative burden is.

There is, of course, a technical component of this and that the NET-FIT systems need to be monitored. They need to be compliant with technical standards. There needs to be some ability to potentially shut the systems off if there needs to be work on the lines, distribution lines in that area to avoid live wires. So, there are some issues there that do entail costs for the utility. That's partly why the need—the search here should be for a good win/win pricing arrangements that enable the utility to derive some benefit, some cash benefit, some saving, as well as the customer. I think, again, solar has gotten cheap enough today that in many markets around the world, the potential for that win/win is there.

Final potential challenge here is issues around taxes, especially for commercial customers. In most cases, residential customers are unaffected by these. They may have to claim it as income if it's significant or above a certain threshold. But for commercial customers, then there's VAT and other issues that enter in. So, those, clearly, need to be clarified and the tax authorities need to provide guidance on how solar customers can appropriately navigate these tax issues.

Now, some key decisions points. So, similarly to the net metering and net billing presentations, I've laid out here a series of key decision points that policy makers need to think about as they consider implementing policies like a NET-FIT. First, the methodology. How do you actually determine the net rate? Is it a flat rate? Should it be differentiated by size, by location, by customer type, by time of day?

Which technologies are available? Is it only solar or are biogas and wind and other technologies eligible? Which customer types? What are the project sizes? Is there a cap on the total of capacity? For example, Senegal's program or Senegal's policy is initially capped at 10 megawatts on a pilot basis to see how the program goes.

Do existing projects qualify? This is another tricky issue in many cases and, again, requires guidance from the regulator or from the utility. Are there additional charges or fees? Finally, are any bill components ring-fenced or made non-erasable through self-consumption. So, all of these things really need to be carefully considered in the design of the policy, again, to make sure that the policy is balanced and achieves the objectives set out.

Now a few final remarks before wrapping up. Providing a cash payment for the net excess generation instead of simply a bill credit like net metering or net billing represents a fundamental step forward in distributed generation policy, making it more bankable for a wider range of customers. So, in that regard, NET-FITs have the potential to be even more transformative than policies like net metering were and have been in the U.S., in particular, and are likely to be more attractive for both customers as well as for banks interested in investing more in the solar sector.

So, in that regard, NET-FITs can help catalyze much needed investments in clean energy but also can help defer unnecessary investments in distribution grid infrastructure by providing more distributed supply within the wires in the distribution system and helping save some of those costs elsewhere in the system. Because the NET-FIT rate can be set below the retail rate, in some cases even significantly below the retail rate, there's the opportunity here, again, for some quite significant win/wins. I think we are just at the beginning of unlocking some of these win/wins. Once utilities really get it, that as they have in many parts of—in most parts of Australia that this actually can be attractive, this can be a viable way forward for the utility and can actually still be profitable for them, I think we're going to see a lot more interest and a lot more effort to implement policies that try to strike, again, this middle ground, this hybrid space between classic feed-in tariffs and net metering policies.

So, with that, thank you very much for your attention. I hope this has been insightful and that you've learned a little bit about NET-FIT policies, where they are around the world, some of the jurisdictions that are using them, and some of the nuances and some of the policy options that are emerging to implement them. I've provided here a few additional reports as further reading. Like to thank, again, you for your time as well as the International Solar Alliance and the Clean Energy Solutions Center for making this training series possible. Now, I'll invite you to take a few moments to answer the knowledge test at the end. Thank you very much, again, and wishing you all a great day.