

Deep Dive: New Business Models in the Solar Sector/Part 1: Solar PV Sector

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Welcome everyone to the International Solar Alliance Expert Training Course. This particular unit is focusing on the rise of new business models in the solar sector. We've seen in recent years significant changes in the solar market in particular driven by these new business models that are now making it easier for people who don't yet have solar on their rooftop or near their home or business to go solar. And these business models are having a pretty fundamental impact on the way solar is being purchased and scaled up in a number of key jurisdictions around the world. So we're going to try to provide an overview of these business models in the first part of this lecture series. The second part is going to focus more specifically as we'll see in a moment on the impacts that these business models are having on the traditional utility business model itself.

So first a few words about this training series. This is supported jointly by the International Solar Alliance in collaboration with the Clean Energy Solutions Center. The International Solar Alliance is a grouping of countries around the world that it was founded after the Paris Agreement to really scale up solar power with a focus on the sunny, the sunniest countries in the world sort of around the, essentially around the center of the equator and the equatorial countries and north and south of the equator. The Clean Energy Solutions Center is one of the leading platforms providing technical assistance for countries around the world with a particular focus on policymakers and regulatory agencies in trying to scale up investment in clean energy.

So I'll provide a few—I'll say a few words about the overall structure of the training course. You've probably seen this briefly from the introduction as well as from some of the other training materials but just briefly, this training

course has eight different modules ranging from policies for distributed and large-scale PV down to socioeconomic aspects, market integration, as well as even off grid solar and solar heating and cooling. There's also a segment on technical aspects of solar power. So this is really—the goal is to provide a comprehensive overview of major issues, cutting edge trends and developments in the solar sector. And as I said at the outset, this particular module focused specifically on new business models. Part one is on the business models themselves and part two will look at how these new business models are actually impacting the traditional utility sector.

A few quick words about myself. I'm director of E3 Analytics and I have over 12 years of experience working in the clean energy sector. I've worked with over 40 different governments around the world from the Asia Pacific region, island states to a wide range of countries throughout Africa and Central America and am currently teaching a renewables MBA program course here in Berlin. In some ways a lot of the, there's a growing interest in capacity building and learning around solar development and renewable energy development. And this new training initiative from the Clean Energy Solutions Center and the International Solar Alliance is a fantastic platform to provide some of that knowledge and learning from markets around the world to a broader audience.

So a quick overview of the presentation. Here first we'll look at the learning objectives, will look at the business models themselves and then I'll wrap up with a few concluding remarks. The—it's important to note also that you should pay closely attention throughout the webinar because there will be a series of multiple-choice questions at the end that will require you to actually think back on the content and the material covered in order to get the right answer. So that will come after the webinar is completed.

So first, what are the goals? What are the learning objectives? First, we'll look at a little bit of the historical context for the emergence of new business models in the power sector. We'll look at the rise of these business models and how they work. We'll look at how they're helping reduce the barriers to going to solar. And we'll look also at the advantages and challenges that some of these new business models are facing. So without further ado, let's dive in.

The historical model on which the utility business is based goes back over a century to the beginning of the 20th century. And it's based essentially on large centralized power plants providing power to captive end users. For most of the 20th century customers were effectively connected to one monopoly utility and had no option to switch providers and very little ability to engage in self-generation. So a household in say the 1960s in the US or Europe wouldn't have had an easy option available if they didn't like what their utility was providing them in terms of service or in terms of cost. All of this has changed as we'll see in a few moments with the rise of distributed technologies like solar power. And particularly with the rise of affordable solar power where solar is now increasingly becoming the least cost option for new electricity supply in many countries around the world.

And solar is also very highly scalable so it can be developed on individual households. It can be developed from tiny PICO solar units common throughout sub-Saharan Africa that range from 20 to 30 watts up to 200 watts to large household systems that can range up to 10 kilowatts or more and onward from there to utility scale, larger scale ground mounted solar power. But in the beginning throughout the 20th century with the rise of electrification around the world there were comparatively few independent power producers after the 1930s. Utilities were largely nationalized. Electricity became in many cases a state-owned business and a monopoly business where one entity owned the generation, transmission and distribution infrastructure and took care of customer service and the retail end of the business.

Now what we've seen in recent years and particularly in the 1990s and 2000s is that this has started to change. And market regulation has started to enable and even in many cases encourage more actors to participate, compete and invest in the electricity sector. So before in many ways in the past, electricity sector was a very—it was a sector dominated by a few very large corporations and entities. Now we're seeing the rise of a much more distributed, much more competitive, much more diverse sector. And in many ways solar power is leading the way on that partly because of the fact that it's a very distributed technology and also partly because of the fact that it's becoming so cost effective compared to other forms of power generation.

Now it's important not to forget that this has not always been the case. Solar used to be one of if not the most expensive source of power generation. And it's only really in the last five to ten years that we've seen solar starting to become cost competitive with traditional sort of utility scale generation like coal plants, nuclear plants and natural gas plants. So in many ways the historical context is that the rise of these new business models is a direct consequence of this prior period of opening up and what we sometimes called liberalization in the electricity market. And different countries around the world are at different levels of liberalization.

And it would—whether if you look at countries like Brazil or Ghana, South Africa, the Philippines, Thailand, the different countries around the world all have different levels of liberalization in terms of how open the electricity market is, how much competition there is. And that has a very direct impact as we'll see on the rise of these new business models in the solar sector. In some cases, it remains the case that these business models can't take root because the regulations explicitly forbid it. And in that sense, the evolution of these business models is very closely linked to the regulatory environment in which they exist.

So I've been using the phrase a lot, a business model. But let's think a little bit more critically about this for a moment. What is a business model? What do I mean? What do we mean when we say a business model? So in a nutshell a business model defines how a particular business creates, delivers and harnesses value for its customers. That's really at the most basic level what a business model is. And why do new business models emerge? Well, in

the power sector, there are two major drivers. One of them as I pointed out is technological change. The second is changes in actual electricity market regulations themselves. Changes in electricity market regulations make it possible as we saw a few moments ago for new actors to emerge and that has helped enable the rise of these new models. So we see that new businesses are capitalizing on niches that are opened up by a rapidly changing technological and regulatory landscape.

But there are some other factors that are important and that have played a major role in the emergence of these new business models particularly in markets like the US and to a lesser degree in Australia is changes in tax policy. Taxes have played a major role in enabling the new business models that we'll see in a moment to really emerge in the United States. And there's a number of reasons for this. Further important component here is changes in consumer behavior. Before the electricity sector was largely one that you could connect up essentially and forget and not really worry where your power comes from, who is producing it and really for many users even how much it costs was only a secondary consideration.

This has started to change as more competition has entered into the market and also as retail prices for many customer classes have gone up very rapidly. So as retail prices go up you have people starting to look at their options. How can I reduce my power bill? How can I do things differently. And that's been another important catalyst. The third component that's worth highlighting here is the role of financial innovation, particular new financial products and services that make it easier for customers to invest in solar. And we'll see how that has helped in many ways unlock the solar market and it's helped fuel the rise of these new business models.

Now as I mentioned a few moments ago, the solar PV market is growing exponentially. There are some very rapid changes taking place and in the last few years in particular the pace of change has accelerated even faster. Much of this growth has been driven by large scale solar PV projects. So we're talking over 50 megawatts. But there's a significant amount of growth happening specifically at the distributed end of the spectrum, at the customer end, at the rooftop end of the market. And as we'll see in this presentation which is really what we're focusing on here is this more distributed end of the market.

In some ways the large-scale ground mounted utility scale solar market is healthy and, in many countries, thriving. It's not the case universally that the distributed solar power market is thriving in every country. So what we're going to focus on is how this new, these new business models are helping unlock the distributed, the customer end of the solar market to unlock more potential out of rooftops and businesses who can now more easily and more cheaply than ever before invest in solar power.

So as you can see here, this is a recent chart from an IRENA report looking at solar PV costs. You can see here on the far-left total installed costs have come down dramatically even just in the last seven years and similarly cell efficiencies have gone up and continue to rise. And the overall levelized cost

of solar power has also experienced dramatic declines. So this is really the technological transformation that we're talking about. This is what's made it possible for households, for small businesses around the world to start investing in solar to reduce their utility costs.

Globally, you can see that the solar market is still very—the potential for growth and continued growth and expansion in solar is massive. Some of the largest markets in the world are currently China and India. Japan is also booming. Germany remains a stable and growing, though more slowly growing, still growing solar market. And you can see on the far left the United States. But much of the world has just, is just beginning to tap into the abundant potential of cost effective solar. And in many ways, one could argue that this is really—we are just at the beginning of seeing a massive transformation in the overall electricity system driven by the emergence of increasingly cost effective solar. And you can see here throughout South American, throughout Central America, throughout Africa and much of Asia the potential is absolutely tremendous.

This graph shows quickly the growth in solar PV consumption. You can see here that the Asia Pacific region has effectively overtaken Europe and now if you're looking at 2018 numbers and data, the amount of PV installed and the amount of PV being injected into the grid—there's solar PV being injected into the grid in the Asia Pacific region is larger than the rest of the world combined. So the Asia Pacific region is really emerging as the center of gravity of the global solar market.

Now let's take a closer look at what we mean by these new business models in the solar sector. As I pointed out a few moments ago, new business models almost always evolve in lock step, in other words in tandem with a shifting regulatory landscape. It's the niches that are opened up by new regulation that often make it possible for new businesses to take root. And you can see that new business models either emerge in places where there's little or new regulation at all. And one example of that is the rise of pay as you go solar in Africa and in other parts of the world or after such regulations opening up the market have been introduced. And there you could cite the US, Australia, the UK, much of Europe as examples.

Now there are four main business models that we're going to focus on in this presentation. Most of what we're seeing around the world in terms of the—let's call it the evolution of new business models. The four main models that we're seeing are listed here. The first that we're going to look at is leasing models. The second is third party PPA models. The third we're going to look at is prepaid solar or sometimes just simply called cash sales. This is basically the oldest business model in the book and community solar which is where individuals can group together and develop larger solar projects as a community, often in a location that's not their own house or their own business.

Now while there are a few companies that dominate the headlines in the solar sector, particularly in these new business models, there's a range of actors that are now developing and emerging in this space in the utility sector as a

whole. So the solar, the new solar companies that we're seeing in this sector are only one part of a much broader ecosystem. And these different businesses that are starting to emerge, there's a number of different forms we'll look at more closely in part two of this training series but I've listed a few here. Aggregators, merchant-based models, virtual utility models or virtual power plant models, then providers of smart platforms like peer to peer training which we're starting to see in jurisdictions like Australia and to a lesser degree in the UK. Now the four options we're going to focus here are specifically the options or the business models emerging in the solar sector. So we're not going to look at all of the other variations.

Now many of the companies in this space also offer customers more than one financing option. So it's difficult to speak in universal terms about one particular business model versus another because many of these companies are overlapping in terms of the business models and products and services they're offering. So it's important to keep in mind the landscape is evolving rapidly. And there are no clear-cut categories. But we're going to look at the four major categories we've laid out and try to better understand what all the fuss is about and why this new market segment is so exciting and is in many ways why it holds such potential for jurisdictions around the world.

Now a quick snapshot here. I apologize if this is a little bit blurry. You will see the chart provided here available on the citations under the RMI report and can get a clearer version there. It provides a nice overview of the key functions of the solar business model. You can see which parts of the activities utilities are responsible for, which parts the solar company are responsible for and which parts the customer can and in some cases is responsible for, can be and is responsible for. So really at the end of the day a core function of these new businesses is to provide a bridge, a bridge between the theory of going solar—so a household or a business saying hmm I wonder what that would be like to invest in my own solar system to provide my own power? And bridging that theoretical conversation and the actual practice of investing and developing your own solar project.

And because of the complexity of this sector and because of how rapidly it's changing and because of all the tax and regulatory and permitting related steps and hurdles that a particular household or business has to go through, companies have emerged that start to take over those responsibilities and say we will make it easy for you. We will take care of your permitting. We will take care of your overall administrative processes and fees and we'll simplify the process so that you can go solar on your own terms without needing to worry about all of the particular details of the administrative or permitting process for instance. So one of the major advantages is simply to make it easier for customers to invest in solar.

So let's look more closely at each of these four business models in turn focusing first on leasing models. So leasing models effectively involve a third-party developer installing and maintaining a solar system on or near someone's house or business. Most leasing models are based on a zero-cost model. In other words, they go to the customer and say you do not have to

pay us anything up front. We will take care of everything. You just sign a contract and you pay us a monthly payment. The customer in this case effectively signs a rental agreement and agrees to pay a fixed monthly rent in exchange for the ability to consume power generated by the solar system and in exchange for the ability to have solar on their rooftop.

The lease payment is often structured to be cheaper than the utility, than the customer's utility payment. So it's already possible for a new business model in this sector in many countries to provide a contract that beats the utility on price. That means solar on your rooftop can be cheaper than what you're buying from the utility. And that's what's really catalyzing this market and that's the opportunity that is opened up by technological change and it's made these new business models in many cases possible. In most cases this arrangement is designed to make use of policies such as net metering. Customers can choose a wide range of financing options and they can lock in solar power at zero down payment or with little down payment.

Now the solar company in exchange typically monitors, maintains and insures this system over the course of the contract. So again, the idea is to make it as easy as possible for the household or business. In exchange the customer receives up to 20 years of predictable monthly cash flows. In turn, the company often qualifies for a range of tax benefits. One of the reasons that these new business models have emerged first and most prominently in the United States is that in the US there are a range of tax benefits specifically that enable companies to develop these systems, take essentially monetize those tax benefits and scale up their business in the process.

And it's because of the uniqueness, the unique elements of the tax regulations that have actually made these new business models make economic sense in the US before they made economic sense for example in other markets like in Europe or Japan for that matter. Often both individuals and companies benefit in a range of different ways. And we could get into some of the advantages—we will get into some of the advantages. The idea at the end of the day behind these new business models is again to provide some kind of a win-win for both the customer and for the business.

There are however a number of differences and I've just highlighted these here for quick reference. For example, the installations can either be subcontracted or done by the company itself. The financing can either be provided by the company or can be done by a subsidiary like a bank that they cooperate with. Some companies also offer things like energy optimization software. They allow you to monitor in real time with your iPad or your iPhone or your mobile device directly the real time performance of your solar system, of your storage unit if you have storage. So different companies differ in the level of sophistication they offer. Another component is whether the energy cost savings or even the PV system performance are guaranteed or not. That's another key element of the contract design. And finally, there's a host of issues around the end of term. So what happens after 20 years? Who does the system belong to and what's the buy out? What are the buyout conditions?

Now a quick overview of the advantages and challenges. Now I won't go into all of these in great detail. I'll leave them there because it would take too much time to go through each and every point. But the slides are available and you can go through these in more detail and really think through the different advantages and disadvantages or challenges that these business models present. One of the main criticisms just to—we've been focusing a lot on the positive aspects but there has to be—many of you are probably thinking what's the catch. I can sign up solar on my roof, no down payment, cheaper than my utility bill. Why isn't everybody doing this? And there are a few points worth making.

One of the most common criticisms is that customers that go solar via these new business models are actually left with too little of the benefits of going solar. In other words, if they did solar themselves—if they hired their own installer and built their own system, financed their own system, they would get more of the benefits. So they say you're giving up—customers are giving up too much of the profit of going solar by outsourcing the work to these companies. Now the companies say in their, in return, well, we're making it easy for people. And for most people thinking about solar power as much as it interests energy geeks like all of us, isn't really their core specialization. And most people have other things they would like to focus on. So one of the main benefits of these business models is they allow again the process to be easy and simplified for the customer often at no up-front cost.

There's been some issues in certain markets with low or poor quality service, customer service or substandard installations. There's also some important exposure to regulatory changes. What happens if the government changes the net metering rules? What happens is policy over taxation changes? Different things like that. So it's not a risk-free proposition. There is no free lunch as economists often say. And hopefully this table of advantages and disadvantages helps you better appreciate what some of the tradeoffs here are.

Now let's dive into the third party PPA models. A PPA is a power purchase agreement and the third party PPA models are essentially similar to solar leasing except that the difference is the owner of the system sells power directly to the customer under a PPA style arrangement. So it's basically a fixed price per kilowatt hour rather than a classic rental agreement. So a rental agreement may have a range of other provisions in it and it may not even be based on a kilowatt hour. In many cases it's not based on kilowatt hour consumption at all. It's simply—as described it's essentially a rental agreement. You rent the solar system even though it's on your own rooftop. A PPA style arrangement provides a fixed rate per kilowatt hour for every kilowatt hour that you consume from that system. And the rest is then marketed or injected into the grid by the company and the company gets whatever price they can get from the utility in that service area.

So instead of a fixed monthly fee the customer receives a bill from the solar company based on the kilowatt hours they consumed from the solar array. And that consumption may represent all or only a portion of their total consumption. Similar to the rental agreement however the PPA is often

structured to be cheaper than what the utility is offering. So it's the retail rate minus some percent. And often that's really the driver of the business model. This is also something that's being done by a growing number of government agencies and institutes as well as international agencies like the GIZ in other countries where they can sign solar essentially with a company and reduce their overall power rates.

So even government buildings could technically sign a for example a PPA agreement with a private company at a rate that's cheaper than what the utility is offering them and effectively pay taxpayers money. So it's at the core of the business model it's really the economics that are driving it. This is no longer a market that's driven in most cases by subsidies or by handouts. It's really driven fundamentally by economics.

Customers can retain their grid connection or they can disconnect fully by adding storage. In most cases these are systems that retain grid connection. The household or business continues to maintain a relationship with the utility. They just consume part of their own power from their own rooftop solar system under a PPA type arrangement. Similar to the leasing the company typically monitors, maintains and insures the system although different companies differ on the terms. And another critical point is that the PPA rate is often indexed. In other words, it goes up over time.

And that's another key feature that a number of customers have been and continue to be critical of because the solar system is once it's built it's in there and it doesn't face fuel costs. Why should the PPA rate continue to go up over time just because retail prices are going up. So there's a host of questions around that that I would say legitimate questions that customers continue to have and ultimately the goal is to try to find a way where the win-win is positive. In other words, there's enough savings for the customer while still leaving enough profit for the company to make the investment as a whole worthwhile and to make the business model as a whole profitable.

Now a critical point here in contrast to the leasing models is that there is an actual sale of power. And where there's an actual sale of power from a third party, this often requires a change in legislation or a change in regulation that allows these third-party companies to actually sell power to end users. In many cases in many markets, retail sales are still heavily regulated. And it's not possible for some third party just to step in and start selling power to customers. So there are regulations that often protect these new business models from all of the requirements of being a public utility while enabling them to sell power on a limited basis to end users.

So there's a host of considerations and in every market that is interested in developing or encouraging investment in these business models it's really critical to get these regulatory and legal aspects clarified so that the business models can actually move forward. Again, some advantages and criticisms or disadvantages—many of the similar advantages as a leasing model fundamentally some slight differences in contract design and differences in the pros and cons from the user standpoint. But many of the same issues characterize both business models.

Now let's move onto cash sales. Under this approach, the customer as the name implies effectively uses their own disposable income or an individually secured bank loan to purchase their own solar PV system. In this case the customers responsible for selecting their own installer. They're responsible for maintaining the system often. They have to go through the paperwork, the permits, the regulatory documents, all of it in order to move forward. So the onus is really on the end user. Now in most cases this is connected—this is not for like off grid customers that are really just looking to go energy independent. This is for customers who are connected to the grid and who are able to engage in either net metering, in some kind of feed in tariff policy or a net fit policy. And I'll describe each of these here briefly just to provide you with an idea.

There is a separate training module in this training series focusing specifically on these different policies and we'll get into much more detail there. But I'll provide a quick overview here. Under net metering, customers effectively consume their own self-generated electricity and they can export the net access generation to the grid. For that, they receive a credit on their bill. There's no cash payment for the electricity. It's just a bill credit. And in the next month they can use up that excess injection into the grid and use it to cancel part of their bill in the following months. Under a feed in tariff customers effectively receive a fixed payment for every kilowatt hour produced. There's typically no self-consumption. In other words, these are 100 percent crude export focused projects.

And finally, under a net fit it's kind of a hybrid of both. Customers can consume their own electricity and they received a fixed payment but only for the net excess generation. So in this case there is a cash transfer. There is a purchase of excess electricity so it's different from net metering. But it's also different from a feed in tariff in that it's only for the net excess generation, not for all of the supply from the solar system.

A cash sales approach enables the customer effectively to derive the maximum benefit from going solar as all savings and environmental benefits like renewable energy certificates for example belong to the system owner. However, one main challenge is that it's difficult for customers without much financial capacity to invest in their own system. And this means it's also limited to customers either with their own land or their own rooftop which by definition shuts out much of the population. And that's where our fourth model on community solar is trying to provide a solution particularly to that challenge around land and rooftop access.

So some advantages. Customers can select their own installer based on the best price available in the market at the time. They can own their own system as well as any tax benefits or certificates involved and they keep all of the benefits and own essentially the system throughout the contract term, throughout the project's life. However, as we saw a moment ago it's especially difficult for low income households to go to do cash sales, to invest in solar with their own disposable income because often they just don't have—most households do not have the disposable income to go with solar in

this way. So that's again why these new business models that we saw in the first two components namely leasing and PPA, third party PPA models have played such a critical role because they've helped make it possible even for low income households to still go solar.

Now the fourth one, community solar. The main advantage or the main benefit, the main driver behind going community solar is for people who do not or owners or companies who don't have enough roof space or any roof space to invest in their own solar. And they may be able to secure a better price, a better deal by investing in a project offsite and potentially a larger project than one they can put on the roof alone. Typically, there's two options. They can own a share of the total production, like a percentage share of that monthly production from the system and use that to offset their utility bill. That's kind of like a net metering, an advanced net metering relationship. Or second, they can subscribe to or lease a portion of the project's output for a set price. Two slightly different approaches, both of which are used, both of which continue to be used. It really comes down to how the contractual arrangements are structured between the many members of the community and the solar project development company or ownership vehicle.

So there are four broad types of community solar. One of them is utility led. This is where the utility effectively owns and develops a project and then offers to the rate payers the ability to invest in that project on a voluntary basis. The second one is a special purpose vehicle model. This is where a separate legal entity is established to finance the system and individuals from the community can contribute into that special purpose vehicle to help finance the overall system. Often the system will use leverage so they will use a bank loan or some kind of loan to help finance the system, in addition to the contribution, the equity contribution of community members.

The third approach is an on-bill credit model where participants effectively get a credit on their monthly bill based on a share of the project. And that's again this net metering variation. And the fourth model is a nonprofit model where donors contribute effectively to finance a community installation often for a charitable organization or other. Could be a university or a school. These are the four most common community solar models currently seen.

The main driver—so you say people often ask well, why would you not just go community, go solar on your own. One of the main challenges that a community solar project addresses is it makes it possible for people without a suitable roof or who don't own their own roof to also participate. So an analysis about a decade ago by researchers at NREL found that only 22 to 27 percent of residential rooftops in the US are actually suitable for developing a solar PV system and that shuts out much of the market. So if we want to unlock that market, we want to open up the potential we need to find solutions and one of the main solutions is to allow community solar.

So some advantages and disadvantages. One of the main advantages is the customers can lock in stable electricity prices by participating in a community solar project. They also benefit from economies of scale. Instead of building a five-kilowatt system on your own rooftop, communities can invest in a multi-

megawatt scale project and develop a project for cheaper overall cost per kilowatt. And that means cheaper power, cheaper solar for everyone in the community. In many cases also the paperwork and permitting and all that is taken care of by the community or by the project developer so that simplifies things for everyone.

There are however some challenges. The logistics and the community engagement required to make a community solar project happen can be difficult. There's obviously tax and regulatory issues and in some cases, larger projects may face higher environmental barriers than individual rooftop systems. So the larger the system then you start getting into environmental permits and that can also take more time.

A few concluding remarks. Now that we've seen the four core business models covered here. Business models, regulatory frameworks and financing tools are all inextricably connected and all of them have to evolve together. In many cases as we saw, these new business models only emerged because the regulations changed and they allowed these developments to take place, they allowed in many cases these new business models to actually take root in the market. And it's critical to understand the development of the solar, what's sometimes referred to as the solar ecosystem. It really requires a holistic more ecosystem level perspective to understand how to really scale up the distributed solar PV market because there are so many different factors that are important to consider in creating an environment that's suitable to the scale up of solar.

New business models are making it much easier than it ever has been to invest and go solar. This is a really key development and it's a very important and, in many ways, very positive development for solar power as a whole. By providing zero down payment or little down payment, streamlined procedures and easy no hassle process new business models are making it easier for people who otherwise wouldn't go through the trouble of going solar to actually go solar. And this is really a critical part of further catalyzing the growth of the market.

As we saw at the outset there are the ground mounted utility scale solar market is healthy and in most countries is robust. But it's not the case in all countries or in all jurisdictions that the distributed or rooftop solar market is also robust. In many cases in the Middle East throughout Africa and in many parts of Asia the rooftop market is barely starting. And that indicates that the potential for growth in this market segment is huge. We'll get to this a little bit in a moment and I want to take that point a little bit further.

However, the growth in certain business models it's important to note has also slowed in some of the key markets in recent years. So I mentioned where these markets have started—or where these new business models have emerged and really grown and developed. The key market has been an in many cases remains the United States but we're also seeing quite a bit of activity in Australia and in markets like the UK as well as here in Germany. But in key markets like the US, the market for third party PPA models and solar leasing companies has slowed down. And that's an important point to

make before wrapping up this presentation and this overview of these new business models.

So why is that? I've highlighted here four key factors. On the one hand solar power is becoming more affordable which makes it easier for people to purchase a system on their own. Before investing in your own rooftop solar system may have cost you upwards of \$30,000.00 for a large sort of North American style household. Now with the cost of solar coming down it's possible to invest in the same size system for \$5,000.00–\$6,000.00 or less and that's make it possible for a much larger spectrum of the population to go solar. And without the help or without needing the help of a third-party company because the amount is now one that more people can afford on their own.

The second is that with these PPA and leasing models, in many cases the solar company and its investors get most of the tax benefits and incentives, not the end user. So there's been concern around the end user not getting enough of the benefit. So some people are starting to cool on the overall hype in third party solar business models. That's another major factor. The third is that awareness is actually growing due to articles and contributions and a number of features in major publications that customers can actually save more money by buying their own systems themselves with cash or with a loan. So we're seeing more people actually deciding to finance their own systems without relying on a third-party intermediary.

And fourth major factor is that some owners are facing difficulties in selling their house when they have a solar system on it that's locked into a leasing arrangement. The new owner may not want the solar lease and they may have difficulties transferring that easily and that can create some friction for people who want to sell their home. So that's another factor that is contributing to people not signing up in as large of numbers as before.

This chart here from Bloomberg and GTM Research shows this rise and decline in solar leasing as a percentage of the total rooftop solar market. You can see that around 2014 things peaked. Over 70 percent of the market, of the rooftop market was driven by solar leasing sales. And now that share has dipped below 50 percent and continues to slide. So we're seeing a significant shift.

However, there's still tremendous potential for new business models like leasing and solar PPAs particularly in emerging economies. And there are a number of reasons for this and this is really where I want to end. I was recently in the Philippines and was able to see these third party PPA models unfold within the Philippines regulatory environment and it's now viable. It's now attractive. A growing number of companies are starting to do this. The same is happening in Vietnam. We're starting to see some companies doing the same in South Africa as well as in parts of Latin America. So these new business models are starting to spread beyond their traditional markets into developing or emerging economies. And there are a number of reasons why this should be seen as a very promising development and why this challenge

that these new business models are there to serve or to solve rather are particularly important to solve in emerging countries.

For one, most households on average have less disposable income than customers in the US or Australia or UK. So as a result, the willingness to go solar even though solar prices have come down—and let's say you can get a household system for \$2,000.00 to \$4,000.00 fully installed. That still remains a considerable barrier for many households in developing countries. So the ability to still go zero percent down payment on a system like that is still quite attractive and could really help unlock significant rooftop solar potential in major markets, major cities, major urban and suburban areas throughout the developing world. Whether it's in Abuja, in Nigeria, Nairobi, in Kenya or cities like Bangkok in Thailand there is tremendous potential for unlocking more distributed solar both on households and on businesses using these kinds of business models even if they have peaked in major markets like in the US as we saw a moment ago.

Another key reason why these emerging markets are particularly promising is that it's often difficult for small households to obtain bank loans to finance solar. The banks often don't understand solar, don't have time and don't allocate resources to or sufficient resources to actually finance these kinds of projects. So that's another really key barrier that can be solved by these new business models. Cost reductions are also making it possible for solar to undercut utility rates even in emerging markets where often retail electricity prices are quite a bit lower, not always, but quite a bit lower on average than rates say in Europe. So that's another factor is now it's possible even there to undercut retail prices. And there may be fewer tax incentives in place which may make it even more attractive to go with a business model that can offer to you on a retail price minus x basis where you get a cheaper rate and you can just lock up, lock in solar right away.

And the final point is that there's a fairly, remains a fairly low level of awareness of the potential of solar in many emerging countries and this points to significant potential for growth and further development there where there, again, there is so much untapped potential and also where the level of awareness stands to grow.

Some main regulatory risks that these businesses face. There are four major structural changes here that can significantly impact the market. One of them is the introduction of fixed charges or other levies on solar customers. We've seen this happen in some jurisdictions and it can help—it can contribute to cooling the market very rapidly. Changes in net metering or other self-consumption regulations, changes in tax laws obviously and changes in electricity market design or regulation. All of these can have a significant role and they remain important risks that any investor, any developer, any household who is interested in going solar via a business model like this, that they should be mindful of.

The key final point is that governments who are keen to support the emergence of these new business models need to focus on providing a supportive enabling environment. This goes back to the point I made at the

outset around the importance of thinking of this as an ecosystem, looking at the legal framework, at the tax framework, at the electricity market rules and trying to provide a holistic policy and regulatory environment that enables people to go solar. And I think the more, the cheaper solar gets—and it can costs continue to come down, the more potential there is to unlock this tremendous market opportunity via these new business models.

So as I pointed out at the outset this was part one of a two part series and the next component or the next lecture in the series will take a closer look at how these business models in the solar sector in particular are impacting the traditional utility sector. Thank you very much for your time and I look forward to seeing you around next time.

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