

Corporate Solar PV Adoption: Case Studies from Developing Countries

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Webinar Presenter

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Toby Couture Welcome to the International Solar Alliance Expert Training Course. This is Session 12 of this training series, focused specifically on the topic of corporate solar PV adoption, or what is sometimes referred to corporate PPAs. This webinar series is part of a collaboration between the International Solar Alliance and the Clean Energy Solutions Center. And this training module is part of Module 2, which is focusing specifically on policies for large scale PV. The issue, as I highlighted at the outset, is specifically on corporate adoption of solar PV, in other words when companies themselves procure solar power to meet their own company electricity needs. A quick overview of the presentation: We'll look at the learning objective—that would be the core of the presentation, followed by a few concluding remarks. I've picked out some further reading for those of you interested in diving more deeply into this topic. And at the end we'll have a knowledge check to check whether you've been paying attention. So first, the learning objective is ultimately to understand the rise of corporate PPAs, understand how they work, and what are the main drivers behind them; to understand where they're currently being used in jurisdictions around the world; as well as to understand some of the advantages and challenges associated with them. So, let's dive in.

A growing share of renewable energy investments worldwide are being bought by large companies, or being purchased to meet company-specific electricity needs. This is a major component of current renewable energy investment worldwide, and it continues to grow. Hundreds of companies around the world, including some of the biggest names and some of the biggest power consumers in the world, are starting to look at buying renewable energy under a range of different contracting models and platforms, and it's really starting to shake up ultimately the renewable energy investment landscape, but also in many ways the renewable energy industry

more broadly. In the first ten months of 2008, there were just under 5 gigawatts of deals announced in the US alone, and the US remains one of the most important markets for corporate PPAs. It's also where the market really took off, with companies starting to procure their own renewables in a range of different configurations, and we'll have a closer look at that, and look at some of the ways that these different deals have been structured, as well as what some of the trends in the market look like. The focus of the presentation is particularly on the rise of corporate PPAs, but also on the rise in developing countries, so we'll look at some examples of corporate PPAs for projects that have been developed in regions outside the major markets, outside of Europe and North America and China. And there's some interesting developments happening, so it is turning into very much a global conversation, and this is very much part of a broader global trend. What we're seeing is it's particularly being adopted and pursued by tech companies and others that have large power demand. There's also mining companies, a lot of your resource-extractive companies, materials companies. But in particular the ones that have gathered the most headlines, beyond sort of mining and materials, have been the larger tech companies that hold and have large data centers, large-scale retail operations. In some cases larger companies, larger retail companies, clothing companies, overseas manufacturing companies are starting to develop their own renewable energy, and we're seeing a growing amount of innovation and also a growing amount of interest in this space. So this is a very timely topic to be looking at at this stage. Ultimately, corporate sourcing enables companies to meet their environmental and CSR commitments by directly purchasing renewable energy. So CSR refers to corporate social responsibility. As we'll see in a few slides, this is part of a broader movement which is now increasingly referred to as environmental and social governance, a broader umbrella looking at how companies are behaving, looking at how companies are acting on the global stage; what kinds of commitments they're making trying to manage their carbon by developing carbon reduction plans; trying to also reduce emissions in other sectors, in other areas. So we're seeing a wide range of companies really taking the lead on this and using traditional CSR or environmental and social governance arguments to bring their boards on board, so to speak, in committing to renewable energy purchases. Ultimately for companies there's a number of layers of decision making that need to go into making a particular decision for a particular wind or solar or other renewable energy project, and the devil is always in the details. So for an individual company to make a particular decision, a particular investment, in some cases we're talking quite large investments—hundreds of millions of dollars. It often needs broad-based support within the company, and it needs approval pretty well all the way up to the top of the company, and often even at the board level. So this is major part of the conversation across many corporate tables around the world. In many cases, PPAs like these, corporate PPAs, can offer valuable cost savings over traditional utility purchases, and that's really one of the key factors here. If a company, whether it's an Apple or a Google or a Walmart, can develop renewable energy themselves, in a range of different configurations, and reduce their overall power costs, then there's a strong rationale for a growing number of companies to do so. Because they don't need to be purchasing that electricity from the utility if there are other

independent power producers who can produce that power at a similar or even lower price. Or if they can even invest in it themselves, as we're seeing some of the larger tech companies do, effectively owning the renewable energy project themselves, that provides another pathway through which this can happen and be scaled. So the underlying driver behind this really comes down to economics, and there's a number of other arguments, as we've mentioned, around CSR and ESG commitments, but the real driver here is fundamentally about the economics. Technologies like solar are becoming cheap enough to undercut traditional utility-based power supply on price, and that's a really key catalyst for this market. Although there are a number of different models occurring around the world, the self-consumption model remains currently the most frequently used and the largest, though that's likely going to shift in the years ahead as we see more and more corporate PPAs in particular emerging.

So in this presentation I've been referring to corporate PPAs, and corporate PV adoption, and what we'll talk about in a moment as corporate sourcing of renewables, as effectively synonymous. Now, it's important to keep in mind that they're not exactly synonymous. Corporate sourcing, for example, refers to the broader range of contracting options that a company would have to procure its own renewables, whereas a corporate PPA is really a contract signed with a third party for power supply or the environmental attributes of that renewable energy project. And we'll unpack this a little bit more, but just to clarify the linguistics side of this, there are a number of different terms, and I'll be using some of these terms interchangeably over the course of the presentation. So let's look at these four different options. This is from a recent IRENA report that provides a great overview of the state of the market for corporate purchases of renewables. The first tier is unbundled, what IRENA refers to here as energy attribute certificates. I find that terminology, and many others in the industry find that terminology, a bit of a mouthful. Traditionally these are known as RECs, or renewable energy certificates, sometimes tradable green certificates in the European context. But the way they've most frequently been referred to is RECs, at least in the English-speaking world. These unbundled energy attribute certifications are designed—at least the term is designed—to capture all of these different things, namely RECs, tradable green certificates, guarantees of origin, as well as other forms of certificate-based renewable energy schemes and policies. So how those work is, you effectively have a company, and you can see this loosely sketched out. A company signs a contract with a particular, say, wind farm or solar project, and they purchase effectively the renewable energy attributes of that project without physically buying the power. In other words, the power can be sold to the utility unbundled from the renewable energy attributes. The way this is often described is when you're, let's just say, a large solar farm, you are producing two different products: electricity and renewable energy certificates, or EACs in this case. You can sell electricity to your utility; you can sell it on to the wholesale market; you can sell it on to a third party who is buying—an offtaker who's buying that power, say another large company. And the same goes for the attributes. Those are the renewable energy or the clean energy attributes of that power. And those can be purchased separately from the electricity. It's often, at least in the North

American context, referred to as the voluntary green power market, because it's largely based on voluntary contributions or voluntary commitments from companies to buy up the renewable energy attributes and thereby be able to brand themselves as a green, as a sustainable, as a progressive company on environmental issues.

Now, that component of the market is still a major part of the market. We won't focus on it as much in this presentation, but I do want to underscore that this is a significant market in its own right, and I've provided a couple of sources at the end in the further reading that look more closely at this particular industry in this particular market. The second one is more the core of what we're focusing on in this presentation, which is power purchase agreements. In this model, a company enters into a contract with an independent power producer, a utility, or an investment firm, and commits to purchasing a specific amount of renewable energy or the output from a specific project at an agreed price for an agreed amount of time. So it has all the characteristics of the classic power purchase agreement, it's just signed by a company. The company is the buyer, rather than a utility, which is how it's traditionally been. So in that sense, large customers like corporates, like the large companies, can become offtakers in their own right. They become buyers of the generation and can effectively compete with the utility for purchasing that renewables. The third is renewable energy offerings that come from utilities or other electricity suppliers. There are a number of utilities that offer green power programs that effectively offer a tailored renewable electricity contract. In some cases these are referred to as green tariffs. The utility effectively under this one is the main point of contact. It is the intermediary. It buys the renewables, and it wheels that power on to the end user, in this case the corporate that buys it under a special tariff category. So the end user, the company, can buy that power effectively from the utility, still claim all the benefits, but the utility remains, again, front and center in the whole transaction. That's in contrast, in a way, to the corporate PPAs, where the company is more in the foreground. They are the main actor buying the power. They may still be, in most cases, using the utility's wires, the utility's transmission lines, but they are the primary offtaker. It's important to underscore as well that many of these projects that are being financed—large solar projects, large wind projects—may have more than one offtaker. They may be partial contracts that don't cover the entire output of the facility; it may only cover a portion of the output of the facility, or a specific amount of electricity based on the company's actual annual electricity demand. So again, there are different contracting configurations here that are emerging to adapt to companies' different priorities and different needs. And the fourth is production for self-consumption. Ultimately this is the prosumer market. This is where a company or large corporation invests in renewable energy directly, often on site or near site, and uses that power for its own operations. In most cases this involves solar power, although there are a number of instances in the US and elsewhere where wind power is starting to be invested in in this way, as well. Under this approach, we're seeing many different companies with large retail footprints: Ikea, Kohls, Walmart, and some of the bigger shopping malls, large manufacturing facilities. There's a project we'll look at later on from Vietnam by Adidas to develop a large 6 or 7 megawatt

PV project on its facility in Vietnam. So we're seeing companies starting to do that, to supply the primary electricity demand of their operations, and that's another piece of the puzzle here that falls under corporate procurement of renewables. The difference with the fourth is that it's mostly in-house. There are cases under self-consumption where the engineering work, the actual construction and operation of the solar project for instance, will be done by a third party, by a professional solar services company, and that provides a pathway for the company then to sign a contract with them. But the electricity never leaves the company's premises, so to speak. It's not entering the transmission wires of the utility or the neighboring current system. It's a direct on-site purchase.

A hundred and eleven companies worldwide currently are estimated by IRENA to meet between 85 and 100 percent of their power needs with renewable energies, and this number is growing rapidly. So you see a snapshot of how this market breaks down, drawing on the same distinction from the previous slide of EACs, the PPA market, utility programs, and self-consumption. So self-consumption remains the largest at 165 terawatt hours of supply in 2018, followed by the REC market, the unbundled renewable energy attributes, and then corporate PPAs, and the fourth is utility green procurement programs. So you get a sense of the order of magnitudes here. Four hundred and sixty-five terawatt hours is quite a lot of electricity. That's comparable to the electricity supply of a major European country like Germany, France, or Spain—a little bit less, but in that ballpark. And you can see here that given that the market is still relatively new, this is a fairly substantial development, and we'll start to see why in a moment. This chart provides a good overview of some of the main companies, as well as the industries that they come from. If you look across the sectors, materials companies—that means largely extractive companies—are currently the largest corporate sources of renewables. And you can see a couple key examples here: Rio Tinto, Vale, Norsk Hydro. These are really some of the biggest current companies procuring renewables. In the other sectors you see Volkswagen there, Deutsche Bahn, Alphabet, a parent company of Google. Some of these names are not doubt familiar to you, and it gives you a sense of some of the players, and also where they stand on the spectrum, so in terms of the share of renewables, but also on the X axis in terms of how much actual electricity that is and that represents.

So is this a big deal? That's perhaps the most obvious and straightforward question. I mentioned 465 terawatt hours is a fairly substantial amount of electricity, but why is the corporate uptake of renewables such a big deal? And I argue here, yes, this is indeed a big deal, primarily because companies in the commercial and industrial sectors worldwide represent an estimated two-thirds of total global electricity consumption. So this is a major potential industry. And of course companies can become greener, can become more renewable by continuing to buy from their utilities, which are themselves becoming more renewable in the process by procuring their own renewables or by meeting their own renewable energy targets. This really shifts the market to a different place, where the actual investment is no longer dictated or driven even by the utility, or even by policy makers or by governments. It's

driven by companies making a decision on the basis of a host of different drivers, which we'll look at more closely in a moment, to invest in renewables. And given the share of the market they represent, this is really a very significant and important shift indeed. So corporate sourcing can take a number of different shapes. It refers to, on the one hand, and the first option here, directly purchasing that power from a third party. So an independent power producer via a real PPA—in other words, a power purchase agreement that actually includes the transfer of electricity—or a virtual one. A virtual PPA, as we'll see a little bit later in the presentation, is a PPA that involves no transaction of electrons. In other words, it's just a financial agreement. The power goes into the system, and the buyer, the offtaker, is buying notionally that power, but it's not a direct delivery in the classic or traditional sense. The second is through the output of an on-site renewable energy project, so a self-consumption or own use—that's what we saw earlier in the prosumer market. The third through the utility, as we saw, or fourth, through the purchase of attributes. So you can see each of these effectively mirror the four options that we looked at earlier, each of which had their own unique characteristics.

Now, let's look at some of the main drivers. As I highlighted a moment ago, the main priority in most cases is fundamentally coming down to economics. For companies, the first priority is reducing power costs. We've seen around the world in a number of key markets, not only here in Germany but also in countries like South Africa, the Philippines, across Southeast Asia, parts of Latin America—power rates are going up rapidly, and often hitting companies and corporates in particular quite heavily. This provides a further impetus to invest in renewables. As renewables become increasingly cheap, and as new contracting mechanisms open up or emerge to enable companies to easily, in a fairly low-friction way, invest in a renewable energy project that's going to save them money, we're going to see more of this happening, because the economics, again, are there. Now, it's not all about economics. There's a number of secondary priorities that enter into the picture, of which I've listed a few here. Some companies have company-specific emissions-reduction targets as part of the climate agreements. Improving environmental performance—a growing number of companies see improving environmental performance as just another component or another part of good corporate governance. In other words, it's not just environmental governance; it's a sign that the company itself is well managed and is paying attention to its overall impact and footprint in the world. The third, delivering on ESG goals, as we discussed at the outset. In some cases it enables a company to invest in renewable energy off site, in other words on land that's not their own, as well as off balance sheet. So some companies don't have the capacity on their balance sheet to take on that kind of a liability, that kind of a scale of debt. For instance, if they want to invest in a large renewable energy project, and they would rather contract that with a third party who takes that own their own balance sheet. And then they just become a purchaser, so it's essentially part of their cost structure. Taking that off balance sheet has a number of advantages, and this is other really key driver here. Now, it's important to underscore that off balance sheet here doesn't necessarily mean shady in any way. An off-balance-sheet transaction is simply one that the company does not have the physical, the internal capacity, or the desire to have exact

directly on their assets and liabilities. Renewable energy PPAs may also provide tax, accounting or other advantages, particularly in the US, where all of this started. Tax regulations have played a very supportive role and have been a key part of catalyzing this market, and it enables companies to go directly invest in renewables without needing to go through the utility. So a lot of utilities looked at green purchasing programs, at green tariff programs, offered by the utilities—they look at them increasingly skeptically, because often those green power programs are priced at a premium. In other words, you have to pay more to have a renewable energy tariff bill in your electricity rate structure. So if you're buying a renewable package, you're paying more. Whereas the market is actually shifting, where you can start to do it cheaper on your own than the power the utility is providing. So the idea of a green premium tariff category that customers should pay more for is starting to be subverted and is starting to be flipped on its head. And I suspect we're going to see many of these green tariff programs change in the years ahead, as that reality asserts itself in the market, and as customers start to demand that the green option, the green tariff or green power option, actually become the cheaper option.

Another motivator here is obviously branding. For many companies using this, whether it's large clothing companies—Patagonia using renewable energy and the purchase of renewables as a branding strategy—is also gaining ground around the world. Here's a quick snapshot of some of the number of deals around the world taking place. You can see here from the deal tracker—This is from the Rocky Mountain Institute analysis; they've set up the Business of Renewables Center, the BRC that's been doing some tremendous work in this space, working with a lot of these key corporate players to support investment in renewables. And you can see how the market has grown, shrank again, and then grown, up to 2018. 2018 was a record-breaking year, and things continue to scale across the major players, and we're seeing more and more new players, in other words more and more new companies, enter into the market and start to express an interest in doing their own corporate PPAs. So let's look at this a little more closely. We've provided an overview generally of the market, the main forms, the main ways of contracting, and let's take a closer look at how this plays out. I mentioned earlier a real PPA, or what's sometimes called a classic PPA. This is the direct power purchase agreement similar to what utilities traditionally sign. This represents a part of the market and was really where the market started, but now we're seeing a growing number of companies move away from that model in favor of number two, the virtual power purchase agreement model. Under this approach, a financial contract is signed through which the electricity is only nominally purchased by the company, but is delivered over the utility's wires. So you can see here the financial contract effectively is the core of the agreement. It's not actually resulting in the transfer of electrons. The financial agreement enables the project to get financed. It provides the money required to invest in the initiative or in the project, but it's not directly purchasing the power in the sense of a classic PPA. The third option is the prosumer model, where the project is located on or near the facility and serves on-site load. This is sometimes referred to as the self-consumption model, as well. Now, classic PPAs typically involved a 5- to 25-year offtake

contract, signed for all of a project's output. That's sort of the standard form. They involve the actual exchange of electricity between a buyer and a seller. So in the past this was a utility in most cases buying the power from an independent power producer. Direct PPAs can contract with a specific wind or solar project, and a contract like that, like a PPA, enables the developer to obtain financing, so they can say, "Listen, I have a buyer for this power. I'm going to produce power, sell it to them for this price over this duration." And the bank will unlock the financing and enable the project to be built. In these cases, the corporate buyer becomes the sole offtaker. In other words, they become the buyer of that real electricity that's being transmitted. In competitive electricity markets, the corporate buyer typically pays a fixed price in exchange for the spot market revenue derived from electricity sales, so we're seeing different contracting forms that the classic PPA already starting to emerge. The buyer typically receives, then, the renewable energy certificates, or the EACs. Contract duration, as I pointed out at the outset, ranges from 5 to 25 years. That's sort of the classic corporate PPA model. In contrast to a PPA, the duration is typically shorter. There are very few companies signing PPAs for as long as 25 years. What we're seeing is many more contracts signed in the 5-, 10-, 12-year time frame, and then with a flexible, open-ended option after that duration to either continue extending the contract to purchase the power, or the producer, the developer, would then have to sell that power on to someone else, or on to the spot market in that given electricity market. So this provides you a visual, stepping away from just text for a moment, and looking at this plays out in visual terms. You can see here that the wind project sells its RECs to the corporate buyer. It sells, in this case, the electricity to the utility wires, and the utility then passes that electricity on, effectively on to the corporate buyer through their transmission system. There are corporate PPAs that involve a direct purchase not only of the RECs but also of the electricity. That's more common with larger facilities, where there's a direct wire, a dedicated wire that actually supplies that. But given the difficulty of doing that in many markets, including the costs of doing that, it's more common for corporate PPAs to be structured this way, where they sell the power to the utility and sell the RECs to the corporate buyer.

Now, partly because of some of those issues and some of those realities, we've seen the emergence of what are called virtual PPAs, or sometimes referred to as synthetic PPAs. These are financial instruments that can help create a bankable investment without relying on the actual exchange of electricity. So a virtual PPA involves a clear price, or a price schedule, as well as a clear contract term. It's often shorter than real PPAs, five to ten years, with the supplier, the producer taking merchant risk thereafter. Virtual PPAs involve signing essentially a financial contract that's primarily based on the purchase of RECs, not electricity. In other words, you're buying the attributes, not the power, and basing the transaction on that. All of this comes back to the distinction we set out at the beginning between the two products produced by a wind farm or solar farm: electricity and renewable attributes. And those two different products can be sold and transacted in different ways. So this picks up on that distinction and enables a new business model to emerge on the back of it. This sketch provides an overview of how this works in

practice. You can see here—let's start with the wind farm in the middle. The RECs are sold to the corporate buyer. The corporate buyer pays a fixed price to the renewable developer. The electricity still goes to the wires, and the utility then sells it on. The grid electricity mix on the bottom is then also transacted. It effectively goes through the system, and the corporate buyer will buy the electricity, in this case from the utility, as they had in the past. So the utility remains the source of the actual electrons. The renewable project becomes the source of the renewable certificates.

Let's try to unpack that a little bit further. In this depiction you can see here the renewable generator sells its electricity on to the spot market and settles the price based on the difference between the variable market price and the strike price with the company who receives the renewable energy certificates, in this case. So there are different ways of structuring this. This particular depiction comes from the same IRENA report that I summarized in the beginning. You can see here the same basic logic. Wind farm sells to the utility; the utility provides power ultimately to the company; and there's a contract between the company and the wind farm for the attributes. So a synthetic or virtual PPA is really built on the secondary attributes. Now, why would a company do a virtual PPA instead of a real one? Well, as we pointed out, in many cases the wires don't belong to the project developer, so the project developer has to evacuate that power. They have to push that power on to an electricity system. And if the site is not directly next to the facility being supplied, it's helpful, if not necessary, to actually use the utility's wires to wheel that power. A company's load—another key reason here, a key driver—is that the company's actual electricity load may not be sufficiently high seven days a week, 365 days a year, to buy all of the power produced by that facility themselves. So by signing a contract for the renewable supply, they don't need to worry about the real minute-by-minute wind power or solar power output; they just buy the aggregate production of that facility basically on what they produce on an annual basis. So if you're producing 35 gigawatt hours per year, you're buying 35 gigawatt hours of electricity, and that's that. The customer, the corporate, is not responsible for buying those exact kilowatt hours, or those exact electrons, in real time. The utility in this configuration is responsible for the balancing. They need to integrate that power; they need to sell it on into the system, and take care of the integration component. Let's just unpack that a little bit more. As you can see here, a company for example may have—one of the issues is they may not be open on Sundays, for example, or on public holidays. But just because it's a public holiday, or just because it's a weekend, it doesn't mean the solar project isn't producing electricity. So if you sign a classic PPA as a company, you run the risk that on those very sunny Sundays, or on those public holidays when your electricity load is quite low, that you're not able to take on all of that power. So you end up losing, effectively, that solar electricity. That's one advantage of wheeling it through the utility's wires and signing a virtual PPA instead, where the utility can effectively manage it and supply that power on to other customers if the on-site load isn't high enough to purchase it. Another concern and another reason why virtual PPAs are becoming increasingly popular is that it's unclear whether the company will exist as long as the wind or solar project. Now, in many cases wind and solar projects can last 20, 25 years, in

some cases even longer, and it's not clear that companies are going to exist that long when signing the contract, so virtual PPAs offer more security in that sense, without committing—the company doesn't need to be the only offtaker.

For the developer, they then know that if the company goes bankrupt, they can find another buyer for the power. So it decouples that issue. Virtual PPAs also offer more siting flexibility. So if you're signing a real PPA with a real project that has to be directly supplied on your roof or near your premises into your building, you're limited in terms of how big your facility can be. Often the roof space is limited, or the land is limited. You're also limited, obviously, in terms of what technologies you can build. The best wind resources may not be just outside of the supermarket, shopping center, or other large facility, manufacturing site, industry, mining facility. The best resources may be a little bit further away. So you may want to build that project a bit further away and have the power exported to the utility instead of directly wiring it to your facility. And finally, it may offer additional accounting and tax advantages. I don't want to get into all of those issues, but there's an active case to be made that in some cases, for some companies, it can be advantageous to structure the PPA this way. Now, what about if more companies have that sunny Sunday problem that we talked about a moment ago, or the holidays problem, and they want to diversify their risk. They would like to invest in a particular project, but they're scared of not being able to buy all of it at once, or there being inefficiencies, or they don't want to take on the risk of being the sole offtaker, the only buyer of the energy from that project. In that case, it's possible to bundle together as a group of companies.

Now, obviously there's higher transaction costs, higher due diligence costs, but there's—A good example of this recently was developed in the Netherlands. I've provided the link to you, here at the bottom, that shows how such a consortium model, or an aggregated corporate PPA, can work. And we may see more of those in the years ahead, as the market matures further. Yet another term here to add into the lexicon is what's called a sleeved PPA, so this is where effectively power is sold to a company via the utility's wires. So it's a term to capture what we've been talking about in the earlier examples, but instead of it being the RECs that are being sold, it's the actual electricity. At least in this case, the aim is to make it a physical sale. So if you think of your arm going into the sleeve of your shirt, the same basic principle—the electricity is sleeved through the utility's wires and passed on to the business on the other end. Now, under this configuration you can have a direct contract, a direct PPA, for the purchase of the power, and you pay typically a wheeling fee to the producer, to the generator of that electricity, be it a wind farm, a solar project, or other. So the utility gets a bit of revenue from the use of the wires, and the project developer doesn't have to worry about having to build new or unnecessary or additional transmission and distribution infrastructure. So all of that said—a lot of terminology, a lot of innovation—as you can see, it's still a fairly dynamic and fairly new market, so things are very much changing rapidly. Let's take a look at a few quick trends. For one, the corporate PPA is spreading rapidly from the US to markets around the world. So we're seeing corporate PPAs emerging in places around the world,

from Africa, Latin America, Asia, as well as here in Europe. We're also seeing a trend, as I pointed out, away from physical PPAs towards virtual PPAs, and again, there's a number of reasons for that. We don't need to unpack all of that, but we've looked at a few of the arguments. Suffice to say for the time being, virtual PPAs are becoming more common. In the US, "unbundled RECs, in other words just the renewable attributes, have long been the workhorse of the voluntary market, but are slowly being overtaken by direct PPAs –" in this case direct or virtual PPAs. That is a quote from a recent NREL report, or an author of an NREL report, cited here. And you can see that the voluntary market, which is what this corporate renewables market was long called, is really starting to shift. As the economics become increasingly attractive, a growing number of companies are starting to do this themselves, and take an interest in not only buying the renewable's attributes, but also actually buying the power, or investing in projects and owning, in some cases, projects themselves. So again, this signals a fairly significant shift in the renewable energy industry.

Now, let's take a look at some examples from around the world before we wrap up. Although Europe remains the largest market in 2018, this is likely to change as Asia grows. So you can see here the number of companies that are starting to invest in corporate renewables, and how those numbers play out across Europe, Asia, North America, Oceania—so that's broadly Asia Pacific, beyond continental Asia—Latin America and the Caribbean, as well as Africa. So pretty well around the world this is happening. Now looking at some of the number of companies, as well as the share of the companies, seeing this is based on survey data compiled by IRENA. The percentages here show the share of companies in those countries actively sourcing renewable electricity, and you can see here how this plays out. So the US, Japan, UK, and so on—a very, very diverse space. Now, in terms of sectors, as we pointed out, materials are the largest single corporate buyer of renewables, partly because they're such a huge electricity consumer, but also because they're one of the ones that are most sensitive to energy input costs. So mining companies, large extractive companies, large materials companies, have really been on the vanguard here. IT companies are a growing share, and we're also seeing a number of others across the landscape. And as we saw a few moments ago, corporate sourcing is also starting to spread globally. So in Brazil, retail prices increased rapidly in 2015. In Argentina, companies now face renewable energy quotas, rising from 8 percent in 2015 up to 25 percent in 2025. So we see here a renewable energy target that's effectively imposed on companies, not just on utilities, so that's really driving a number of companies in Argentina to have to look very seriously at purchasing renewables, and growing the share of renewables in their total electricity demand. In Mexico, a very similar story—lots of development happening, partly driven on the back of market liberalization, but also by rising power prices. In Chile, corporate PPAs are proving popular, in particular with mining companies. We're seeing quite a few of the larger companies there investing in solar, in particular, including solar CSP, or concentrating solar. In Vietnam, major manufacturers are starting to sign large solar PPAs as well, as we discussed briefly earlier. And in other parts of the world we're seeing, again, a very similar pattern. In India, rising retail prices for companies are

making corporate PPAs much more attractive than they were previously. In Jordan, a large cement company recently signed a 15 megawatt PPA for their own on-site supply. There's been push in Tunisia to do much the same with large cement companies. In Egypt a large ag company signed a PPA for 53 megawatts of solar PV. In Burkina Faso, so even in some of the lowest-income countries and some of the least-developed countries in the world, there are developments also starting to happen—mining companies signing, in this case, a 15 megawatt solar PV project to supply their facilities. And in Namibia, another large cement company recently signed a 5 megawatt PPA. So you can see, again, this trend is global, this trend is very dynamic, and we can expect a lot more of this to happen in the years ahead. So before jumping to questions, to your final questions at the end, let's look at a few concluding remarks. The positive news here is that corporate renewables can play a major role in accelerating the global energy transition, so there's a real opportunity here for companies to show leadership, and for companies to really demonstrate and put financial resources on the table to mobilize investment in renewables. And since companies, as we saw earlier, represent approximately two-thirds of global electricity consumptions, what companies do—in other words what kinds of electricity they purchase, from whom, and how—matters quite a lot. So this shift, again, it's a bit like plate tectonics. There's a real shift underground that's starting to happen and is redefining this sector.

Now, the key question that's emerging, and the final thought that I'd like to leave you with, is as renewables continue to decline in cost, and as we see a number of different contracting options available—from direct purchase of renewable attributes to real PPAs, virtual PPAs, sleeved PPAs—as these different contracting options emerge, if they can provide cheaper cost power, how can company executives and managers justify not jumping on the bandwagon and not procuring renewables? Or put differently, and this is potentially a sign of where things are going in the years ahead, is if corporate PPAs can provide proven cost savings for companies by reducing their energy costs, do executives even have a fiduciary responsibility to start corporate sourcing of renewables? In other words, as individuals entrusted with looking after the best interests of the company, particularly for shareholder companies, do they have a responsibility to actually shift in this direction and start investing in more renewables to push down overall power costs in the years ahead? And I think I would argue we're not there yet, but a number of executives do take this very seriously and are looking at a wide range of ways to improve performance, improve cost competitiveness, and improve overall marketing positioning and branding. And to the extent that renewables can deliver on those objectives, there's a pretty strong rationale, again driven by the underlying economics, to start investing directly in renewables. So as the economics shift and continue to shift in favor of solar, we could be seeing a major wave of corporate renewable deals sweeping the world in the years ahead. So the tables and charts that we saw looking at how things were developing and all the major players that are starting to emerge—I think looking at the underlying trends in the market, looking at the costs, the economics, I think it's safe to say that we're at the beginning of a very interesting and dynamic phase in renewable energy investment in the years ahead. So with that, thank you very much for paying attention, and for joining

and staying with us here through to the end of the presentation. As I pointed out, some further readings, a few key reports here that may be of interest: the IRENA report, a terrific piece put out by Rocky Mountain Institute; Baker McKenzie, an advisory and legal firm has put out two of these on the rise of corporate PPAs, another terrific resource; and a report here at the end by NREL researchers on trends in the voluntary green power market. All great reading. Again, this is a very exciting market, and it's been a pleasure to be with you here today and to present on this. On behalf of the International Solar Alliance and the Clean Energy Solutions Center, I wish you all a great day. Thank you very much.

And now we'll shift to the knowledge checkpoint. So a quick note on this—we'll have a few questions, and that'll follow directly after the webinar. Thank you very much.

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