

Deep Dive: New Business Models in the Solar Sector/Part 2: Traditional Utility Sector

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Webinar Panelists

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Toby Couture Good day, everyone, and welcome to this International Solar Alliance expert training course. This is the second part in a two-part series looking at new business models in the solar sector. This training series is supported by the International Solar Alliance, which is a group of solar resource-rich countries from around the world. The International Solar Alliance is partnered with the Clean Energy Solutions Center to deliver these expert training series. The focus of these trainings is to provide global overview of some of the cutting-edge topics in the solar sector.

And the Clean Energy Solutions Center is one of the leading agencies around the world in providing no-cost technical assistance and capacity-building support to governments around the world on clean energy policy. So, a quick overview of the training series. As I said, this is part two of this particular segment. The entire training module course is shown here, and you can see the eight different module components, ranging from policies for distributed PV to the technical integration of solar socioeconomic aspects, as well as off-grid solar and new emerging sectors in solar, such as the solar heating and cooling sector.

This module is found—this particular training is found as part of module one, and we saw last time, in part one of this training module, an overview of the different solar business models that have emerged in recent years to make it easier for customers and communities and individuals around the world to participate in developing their own solar projects, or owning their own solar projects. Part two of this particular training focuses specifically on how these new business models and these new changes in the electricity market are impacting the traditional utility business.

So, we'll take a slightly broader view than in the last—than in part one, where part one was really focused on the business models themselves, part two really takes a step back and looks at the bigger picture, and some of the bigger picture changes that are re-shaping the power sector, specifically with a focus on these new business models. So, here's a quick overview of the presentation. We'll look quickly at the overall learning objective. Part two looks at the history, provides a little bit more historical context so that all of you can understand where we're coming from and hopefully in an aim to get you to better understand where we're fundamentally going in the utility sector and in the solar sector more broadly.

The third component looks at—is essentially the core of the presentation, and then I'll have a few concluding remarks followed by a few suggestions for some additional reading, if you're interested in this topic. And the sixth component will be a quick knowledge check that has five multiple choice questions for you to answer as a bit of an assessment of your understanding of the training material. So, without further ado, let's dive in.

So, the core aim here is to really understand the broader, historical context for the development of the electricity market, the opening up of the electricity market that has led to these new business models being possible. This is part of a process that's sometimes called liberalization, or sometimes deregulation. We'll look at a little bit more about what that meant in practice, and why it's been so instrumental in enabling new business models to emerge. We'll look at some those, and how, specifically, these new business models and other trends that are reshaping the power sector are impacting different aspects of the system, and are ultimately changing the way that utilities provide electricity to customers, and also changing, fundamentally, the way that customers interact with utilities themselves.

And there's a lot of innovation happening in the space. It is impossible to capture all of the different trends and technologies that are emerging, as things are changing very quickly. But the aim of this presentation is to really give you a firm grasp of the magnitude of these changes, essentially what the main drivers are, and put you in a better position to help you understand how the solar sector is fundamentally reshaping, redefining, along with other technologies, the future of the utility sector. And we'll look at some key challenges going forward. So first, some history. As we often say, in order to know where you're going, you need to know where you're coming from.

And it's always helpful to take a historical perspective, to take a step back and look, okay, where did the power sector come from, and how did we get to where we are today? So, the traditional utility business model of selling essentially electrons to customers from large centralized power plants has effectively defined the 20th century. For most of the 20th century, customers were what we called captive. This means that customers did not have a choice. They had whichever region they happened to live in, there was one utility that was actually providing power.

You would have to connect with that utility, and that was effectively it. Captive customers connected to one monopoly utility had some advantages.

They provided the utilities themselves with fairly strong balance sheets, and made them very reliable, low-risk investments. And because they were seen broadly as low-risk investments, they were able to mobilize very large amounts of capital in order to support the further development of the electricity sector.

So, as that need for capital was recognized for low-risk, low-cost capital in particular, regulators effectively established a regulatory formula that varied between different jurisdictions, but broadly shared a lot of key characteristics. And the core characteristics enabled the essentially monopoly utilities to provide power to captive customers at regulated rates, and those rates were designed to allow for a specific, targeted rate of return. So, if utilities said, “Well, we spent this many billion on the transmission assets or distribution sector assets or generation assets, regulators would essentially approve whatever rate increases were needed in order to recover those investments.

So, the utility business was a good place to be. It was fairly low-risk, fairly predictable, fairly stable, and played a key role, ultimately, in driving the broader economic and social development of the second half, in particular, in the second half of the 20th century. So, utilities very rightly are proud of that history. And many utilities are uncomfortable with the changes that are taking place across the sector and all the technologies and the disruption taking place, because they see a lot of this change and this rapid particularly technological change and business model evolution disrupting their particular business model, and undermining their ability to continue to do what they’ve always done, which is provide power to customers at a reasonable price.

So, as the market has changed, so, too, have the technologies and the business models, as we’ll see. This diagram provides a quick overview of the key characteristics of the utility business model. You can see generation into transmission lines, through transformers; transmissions lines delivering up to distribution wires, and all the way to customers. This fairly linear model of power flow really was and in many countries remains the dominant mode of operation for the electricity sector.

And as I pointed out, utilities perception as a low-risk investment was a critical ingredient in this story. The fact that they could—that they were given the right, by regulators, to set electricity rates for customers that allowed them to recover their costs meant that they were effectively protected investments. They were almost providing a guaranteed rate of return. And investors, unsurprisingly, were willing, even glad, throughout the second half of the 20th century, to provide very large volumes of capital to the power sector to enable its growth and further development.

So, it’s important to understand how critically the inter-relationship between the—fundamentally between utility regulation and investment is. In order to mobilize the kinds of investments, the scale of investment that was needed, we needed stable regulatory conditions. And that’s one of the things that some analysts in this debate argue that we are currently losing. We are making the market in many ways riskier. We are making it more complex.

And that complexity combined with that risk is making it harder to mobilize the kind of capital, the level of capital that we need, in particular, to achieve broader objectives like reducing emissions, increasing the share of renewables, improving grid integration, and, where necessary, building out transmission and distribution lines. So, there's a deeper question in the backdrop of this presentation that I encourage you to keep in mind as we go through. And that debate is there are no easy answers. There are no simple solutions. But I encourage you to engage actively with that debate and keep that in mind as we go through the presentation.

So, this started to change around the 1970s. What I've been describing, essentially, as the agreement between regulators and utilities and, broadly, the politicians and the public at large, of providing stable, regulatory conditions so that utilities could mobilize capital to build out transmission and generation is what is sometimes called the utility consensus, or sometimes called even the regulatory compact. This is the idea that there was, essentially, a stable, relatively consensus-based agreement that the regulations should continue to enable monopoly utilities to operation in their current form.

So, the regulation effectively defined and supported, in some ways buttressed, the business model. It was a core part of the business model to have a regulatory framework that essentially was based around it. But this started to change, and we started to see some cracks in the foundation of the utility consensus in the 1970s, driven by a range of factors. So, I list a few here. One of these was rising fuel prices, which drove up electricity rates. As you no doubt know, there was the major oil crisis in the early 1970s that drove up the price of oil and the price of gas.

And this led to rising electricity rates. In some cases, very rapid increases in electricity rates, and started to change attitudes and research focus across the utility sector. People started looking more at things like energy efficiency. People started looking more at diversification, you know? Essentially starting to reduce reliance on fossil fuels, and we saw a lot of national policies emerge for the first time around this time in the 1970s against the backdrop of rising fuel prices.

And a core focus of national energy policy was, at the time, on the one hand to improve energy efficiency, and on the other, to diversify in order to diversity the mix, in order to improve energy security. The second key component here is the rise of distributed energy technologies. In the 1910s or 1920s, it wasn't possible for most people to—or most companies, even, to produce their own power. There were, of course, exceptions for larger industries and some manufacturing facilities, but for most customers, that remained out of reach, partly due to economies of scale and the state of technology.

This started to change around the 1970s and into the 1980s and the '90s as new technologies emerged that enabled, for the first time, power to be produced in a smaller, distributed way at a price that was competitive or roughly competitive with the cost of power provided by traditional utilities.

And that started shifting the balance of power effectively, slowly away from utilities and more towards new technologies and new companies active in the sector. So, this change has taken time.

The third key point here is changing financial market conditions. In the 1970s and early 1980s, interest rates rose very rapidly, which led to several bankruptcies of major utilities and a lot of issues in the utilities sector, because they had borrowed too much, had taken on too much debt, and were unable in a short period of time to recover the cost from rates in order to enable them to pay back those debts, and led to a range of wrenching changes throughout the power sector, as well as a range of other sectors at the time.

The fourth component here that's sometimes underappreciated in the whole debate is there were clear cases of utility mismanagement, where utilities, as some argue, effectively abused their monopoly position, and made investments that were deemed in regulatory speak as imprudent. They were investments that were not arguably in the public interest, or that incurred a higher cost than were justified, or they built excess capacity. In other words, the forecasts on which those new generation projects, in particular, were based proved to be over optimistic. And because they were over optimistic, it led to essentially excess generation capacity at a period in time where electricity demand growth was actually slowing. And that meant that effectively they had over invested, and needed to, then, scale things back.

And the final point here is precisely the impact of lower electricity demand growth, which was driven, in part, by improvements in energy efficiency, but catalyzed critically here by the first point, or the first bullet on this list, namely by rising fuel prices. As price went up, customers started to become more fuel conscious or price-conscious, and that led to greater efforts to conserve energy.

So, this flux of different factors led to what's sometimes called the perfect storm. And this perfect storm drove a number of shifts in the way that utilities are regulated. Regulators started to want to favor more competition to encourage more actors to participate in the market, and fundamentally driven by the desire to create a more open and ideally cost-effective electricity system, where a greater number of investors and actors could participate. Now, the challenge with the perfect storm, that the perfect storm effectively responds to is all these factors in the 1970s and early 1980s that were taking place at the time.

A key part of this, as we saw in the last slide, is that small-scale generation became increasingly cost effective. Not only wind turbines in countries like Denmark and in parts of California, but also the natural gas turbine, which really had a significant role to play in the redefining economics of the utility business, and transforming, essentially, the traditional logic of economies of scale, that it was always cheaper to build ever-larger power plants. And the emergence of these new technologies subverted that traditional wisdom, that it was always more economic to build larger and larger plants. We started to see technologies that for the first time were actually at a fairly small scale comparatively, but could still provide cost-effective power to customers.

So there were a few regulatory steps that helped drive this change. We had—not all of them are listed here. This is—the aim is to provide a highlight of some of the changes that took place. First, electricity markets were opened up to competition, in particular to retail competition. So, that enabled customers to choose their supplier. If you were based in a geographic area, you were no longer forced to buy power from a particular utility. You were, for the first time, given choice. This choice was first opened up for industrial customers, some of whom had maintained that privilege, even before the utility consensus was consolidated, and then eventually for commercial and residential customers.

And we're still seeing this shift underway now, particularly in the US and in certain parts of Europe, gradually are opening up the potential for residential customers also to get retail choice. So, retail choice is a critical part of this because it enables customers, for the first time, to actually make an informed decision about who's going to supply their power. And that further helps fuel competition in the sector and innovation in the sector, because it means there are—that companies with a different business model or with a different approach to the market, or with a leaner overall capital structure can provide a cheaper service for customers, and ultimately gain market share.

The second point is that regulators helped drive what's sometimes called fund bundling of transmission, distribution, generation, and customer service. So, a number of utilities in this de-regulatory drive or liberalization drive unbundled the ownership of the different components of the power system. So, it was no longer possible, in certain cases, to own both transmission and generation. Those two had to be split up into separate entities. And, again, these changes are underway, continue to unfold in a number of different markets, in just about every market in the world.

So, different, although the drive to liberalization that we're essentially providing a crash course view of here started in countries like the UK and the US and spread out gradually to other jurisdictions around the world, to continental Europe, to parts of Asia, to parts of the Americas, and even parts of Africa. But again, it's important not to forget that many utility markets around the world remain under effectively the utility consensus. They remain regulated as essentially monopoly suppliers. So, different jurisdictions are at different points of this evolution.

And that's one of the reasons why we see more innovation in business models, more innovation in dumb technology into the business in certain jurisdictions, precisely because these rules opening up the market have enabled these innovations to emerge there. They've created new opportunities, new niches that actors in the market could capitalize on. So, again, you see the critical role played by regulation in opening up these new niches, and driving innovation and change in the sector.

This understanding of regulation is different from what many people and many of you no doubt think when you think regulation. In many cases, it's about protecting the status quo or preserving the status quo or enforcing certain standards. But it's also important not to forget that regulation can also

play a very—have a very catalytic role in driving technological and business model evolution. And the power sector is a terrific case of precisely that.

A third component here is the role of independent power producers. Regulation started to introduce rules that allowed independent producers to participate, and one of the signature initiatives to do this was launched in the US in the late 1970s under what is called PURPA, the Public Utilities Regulatory Policies Act. And under PURPA, the specific mandate was introduced that utilities had to consider and in some cases were required to purchase power from independent producers at their avoided costs.

So, in other words, if another business out there, another business model, another investor, could produce power for cheaper than the utility could itself, the utility effectively was required to purchase it at their avoided cost. And that really drove, effectively, cracked open the previously-monopolized generation business, and the previously-monopolized utility business. And, again, opened the door to all of these different business models to emerge in the decades that would follow.

So, a few examples here, solar leasing, which we saw in part one, peer-to-peer operators, which are starting to emerge in places like Australia and the UK where power can be exchanged between different users, different customers. Pure retailers that buy, effectively power on a wholesale market and own no generation themselves, they're just intermediators, and in some cases pure play transmission operators that just own transmission. So, all of these and other business models started to emerge in the decades that would follow after these reforms were introduced.

So, you can see here the traditional model of the vertically-integrated utility broken into its four constituent parts. Unbundling or sometimes called liberalization led to a legal separation between these different entities. There are many nuances to the way this was implanted in different jurisdictions, but this is the core differentiation. One of the key challenges, however, was that although the market was opened up to all these new business models and triggered a whole range of changes to electricity markets, it left the utilities, traditional utilities that had dominated the power sector for much of the 20th century, with a fundamental question—which path to take?

And in many cases, even to this day, many utilities are still trying to answer that fundamental question. How do I go forward? How do I diversify? What are the right strategic pathways to restructure our business in this new environment? And the challenge is, as with many things in life, there are often far more than two paths to follow. Life would be easy if it was only a matter of binary choices. Do I go left or do I go right? If I take this option or that option, the truth is, there is if not an infinite number certainly a very large number of different pathways that utilities can follow in adapting to this new landscape.

And that's one of the aspects that we're going to cover in more depth in this presentation. So, if liberalization, previously, from the 1970s, '80s, and '90s was about unbundling the power sector, now we're looking beyond the 2010s

into the 2020s at a potentially much more decentralized power system, similar to the one you see sketched out here. You can see at the bottom right corner, that's the role of centralized power plants, which remain one important node in the system, but by no means the only one.

And you can see the role of smarter networks, the role of renewable technologies, the role of prosumers, or customers that are both consuming from the power grid as well as injecting power back into the grid. So, a much more dynamic and much more interactive and much more complex and multi-layered business environment than was the case throughout much of the 20th century. And this, many would argue, is fundamentally where things are trending.

So, let's shift now to taking a closer look at how these new utility business models are changing the sector. Simply put, there's a deeper transition underway between the traditional or the old utility model and these emerging utility models. There's no utility that embodies all of these changes, but all utilities that are in these new environments, in these new regulatory and business model environments are adopting some of these changes.

So, under the old utility model, customers were charged effectively on a per kilowatt hour basis for their supply. Customers owned everything behind the meter, so all of their appliances effectively belonged to the customer. The utility relationship started at the meter. The customer has little visibility under the old model over their costs. They effectively just get a bill, sometimes one that's broken down into different components, and they have to pay that bill. The only choice the customers basically have is which appliances they buy, and which rate category they fall into, if they're eligible to apply for different rate categories.

And utilities effectively own all the transmission and distribution infrastructure under this traditional model own and operate all generation. Now, in the emerging business models, in the emerging utility models, we're starting to see a number of shifts. Customers are being charged on the basis of their service level rather than just on the bulk amount of kilowatt hours they consume. In some cases, utilities are starting to own or even finance a portion of customers' own on-site equipment. So, we're seeing utilities in some cases directly owning hot water heaters, in some cases air conditioning units, major cooling units, different energy management analytics software and analytics tools, data gathering tools on the customers' premises.

This is particularly the case for commercial and industrial customers, but it's possible now for utilities to own some of those things, even though those technologies and those services are actually found on the users' premises. And in some cases the appliances can even be controlled by the utility. It's no longer the case that the customer is the only one who can flick on their air conditioning unit, their cooler, their heater. The utility can remotely control certain appliances. Like, of course, with the customer's permission, often by the use of algorithms and different smart technologies.

So, you're seeing a shift, essentially a blurring of the lines between what belongs to the customer and what belongs, fundamentally, to the utility as these new business models penetrate more deeply into the home and business of their customers. Customers also have more transparency, increasingly, over the costs of the system, and also are provided with a much wider range of choices. They can choose which utility they want to buy their power from. They can choose often a range of different rate categories, a range of different functionalities.

They can join different programs that are available by the utility or by other third parties. They also have transparency through the use of apps an online energy data or energy management software. So, households can now and businesses can now see in real time their power consumption and essentially manage their demand and manage their real-time use in response to things like price signals and then other factors. This is a very different world than the traditional utility world of the 1950s, '60s, and '70.

And we're seeing more ownership structures for—in some cases for transmission and distribution. We're also seeing a much wider range of actors participating, almost at every node within the utility system, including, most notably, on the customer end. So, that's a quick synthesis of some of the big changes and some of the big differences between traditional utility business models and what we're now starting to see happen.

As a result of this and of these ongoing changes, we're seeing a whole taxonomy of different utility business models emerging. Some of these terms may not be familiar to me, and they are, some of them have only recently been coined. They outline and refer to different kinds of utilities that are either in existence or that are in the process of emerging in different jurisdictions in the world. We won't get into all of these here. The goal is really to provide you with a quick overview of these different business models, and particularly in this presentation to focus on the changes that are taking place and driving all of this innovation.

If you are, however, interested in learning more about these, you can click on the link at the bottom, and read up in more detail about what each of these business models entails. Critically, it's unclear which of these business models will ultimately thrive, and which will fail. Now, as with any market with a lot of innovation, it is unclear what the—who the winners and losers will ultimately be. In the end, it's hoped, of course, that the customers will be the winners, and the companies that are the most adaptive and responsive to customer needs shape and changing technology are going to be the ones that succeed.

And you can see here how these different actors and these new business models are laid out on a spectrum from more heavy asset-based models on the left to more service-based on the right. And you see on the top left the shift from the more generation-focused components of the value chain towards the more retail customer-focused end of the value chain. As was put clearly by the head of ENBW here in Germany, a large utility in the southern part of the country, one of Germany's traditional big four utilities, conventional business

models of larger power supply companies simply no longer work. And ENBW has been at the forefront of a lot of change and innovation in this space, and they've been trying to adapt intelligently to these ongoing technological and business model changes.

These trends are pushing many utilities away from—increasingly away from these low margin parts of the business—for example, trading electricity—and towards higher-margin areas of the business, with a much higher focus on better customer service, more automation, improved software offerings to allow better energy management, as well as looking at smarter appliances and smarter technologies, including smart meters, and the possibility of linking things together in what is sometimes called the Internet of Things, the linking different appliances and smart, responsive adaptive networks.

Broadly speaking, if we look at the way that different utilities are adapting to this rapidly-changing landscape, it's possible to observe a what's sometimes called a barbell strategy. This term refers effectively to movement towards the extremes, or towards the poles of the market. On the left-hand side we have some utilities that are focusing more on the regulated end of the business. So, that's particularly the transmission and in some cases the distribution end, where returns on investment are still relatively protected, and are still fairly secure.

While others are focusing much more on the customer end of the business, where it's much more deregulated, much more open market. And according to some analysts, much more like the wild, wild west. There's a lot more happening, a lot more innovation, but also at the same time, a lot more risk. So, as you can see here, if we look at this simple characterization of the vertically-integrated utility broken into its four key different components, some are becoming more aligned with, or more transforming themselves more into a traditional transmission company, what's sometimes called a "transco."

Others are moving more, again, on the retail end of the market, and focusing more on providing better services to customers, and earning fees on those services rather than just by selling bulk kilowatt hours. And the market that's really being squeeze and that's really facing considerable challenges in the years ahead is the really the generation side of the business and the trading side of the business. It's kind of between these two extremes.

We could get into more why this particular shift is underway and why it's particularly difficult for generators to compete and to survive and to thrive in this new environment. We'll touch on that a little bit in some of the slides ahead. But as utilities devise their new strategies, and they're trying to adapt to this new landscape, as utilities like ENBW here in Germany and as some of the big utilities in the US, like PG&E and SCE in California, we see different approaches emerging. And it's always helpful to keep in mind the wise words of Sir Winston Churchill who said, "However brilliant the strategy, you should, however, occasionally look at the results."

And if we look at some of the results, you can see we still have some progress to make. So, I've laid out here a few snapshots of what's happening across the utility sector in terms of financials, in terms of utility performance, and just to give you an idea of how these changes are impacting the sector as a whole. So, you can see here, this slide prepared by the IEA, that the aggregate earnings of the top 20 European utilities are declining, and fairly dramatically. You can see here over the last five years the decline of over 40 per cent in the aggregate earnings of those top 20 utilities.

You can see in the meantime, however, that capital expenditures in the orange line as a share of their earnings before interest, taxation, depreciation, and amortization [inaudible] are actually going up. So, utilities are spending a lot, and yet their aggregate revenues or aggregate earnings continue to go down. So, this is a bit of a—if this is a forecast of things to come, it doesn't necessarily look very bright for some of the larger utilities in this picture.

Fundamentally, the revenues that are enabled by the utility's business model need to enable the utility to cover its fundamental cost of operation, and its fundamental costs of financing. And as utilities get riskier and are perceived as a riskier investment, their cost of capital will go up, which will further squeeze their ability to operate the business cost effectively, further undermine their ability potentially to compete, particularly against new start-up companies, newer business models, who may not have as much debt, who may not have as many liabilities on their balance sheet, pension-related or otherwise, and who may be able to fundamentally outcompete them in this new environment.

So, there are some very real and very substantial changes taking place across the European power sector. This is in particular when you look at the European. The US market looks markedly different in many ways, even more complex, but this gives you an idea. The net income of these utilities drawn from—this is again European utilities—are also not looking particularly rosy. You can see in some cases actually quite dramatically negative.

This chart shows the number of hours that we've seen in three key countries here in Europe with negative prices. And you can see that the number of hours on the spot market with negative prices was almost zero in 2011, so just seven short years ago, almost eight short years ago, and how that number has risen on a quarter-by-quarter basis since then. And most analysts anticipate that the number of negative hours will continue to go up. So, that means for anyone who's operating a traditional, say, fossil fuel power plant will find it difficult to recover their costs on the wholesale market during those times, because they'll be selling into a market where the prices are negative.

They'll effectively be being penalized to produce power for the power they are providing. So, these changes are driven by a host of factors, arguably by overcapacity in the system, by the growing shares of renewable energy in the system. They're essentially driving very large amounts of wind and solar during certain hours of the day and certain days of the month. And that surplus in the system combined with fairly stagnant electricity demand growth is leading to periods of oversupply.

And when there's oversupply, there is—we see the tendency towards negative prices. Now, some argue we could solve all of this if we just phased out some old baseload power plants, phased out some coal in the system, phased out some nuclear. We could make out more room for more renewables, and we could also ensure that there are fewer periods of negative prices. But, again, those reforms are very difficult to implement, and they would further squeeze a lot of the existing utilities, and hence the difficulties of implementing a sound transition strategy for phasing out assets in the power system, regardless whether they are nuclear or coal, or even gas-based.

So, it's a very challenging—as I pointed out a few moments ago, there really are no easy answers. You can see here by looking at the shift in the German power market, you can see quite a clear correlation. Each dot here refers to a day of supply in 2018. And you can see the amount of renewable energy supply on the right axis and the bottom horizontal axis over time, for that day. So, the days with the most, with nearing up to 1,000 megawatt hours in that one day. You have renewable power supply from wind and solar. Those are the days with the lowest average daily wholesale market prices.

So, a fairly clear correlation there showing that the more wind and solar you have in the system, the more—the lower the wholesale market prices are. Now, on the one hand, this is something to celebrate. Rate payers should be thankful, business should be thankful for lower wholesale market prices, because lower prices have to translate somewhere down the line into lower power prices, provided that lower costs are being passed on to customers at some stage in the chain.

Now, on the other hand, for any business, any traditional utility, this is a very worrisome sign, because it means the more renewables, the more solar and wind we have in the system, the more daily average spot prices are going to converge to, or closer to zero. And there is still an ongoing debate about what this means for the electricity market as a whole, for bigger picture questions of where we're fundamentally—where we're going, and how to reform this energy-only market into something that's a bit more financially sustainable, both for utilities as well as for other independent generators in the system.

So, these shifts are having significant impacts on, again, the traditional, conventional utilities in this space. We're seeing that new business models are competing for different components or different parts, at different parts of the utility business. As I pointed out, we're seeing competition driving new innovation, particularly on the customer end of the business. We're also seeing that equipment providers are starting to get into the game, and are starting to take an active interest in smart technology, smart meters, more service-oriented offerings, specifically for customers—commercial, industrial, and residential customers.

So, essentially chipping away at what were traditionally utility revenues that used to belong, effectively, under the monopoly model to utilities. And that competition, as one might expect, is eroding utility revenues as the number of new actors continues to grow, and as the number of new companies competing for this market share, so to speak, the broader share of total

electricity market demand and as a result that has to have negative impact on the utilities, because there are more—the pie is not growing that rapidly in most jurisdictions. In other words, the total electricity demand is not growing that rapidly.

So, the more actors there are, you have to split that pie into an ever-greater number of pieces. And that simple fact alone means that there are fewer revenues left for the traditional, established utilities. And you can see that in context of the slides that I showed previously showing the aggregate earnings of the utilities going down over time. That's very much a reflection of this broader shift. Now, interestingly, there are very much some positive elements to this as well, particularly for customers. Customers are tapping into new ways of better managing their power demand.

Better customer analytics, better data analytics are enabling commercial and industrial customers to more intelligently manage their power demand, in some cases, shaving their demand charges by reducing their demand peak. For residential customers, they can be smarter about which appliances they use when in order to avoid, for example, peak pricing or evening pricing. And you can see how these different changes ultimately are leading to smarter customers, and in the long run, will lead to better outcomes for the overall efficiency of the power system as we see a greater correspondence between the responsiveness of power demand and the availability of power supply.

And as demand gets more flexible through these new data management and energy management technologies and software, we're going to see a greater ability to ensure that supply and demand are constantly in sync over the course of the day, and in the process also help shave electricity demand peaks and shift load around to times in the day when there's more wind and solar, in particular, available, so that we can increase the share of renewable energy in the power system as a whole.

As we're starting to see as well, there are a number of positive changes happening on the company end of the spectrum. Large companies are starting to supply their own electricity in ever-greater numbers. Many large companies in countries like Germany and France supply their own—have their own generators on-site, often from fossil sources, for historic reasons. But a growing number, both in Europe and in North America, as well as parts of Asia and Latin America are starting to sign long-term renewable energy contracts. So, we're seeing a growing number of companies and corporates getting in the game and starting to become more self-sufficient in their power supply.

Now, that means, effectively, that all else being equal, they are consuming less power from utilities, because they're producing more of it themselves. So, that's another major shift here that's shaking up the sector and further eroding utility revenues. And the same is happening on the residential end of the spectrum with the rise of self-consumption, the rise of net metering and net billing, and other policies like that, particularly to govern rooftop solar. So, the more that customers become prosumers, the more you see the emergence of a—the more utility revenues decline, on the one hand, if they're

not changing anything, and the more you see the rise of smarter and more interactive customers, and more two-way power flow between the customer and the utility.

So, it's not just the utility providing power to captive customers anymore. Customers are becoming a very real and a very critical part of this transformation. Now as I've been pointing out throughout the result of all these changes—and there are more—is that utilities are fundamentally losing out on their traditional sources of revenues. This is forcing utilities in the process to get creative in how they generate value for their existing value, how not to lose existing customers, how to continue gaining new ones, but also how to continue to provide value for shareholders. And that is proving to be particularly tricky.

Against this backdrop, if we look at the way the markets—the financial markets—are unfolding in relation to these changes, the recent analysis of 50 major utilities, not just from Europe, not just from North America, but from Asia as well, reveal that cumulative returns to shareholders were about one per cent between 2007 and 2017. This means very, very low, almost negative returns over that period. That's compared to a 55 per cent return over that period in the overall MSCI world index. You can see that shareholders who own significant shares in utilities in these 50 major utilities, in particular, must not be too happy about the performance of these traditional utilities.

So, there's clearly a need for a new approach and a new strategy. Many utilities are already investing considerably in trying to diversify, trying to adapt their business model. We are arguably at the beginning of that process in many jurisdictions. Some are more advanced than others. But it's clear that if utilities are going to go back to anywhere near their previous historic position as providers of reliable, low-risk dividend, almost annuity-like returns to investors, they're going to need to strengthen their business model and improve the service offering, because in a lot of cases, it isn't clear that the existing utility model is going to be able to mobilize capital at anything like the scale that it used to in order to meet the challenges and the transformation ahead.

Another example here from a recent article in the Financial Times is Centrica in the UK that's seen its share price fall 50 per cent over the past five—over the past four years. In France, EDF has lost 65 per cent of its value since 2005. And, despite some recent recovery, the German utility, RWE—it's a large heavily coal-based utility here in Germany—is worth little more than a fifth, so a little more than 20 per cent of its peak value ten years ago. So, you can see, this is really—these are deep and wrenching changes that are taking place in the utility sector, and that are effectively leading to the—if not the demise, certainly the decline of what were previously giants in the corporate and utility world.

Now these shifts, as we've seen, are driven by a whole range of factors, and each utility has a different story to tell, because each utility has different exposure to these different risks. And each utility operates in a unique, regulatory environment. But broadly, we are seeing weakened price signals

from the energy-only markets. As we saw a few moments ago, there are more and more hours in the year with negative wholesale market prices, prices below zero. So, nobody's earning any money. We are seeing fairly low, if not flat, electricity demand growth.

Some countries, like Spain, have even seen periods of negative electricity demand growth due in part to the financial crisis and to the effects of the economic crisis that followed. We are seeing low to negative profitability on existing generation assets. And all of these factors, when you combine with digitalization, virtual power plants, the increasing role of prosumers in the utilities sector and the electricity sector, the emergence of these new peer-to-peer power sharing platforms that allow customers, essentially one household or business, to share their power, their excess power, with others.

And we're seeing more and more third parties, more and more new businesses, competing for the supply of energy capacity as well as flexibility in the traditional, again, the model of business that was traditionally dominated by these large utilities. So, these factors, all of this competition, is in the process of fundamentally re-designing, fundamentally re-shaping the power sector in markets that have been—particularly the ones that have been more heavily liberalized, that have been more opened up.

The recent fall of some of these major, major companies in other sectors, which I've flagged, too, here—Kodak and Blockbuster Video—is a reminder that nothing is forever, and that no businesses are fundamentally immune to the changes that are taking place in their sector. The deeper shifts that are taking place across the utility sector in that sense are a wake-up call for many in the utilities sector that nowhere is it written in stone that the utilities that are currently dominating or that used to dominate the landscape are going to continue to do so in the future.

And all businesses fundamentally, even the largest or even particularly the large ones in the utility space are vulnerable to rapidly-changing markets, and rapidly-changing technologies. These risks that the large utilities are facing really underscore the, increasingly, thin margins on which many traditional utilities are currently operating. Where the utility business used to be a fairly—as we saw at the beginning—it was a fairly profitable, fairly stable, fairly low-risk business that, in many places and in many jurisdictions, in many parts of the electricity sector, is no longer the case.

Now, the deeper question that's looming behind all of these transformations is how are we going to mobilize the kind of capital that we need in the decades ahead if utilities aren't there to do the job, if utilities aren't there to mobilize those investments? According to the IEA, they estimate that we'll need somewhere in the order of \$3 trillion for transmission and distribution alone worldwide between 2016 and 2025. And with \$3 trillion of investment, utilities or whoever's making those investments is going to need to be in a market in a jurisdiction where the risks and the costs of doing business are low enough for them to be able to mobilize those investments at a reasonable cost of capital.

And currently, on the transmission and distribution end, that's arguably less of a problem, because the transmission and distribution sectors remain more heavily regulated than, particularly with the generation side of the market, or the customer end of the market, but concerns remain. The critical question here as well is if we keep in mind the fact that the world is collectively trying to reduce its emissions and significantly scale up new, cleaner technologies, like wind and solar and geothermal and hydro around the world, we are going to need massive amounts of new investments in generation as well.

And the riskier the market gets on—particularly on the wholesale market and on the fundamentally for any generator who's in that market, the harder it becomes to mobilize the kind of capital that's necessary to actually drive that transformation. So, at the very moment when we arguably need the stability of revenues, the reliability of fundamental revenue profitability in the sector to drive the kinds of changes that—to drive the kinds of investments that are going to help us transform the power sector into a cleaner, more sustainable system in the years ahead.

Precisely at that moment, we are entering into a phase when the generation, particularly on the generation side, the market is riskier, arguably, than it's even been. And how we reconcile those—that contradiction or that challenge is—remains unclear. So, a few concluding remarks before we open up, and before you get some questions on this module. Globally, almost regardless of where you're based and where you're living, the key priorities for the electricity sector remain the security of supply, providing low prices to customers, and ensuring that there is a transition to a clean generation mix.

Those are really the three core guiding principles, if I can call them that, underpinning the utility—the electricity business more broadly. And as utilities try to balance these different priorities while remaining profitable, it's getting increasingly difficult for them to make sound investment decisions. Now, some will say, "Oh, this is all fine. This is a good thing," because they are, increasingly, not the ones making the decisions anymore. We are seeing new businesses emerge, new companies competing, entirely new actors emerging, providing data management software, providing new tools and new technologies that are enabling smarter management of energy demand for customers, that are providing better solutions to problems that utilities have struggled to solve.

And maybe it's not a big deal that the utilities aren't the ones making the decisions, or that they've become a smaller part of the market. Maybe we see power shift more and more to a wider—either a wider number of competing smaller businesses, or the market starts to become more significantly influenced by other larger—even larger players. For example, in the larger tech companies who get involved—who may get involved in this sector in order to attempt to adapt their business model into this rapidly-changing landscape, and to try to provide a better deal for customers than the current utilities are able to, given, again, the traditional utilities often have large debts, often have significant liabilities, and are often less able to adapt less

quickly, or less able to adapt quickly to the changes that are taking place across the market.

In that regard, having a long history in the sector and having large debts and having large assets can be a significant disadvantage in trying to adapt to these rapidly-changing environments. And that's why a growing number of analysts, myself included, anticipate that a growing number of utilities are going to be offloading assets in order to try to thin down the business to enable them to be more adaptable, more nimble, more flexible in these rapidly-changing environments. In the process, there seems to be a consensus emerging, if there is a consensus at all in this, again, this rapidly-changing sector, is that we're going to see more focus on the customer end of the market.

More customer to utility relationships, utilities starting to provide, either directly or on contract with new businesses, new business models, real-time mobile and digital services, services like energy audits, in order to provide more information to customers, how they can better manage their energy costs. We're going to see utilities partnering more as—in providing energy management solutions, either directly or via S-goes, energy service companies who can essentially engage with the customer in order to reduce overall energy costs, and potentially take over some of the investments that those customers want to make, but they don't have enough disposable income or free cash flow to do themselves.

And we're going to see much more two-way power flows. The power system in the future is no longer going to be based around the—essentially the linear supply of power from one large utility to millions of captive customers. We're going to see much more dynamic, two-way power flow, not only between—or even multi-directional power flow, not only between the customer and the utility, but also between customers and other customers. And all of these changes are going to re-define, fundamentally, what the power sector looks like in the years and decades to come.

One aspect that remains clear, despite all of the complexity and all of the pace at which these changes are taking place, is that the business as usual—in other words, the traditional monopolized utility sector is not an option, and utilities are going to have to get smarter on how they adapt to these changes so that they can fundamentally also benefit from them, potentially even profit from them, and potentially even thrive in the midst of them. So, with that, I'd like to thank you for your attention for this part two of the training module on new business models in the solar sector.

In this presentation, we've gone somewhat beyond the solar sector alone to look at the—how these broader changes within the power sector are reshaping the utility sector in particular. And I've provided here at the end a list of a few key reports that outline some of these trends and have provided some insight as well as a recent book that was published. The last one here on the bottom, *The Future of Utilities and Utilities of the Future*. And that provides a deeper look at a lot of these trends that are reshaping the sector.

So, with that, thank you very much for your attention, and you will be presented shortly with the questionnaire. It's been a pleasure being with you, and I look forward to seeing you during the next training session. Thank you.

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