HARVARD ELECTRICITY POLICY GROUP

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Rapporteur's Summary*

Markets Abroad: Learning by Looking

Many of the fundamental characteristics of power systems are the same across countries. Even so, the differences in policies and market designs can be striking. Although there has been some convergence, the transformations to create electricity markets followed different paths. Looming challenges have produced similar issues to deal with growing deployment of clean energy. How can we balance the use of markets and mandates to ensure resource adequacy? What are the workable methods for grid expansion and integration across national boundaries? How can we ensure enough system flexibility to manage rapidly changing patterns of available generation? What are the conditions needed to foster the necessary technological innovation? How do the challenges of the future change or reinforce the electricity market reforms pursued over the last twenty years? What mistakes can we avoid by learning from the experience abroad? What might other countries learn from the electricity market laboratories in the United States? The ongoing reform discussions in Australia, Brazil, Europe, and Mexico provide fertile examples of lessons learned or to be learned.

Moderator.
I'm going to serve as the moderator for this session on "Markets Abroad: Learning by Looking." This is something that we have discussed with you in the past, when we were having our face-to-face meetings, about better ways to take advantage of the experience in other countries.

That was always a little more difficult, with the travel problem and then having speakers come from those different countries and all at the same time. But here, all we have to do is keep people up late, and so it's not quite as difficult. I'm very grateful, particularly for those from Europe who are going to be part of the panel here.

What we've discussed amongst them, and also in preparing for this, is trying to take advantage of those experiences, and we're going to have a discussion of that matter here. We're going to follow our usual rules. Importantly, this is not for attribution. We'll have a rapporteur's report, which will record what is said, but we won't identify who said what. That's been our longtime attempt to be open to this, but also allow for open discussion. Then, we have asked the speakers to not be comprehensive about everything in their country, but rather to give us a little bit of background, but by way of focusing on issues and trying to be provocative to stimulate discussion. We'll have their initial presentations and then we will follow with the usual format that we have had with interaction and questions.

The context, of course, is that electricity systems around the world have many similarities. They have same basic physics. The institutional structures are different. And there's a large element of I guess what you would call path dependence: we did it one way, and then it was hard to go in a different direction.

*** HEPG sessions are off the record. The Rapporteur's Summary captures the ideas of the session without identifying the discussants. Participant comments have been edited for clarity and readability.**

So we have some differences in approach experience that we hope we can benefit from. We're going to have an opportunity to hear what they have to say about what we should be doing and what they're doing and have a discussion of those matters. So I'm looking forward to this. And I hope you are, too. We're going to go in alphabetical order. We didn't think there was a logical sequence other than that.

Our first speaker is a former regulator in Brazil. She's also been a participant in the Harvard Electricity Policy Group as a fellow here. She's keeping track of what's actually happening, as she's now an academic And she's a COVID-19 recovered person. So she's been through those difficulties. I'm looking forward to getting caught up on what's happening on Brazil.

Speaker 1.
Thank you. It's quite an honor to speak here, I have been following the developments and the discussion is quite enlightening. I prepared a few slides, according to your recommendation. The idea is just to foster the discussion in the Q&A session.

So this is just an overview to present the basics. Even though electricity systems present a lot of similarities, there are some specifics, and, in this case, the Brazilian power system has a high participation of renewables. Renewables already account for roughly 86% of the installed capacity. This is a predominantly hydro system equipped with high flexibility by water reservoirs. The major water reservoirs are located in the southeast center of the load and they provide more than 200 terawatts hour of capacity reserves. It corresponds to roughly four months of load.

The variable renewable resources in this context are highly complementary, since the availability of [UNINTELLIGIBLE] power in sugarcane biomass is higher during the hydropower drought period from April to October.

The country also has a vast high voltage grid. The national interconnected system or the SIN**.** Counting on large volumes of investments made in the past, the SIN interconnects almost the entire country, enabling electricity exchange among the country's regions.

Hydropower participation reaches around 80% of the generation during the wet periods in the summer months, but it can drop to nearly 60% during drought periods in years with unfavorable hydrologic conditions. This broader range in hydropower generation is a new condition for the [UNINTELLIGIBLE] system. There is a gradual loss of the reservoirs' regularization capacity and this is a trend. Since the 2000s, the ratio between the maximum power that can be stored in the reservoirs and the annual load has been decreasing steadily from six to four months at the present.

The ratio between the energy effectively stored in the reservoirs and the annual load indicates the need for complementation from other sources, something that we already are experiencing.

This slide, it's almost self-explanatory. As a result of this devolution of the system electricity prices have been growing, and this is something related to the institutional structure the moderator was mentioning

Taxation is a significant part of the story. Even though we benefit from a high participation of renewables in the electricity mix, we face high prices and also, since we have universal access to electricity, electricity bills are convenient vehicle to

collect taxes that has been exploited by federal and state government.

This slide is just to present the beginning of this story of the liberalization in the country Coopers and Lybrand was commissioned to advise on the restructuring of the power sector in Brazil in the ’90s. It's interesting that in their first working paper they presented two alternative approaches to electricity price formation.

Option one would be a cost-based dispatch and option two would be a bid-based dispatch. Market price would be calculated on the basis of bid data. But, in fact, the chosen option was number one. And it's interesting because Bill Hogan sent us a paper he wrote last year in which he describes the evolution of PJM along the similar period, starting from a cost-based dispatch and zonal pricing. But PJM kept evolving, and I'm going to tell you here a slightly different story. But what is interesting is that 25 years later, we are back to a fork in the road.

So what you have the grid is an operation model in which the grid is represented by approximately 7,000 nodes. However, we have zonal pricing, in which the zones roughly correspond to the regions of the country. This allows for some efficiency and a lot of cross-subsidies. There are additional distortions. The recent larger hydropower plants in the Amazon Basin that are considered part of the southeast zone—this implies spreading high transmission costs among all electricity users.

Also, the grid expansion is contracted on an availability basis. Transmission auctions are held regularly. The winner is the competitor who asks for a lower annual revenue in a 30-year contract. This regime manages to attract investments to expand the grid. And this has happened significantly in the last 20 years as a result of centralized planning.

The model in place allows for two contracting environments, free and regulated markets. In the regulated market, we have electricity options that have been held regularly since 2005 to procure new capacity. This is not a single-buyer model, though. There is no risk-sharing among generators. Winning bidders, the generators, sign PPAs with the distribution companies that supply roughly 70% of the load.

So, in a sense, what we have is competitions for the market. Large and industrial consumers may contract in the free-contracting environment that represents the remaining 30% of the market. As per the risks in this predominantly hydropower system, the choice made 20 years ago was to implement a risk-management mechanism called the MRE that made the hydropower plants’ shareholders of a virtual single reservoir.

A water market would have been a solution to deal with the extenalities in the system, with several plants cascading the same river. Today we have a slightly different situation, because water security is an increasingly important problem for the country that is now experiencing water stress in different regions.

We have three moments of reform evolution of this institutional structure. The first one we had the initial liberalization. We have privatization, mainly in the distribution segment. An independent regulatory body was created and now the federal electricity regulator. It was able to implement regulation, leading to increases in productivity and also quality in the distribution system.

Brazil has not been able to create a functional wholesale and retail market for electricity, though. In 2001-2002 we experienced an electricity crisis that was ignited by drought. It led to rationing and steered policymakers to be more cautious. In 2003-2004, we experienced a political transition and a new model was implemented.

The system expansion came at a cost competitiveness [UNINTELLIGIBLE]. To address this concern, a new reform was enacted in 2012 targeting 20% tariff reduction. These measures were reinforced in 2015 because the fiscal costs became unsustainable. This is something you can see by the green. The green line in the future.

Since 2016, then, the government has been working to change the market design to better address and embrace emerging trends in the electricity industry. There is a consensus that the proposed market design is not robust to tackle changes in hydro in-flow patterns. Climate change has increased the variability of rain with significant impacts on the distortions associated with the MRE. Also, the centralized cost-based dispatch with the zonal pricing system has been unable to properly reflect opportunity generation costs in hydropower.

What have here now is few challenges, important challenges. First one is resilience to climate variability, something I already mentioned; also, an increasing participation of variable renewables and a new wave of liberalization that threatens the current business model in the regulated environment.

So the distribution companies in the regulated market end up with too many contracts for their shrinking markets, high electricity [UNINTELLIGIBLE] and incentives to distributed generation with aggressive net metering policies add to trends on pushing qualifying consumers towards self-generation.

This threatens the electricity auctions' ability to contract and expand capacity in the regulated market. There are some risks, also, because this is an economy that is plagued by macro-economic instability. Also, we have a final ingredient: gas reforms. So in search of a higher participation of gas in the power system, the government is trying to approve in the congress a reform to develop a competitive market for natural gas. This may have some implications for the evolution of the electricity sector. There is a lot of pressure to develop base load capacity for natural gas.

On the next slide, to ensure resource of the equity, the government has been proposing a centralized contracting mechanism of capacity. The government would estimate the capacity requirements. Energy and capacity would be auctioned simultaneously, and the costs will be allocated through all consumers through the market operator.

The reform also embraces phasing out subsidies to renewables that are already competitive and the privatization of Eletrobras, the major SOE in the power sector. However, the delay approving this reform urges the government to enact a provisional measure with urgent measures, allowing for capacity auctions and phase out of subsidies to renewables. This is a mechanism that we have in place.

So the president may send to the Congress a legislation and then the role of the Congress, in this case, is to ratify this within a period of 180 days but it becomes active immediately.

The open question now is how to ensure resource and equity in this changing context. There are emerging discussions on how to

move to a bid-based dispatch in the coming years, but this is a nascent discussion, and nothing has been said so far about a movement towards nodal price. And liberalization is already contracted. So a more reliable and transparent price formation process would certainly help address financial concerns.

So, last slide, concluding remarks. The Brazilian experience in the electricity industry evolution brings lessons from a system that already has a high participation of renewables. Its development is rooted in the answer to the oil crisis in the 1970s and ’80s, and in the pursuit of energy independence. This is a resource-rich country, with several clean energy technologies. The challenge is to move from a highly centralized contracting environment to an architecture in which markets play a prominent role in the electricity sector, so that the system is able to deliver not only resource and accuracy, but also affordable electricity to users and brings competitiveness to the economy.

As for the business environment, the electricity industry is particularly prone to attract investments aligned with the energy transition. However, foreign investors often claim major risks faced are effects and regulations. This is why market design and reliable and transparent price formation is so important.

So last slide is to just present within the figure on *Alice in Wonderland* is very suitable to the moment. The question is, they know where they are heading to. This is something that we have been discussing since 2016 and was part of the discussion when we worked with Bill Hogan, who attended a workshop hosted by the Ministry of Mines and Energy last year. Thanks very much.

Moderator: That was very helpful and raises a number of questions, but we will get to them we get to the question section. Our next speaker is headquartered in London and he led a large effort, recently, working with the regulators in Australia on reviewing the design of the electricity market. I found it very fascinating and I thought it would be interesting to have him give his perspectives on the market design in Australia’s national electricity market. Go ahead.

Speaker 2.
Thanks and good afternoon everybody and, yes, greetings from London. I am based in London and head up our energy team here, but I'm also lucky enough to work globally with a great bunch of energy economists. We have a team here in London. I work closely with Bill Hogan, Susan Pope, and Scott Harvey and others in the US, but also down in Australia as well.

My personal background is, I am an economist and started working in a few markets back in the 1990s, and unbelievably I just saw the name Coopers and Lybrand there in the last presentation. I was part of that Coopers and Lybrand team, working on energy markets back in that time. Most of my colleagues went to Brazil. I actually didn't go. I spent my time working on the British energy market, about the same time. I did a little bit in Brazil. But it's interesting to see that reference to work my colleagues did years ago.

A bit of background, actually, before we go to the first slide, is that lockdown has obviously been unenjoyable for most people around the world. The one fact I found somewhat interesting and sort of unique in a way: it becomes a global, levelized playing field in a way. So whether you're 200 meters away or 12,000 miles away, you interact with your colleagues in the same way. So,

colleagues in the US, myself in the UK, and other colleagues here in UK, colleagues in Australia, spend a lot of time on calls like this, working with clients in Australia to help them think about their electricity market design issues.

And, of course, they're all doing the same thing, as well. In that sense, my lockdown memory will always be looking at Zoom as we're talking through Australian market design.

Just give you a little, few minutes now on the things we've been doing then, some of the issues. Perhaps then we'll discuss. So, a bit of background about the Australian electricity market.

It calls itself the National Electricity Market, but that is, in fact, a misnomer. It only actually covers the eastern half of the country, which is the highlighted states—Queensland, New South Wales, Victoria, South Australia, and Tasmania. The market itself went live in the late 1990s, about the same time as Brazil. Also about the same time the UK introduced its current market design.

It's worth saying that because of the state regions, the state-level approach has very different generation mixes. For example, Queensland is a very coal-dominated system, as is New South Wales. Tasmania is predominantly, nearly all hydro, and South Australia has adopted a vigorous roll out of renewables and closed down all its coal plants. It claims to be one of the longest interconnected power systems in the world. I'm not sure whether that's true or not, but it definitely claims to be that, at over 5000 kilometers.

Just a few quick thoughts on the current market design or where the current market design is, which is interesting. All markets aren't unique, but in some ways it blends itself slightly on the GP approach or the European approach, albeit with some tweaks and nuances that are unique to Australia. In a sense, it's a self-scheduled market. So client contracts and self-dispatch into the market in response to price signals. The spot market is energy-only market, there is no formalized day-ahead market and to the point of view Speaker 1 was just talking about slightly, the price zones relate only to the state level. So that is a single price in Queensland, in South Australia, in New South Wales. It varies between the states, but no greater granularity, no nodal pricing. Related to that is the fact that generation has non-firm access, which means that at times creates quirky bidding behavior. I don't necessarily intend to dwell on that today, but it's something of interest to people very interested in LMPs.

The other point to note is it's a highly politicized sector. Scott Morrison, you may have seen, is the prime minister. He took a lump of coal into Parliament, notoriously, a few years ago, and waved it at the renewables parties and said, "It's nothing to be afraid of." There's a complex and relatively internecine set of relationships between the regulators, and also between the state-level and the federal-level regulatory policies. So there's a lot of complexity in the politics and the regulatory agents. In fact, it's probably the number one political issue in Australia, I would say.

They are trying to promote an approach of rolling out renewables. They've already had a reasonable amount of success, particularly in the more southern states, such as South Australia and Victoria. But they intend to carry on rolling out renewables to a relatively expensive amount through the 2020s and 2030s. This is anticipating that even by 2025, so the chart on the top left shows expected

rollout of renewables. The chart on the bottom left shows the expected amount of times, the ratio of renewables generation to demand and the various scenarios. The red dots are the central scenario. The orange dots are the hours in which renewables meet that proportion of demand. You can see by 2025 it's expected quite often renewables will meet 100% of demand, quite a few hours of the year.

This has inevitably brought system operator reliability issues, and it's made the cost of intervening in the market by the system operators, and the frequency which it does it, both increasing a lot. This has led to a few high-profile events, notably the South Australia power blackouts in 2016, where the whole of the state went down, went into blackout, for about seven or eight hours—and even for some people much longer—caused by a combination of high temperatures and wind.

Also, this year and the back end of last year, there was a number of times where the South Australian market has been islanded from rest of them. And that has led to significant interventions by the system operator—which is an independent system operator, I should add, covering all of that market, called AEMO—spending about six times as much it normally would spend to keep the lights on.

Of course, South Australia is by no means unique. So one shouldn't get too proud, because, of course, California has just been experiencing similar problems and ourselves in Great Britain last summer, we had issues as well, with a blackout caused by various factors. But, again, it's a common theme. The unusual, highly unlikely problems seem to be happening more frequently globally.

In light of that, we were commissioned by the Australian government to help them think about how the market should be redesigned. This was part of a wider piece of work Australian government has initiated, looking at all of the electricity markets, dividing it into these seven key blocks. Number seven was the transmission access and LMP market with discussion. We weren't actually involved in that this piece of work—unfortunately, perhaps, they were looking at that themselves.

That's a highly political piece of work, and I worked on it back in about 2012-2013, where they got very close to implementing nodal pricing, but it was a dwarfed at the last minute. They were also looking at flexible demand, two-sided markets, and how to deal with aging thermal fleets.

The three areas which I myself, Scott, Bill, Susan and others have been working on in 2020, that's been looking at, first of all, ahead markets. Secondly, resource adequacy. By that, we mean capacity markets and scarcity pricing mechanisms, those types of measures and also ancillary services or central system services as they call it in Australia.

And so whilst we talk about all of these, I think one of the other speakers is going to talk about resource adequacy and scarcity pricing. So I thought we would talk today about some of the things we've been thinking about in the ancillary services fields.

As with all markets, there's a whole different range of ancillary services that AEMO**,** the system operator, procures. We put them into four buckets: reserves, frequency, voltage, and system stability services. I think you'll probably be reasonably familiar with all of those types of services. The areas where we figured there was most need and most requirements for intervention were within the frequency area and in the system stability area. In particular, inertia, which is a product

required to maintain system stability when you have unexpected perturbations in supply or demand, have been historically provided in Australia—and throughout the world, for that matter—in just the presence of synchronous generation on the system.

But with the demise of coal plants and thermal plants, more generally, particularly in South Australia, inertia which, again, we thought of as a free by-product to the energy production, is no longer happening. So the clients intervene directly to ensure there's enough inertia from the system. Another systems stability service is called system strength. Now, system strength is a new concept and the Australians themselves can probably explain exactly what it is. I understand it essentially to be closest to localized inertia, whereas inertia applied, you need certain quantities over various levels.

This requires much more local intervention to ensure that the quality of the power and the voltage waveform is appropriately maintained. That's a very nascent service, we've just been talking today to our UK or British system operator, and they define it as just stability. They are also recognizing some issues. Also, frequency is an area and provision of frequency response was an area we thought needed further intervention.

One of the points we've noticed is it's quite easy, when you look at these services, to think about them in silos: "we want some of that and some of this and some of the other." But, of course, in a sense the services are very interrelated and if you have more of one available at any one particular time, there's a degree of substitutability between one service and another service.

For example, if energy production is quite high and you have lots of synchronous plant on the system, you probably need to have less inertia services. Similarly, if you have more energy on the system, you probably need less frequency control and frequency response services, because the two are somewhat substitutable due to system strength. It's all interrelated, and often in a one-for-one bay, which makes life a bit complicated when you're trying to think about procurement of these services.

Our view was that if you try and buy them singly or in silos, you risk having an inefficient outcome and therefore there's benefits to acquiring the services in aggregate—co-optimizing the services is the word we use to ensure that you have a range of them. You buy the right amount of each in aggregate across all of the services.

So when we thought about how you buy in these services, and this is something we workshopped with the Australians—through many late nights, it must be noted, at my kitchen table at one in the morning—talking about ancillary services. We bucketed the approaches you could use to buy them into three distinct categories. The first category is what we call the sort of directed or self-provision services. Essentially, this is the more ad hoc end of the spectrum of procurement, in which the system operator doesn't buy anything until it really realizes it needs it. Then it intervenes, typically at short notice in a reactive way to ensure services are available. AEMO has been doing this a lot this year, particularly inertia in South Australia, where it was intervening at short notice in a benefit or ad hoc manner to ensure there were enough generators on the system to meet particular short-term needs.

In light of this, it's inevitable that system operators move to what we call the bucket 2, this structured procurement of services rather than buying on an ad hoc, short-term basis. Sure, it makes sense to buy these things

longer term, then at least we know they're going to be there, and it might turn out to have some efficiency and look a bit more planning, so we have more reliability and more planning about what exactly we need.

So you bought these from some longer form of structured procurement. These would be typical contractual mechanisms or auctions for these types of services. We see these quite often occurring, certainly in Britain they occur, and in the US, and also in the Australian markets, too.

So the third approach was the newest approach we've developed, which we've called spot market-based approaches. Here, we envisage real-time prices for all of these services. These are set by having demand curves, which express, if you like, a system operator's willingness to pay to the service. So there's a minimum amount it requires, but it also requires a maximum amount, but it might pay a certain amount for a bit more, depending on the prices available in the market at that time.

And it can have more of that one, more inertia, let's say, and less system strength or vice versa, depending on the prevailing prices. So the demand curve is something that sets, and that allows you to potentially co-optimize services.

It can therefore create a real-time price for that particular service in all hours of the year. The point of the pushbacks we had is that potentially creates volatility in prices and therefore wouldn't support investment signals. I think our thinking on that is, you can still have longer-term contracts and they can be potentially CFDs off those real-time prices, should that be what you wanted to do.

This actually is not in itself a new concept and we already see it in relation to reserve. I know Bill Hogan's worked on this in ERCOT's ORDC, or New York and PJM have introduced similar things in reserve. We thought you might want to extend that concept to other services, as well.

Just going briefly, I know we talked about this slightly, what we thought we could do is, you could set AEMO—just to go into the demand curve concept a bit more—the system operator would set a minimum quantity required, potentially to be a saturation point, with any amount of service beyond that would be entirely pointless. Within that, you could have a slope to express a willingness to pay for a particular service, depending on the requirements and whether you thought having a bit more, it would be helpful in some way, shape, or form. And that will depend on various localized factors.

These demand curves could vary by time of day. And obviously, they vary by the particular type of service you require, as well. That would allow you, as the system operator, to co-optimize these to bring about the right amount. One point which is a particular contention in Australia, and it probably is here in the UK, as well, is whether this is consistent with a simpler, self-dispatch, as opposed to centralized dispatch. We believe it probably is, and you could have plants potentially self-dispatching into this market. The prices coming out of the market would be the amount of volume that's been self-dispatched. If you have a lot to be urged onto the system, the price would be 0. If you don't have very much, the price would go up and that would in a sense encourage a plant into providing that service at that time.

The recommendations were, of the services we identified, there was potentially a quite reasonable idea to move to these: operating reserves would have a spot price market, as would inertia and frequency response. Over

time, you can see other types of services moving down away from the structured procurement alone to be complemented by spot-market procurement.

So this stood the rigors of relatively high degree of scrutiny from the Australian stakeholders through a variety of workshops. They actually seem to be quite keen on the spot-market-based approach for those services. That's something they're developing at the moment. So I'll leave it there. And I think that's probably my full allocation of time and I look forward to talking about this, if people want to.

Moderator: Thank you very much. Again, very interesting and will stimulate a lot of questions. Now we're going to turn to the next speaker, from Bravos Energy in Mexico. I first got to know him several years ago when the previous government were working on reforms of the Mexican electricity market.

He was the one who everybody went to get him to write the regulations in a way that was most appealing to them. He knows more about that process and the content than anybody else in the world. And I'm really looking forward to hearing from him.

Speaker 3.
Thank you for the introduction. I thought it was interesting, the cartoon that Speaker 1 showed of the fork in the road over market policy. If I could pull out a cartoon right now, it would be a U-turn.

When I was working in the government, we put in place a market that I'm pretty proud to have been involved with. This is an old slide that tried to explain what the market was all about. This was the market that we implemented through the reforms in 2013-2014.

To steal from the other cartoon, we knew where we were going. We have these objectives to reduce costs, to make the system cleaner, and to make the system fairer. And we knew how we were going to get there. We identified really common, basic themes that I think most people on the call probably agree with, that if you want the system to be more efficient, you have to set the rules so that participants have incentives to make efficient decisions. You have to open the market to competition, make sure that your processes are free and fair and as open as possible, not discriminate in favor of particularly a government monopoly, but in favor of anybody, and be transparent about the data and the rules.

That led us to the ingredients of the reform, and this is kind of where we left the market when I left the government about three years ago. One was to break up the government monopoly. You can see behind me the logo of CFE. That's the company that traditionally owned about 90% of the generation and all of the distribution and transmission and the system control. One of the big pieces of the reform was to divide CFE into vertical and horizontal pieces. So the system control was separated into a market operator called CENACE. Generation was separated from transmission, which was separated from distribution, which was separated from retail. We opened generation and retail to competition. The government maintained a monopoly over the operation of transmission and distribution, although the market allowed for private investment under contract.

Finally, we horizontally separated the generation, so that the CFE generation wouldn't have a dominant market share. That's, I think, a basic best practice harder to do than it might sound, but that was done in the 2014 reform.

The other big piece was the creation of the markets. I think here we stole and adapted and translated a lot of common lessons learned and best practices. We have a spot market that looks a lot like a US spot market, with nodal prices, day-ahead and real-time market, co-optimization of the main ancillary services, and long-term markets, both centralized and free contracting for new generation to sign up with either the government-owned retailer or private retailers.

We promoted clean energy through a certificate system, which is a lot like a renewable portfolio standard, but with tradeable certificates and, importantly, tried to make the regulators and the market operator as independent as possible so that there wouldn't be any favoritism towards CFE or towards anybody else. So that's the goal and the direction and the design that we implemented.

That's the way things were left the end of 2018. Then we got a new president. This is where it starts to get provocative. I'm going to talk about what's happened since 2018. It's pretty crazy. This is a timeline of things that have changed in Mexico under the new administration.

We did some clean energy auctions. That's probably my proudest accomplishment, because it's the only thing that we didn't really just steal from other markets. We designed a clean energy auction that was pretty innovative in the way that it let different technologies compete against each other, even though the products were different. It was able to give more credit to the more valuable products, but at the same time let different projects with different technologies in different places compete.

That was run three times and it got contracts assigned for about 7,000 megawatts of clean energy in the last administration. The fourth option was about to be adjudicated and the new administration—at first, they suspended it and then they canceled it. They accomplished something that we never thought was possible. There are commissioners at the Energy Regulatory Commission who have seven-year terms. And according to the rules they could only be removed for wrongdoing.

But six of the seven wound up resigning. Actually, that's not true. One of them, the term expired, but five others resigned. It's kind of dark or opaque, what happened. At least one of them was publicly threatened by the government, that they were going to expose his corruption, which probably wasn't true. But if the government is threatening you with that, maybe you think twice about confronting the government.

So we got a whole new regulatory commission full of loyalists with not a lot of technical background or principles about electricity markets. The CFE separation was reversed, to the extent that could be. They didn't officially re-integrate the company into one, but they broke down the barriers that prevented coordination between the different areas. So now they're operating kind of like divisions of a big company and they reassigned that generation to be in regional companies.

One of the things we had done was to separate the generation to avoid regional concentration, and they re-concentrated them. One of the less market-oriented pieces, but very important, was that the reform allowed private investment and transmission. There was an aggressive plan to expand and strengthen the transmission network. Almost

all of those plans were cancelled by this government.

There were also some pieces of the market that we hadn't we hadn't implemented yet, but they were in the plans, particularly FTR markets. There was a medium-term auction that was run, but that was going to be strengthened. Those were cancelled, as well.

The clean energy certificate mechanism, there was an attempt by the government to basically make the certificates worthless by giving clean air certificates to all of the old hydro plants that were owned by the CFE, flooding the market with certificates. That's a way to end the mechanism without actually repealing a law that created the mechanism.

Lately, this year, it's taken a turn for the worse, if that seems possible. This year, there have been some really frontal attacks on renewable generation. First, there was an announcement by the market operator that they weren't going to let new renewable plants continue testing, and testing is a necessary step to coming online. So that left the plants in limbo.

There was a new reliability policy that was published by the Ministry of Energy that did all kinds of things. I thought the last presentation was fascinating, because we should be having a talk in Mexico about ancillary services. Like in most of the world, a lot of the services that used to be free because they were abundantly provided in excess by thermal plants, as Speaker 2 mentioned. They're not necessarily abundant anymore. So we need to think about how to either set prices or set responsibilities for who needs to procure how much.

All of this can be done in a number of ways. And I'm sure Speaker 2's had a million conversations about how to design it efficiently and fairly and make it feasible to implement. Here in Mexico, the policy was, I think, a little extreme on the simplicity side. The policy was, we're just not going to let any more renewables come on system, because it's too complicated. We're running out of inertia. We're running out of voltage support. We're running out of—I can't think of the word in English—shock absorption, of oscillations. So we're just going to stop renewables.

That's basically what the liability policy says, but they also give CFE a kind of special role as the privileged recipient of interconnections because it's CFE. And they subjugate the regulators to the Ministry of Energy. Kind of unnecessary, because the regulators have been captured. But if it weren't captured, if they tried to be independent, the Ministry of Energy could step all over their authorities.

Finally, the latest piece of news was a five-fold increase to wheeling rates for renewable plants that were operating under a pre-reform mechanism. So this is what's happened so far.

And I'll go to the next slide. I just pasted this is out of a newspaper in Spanish. This is the agenda for the next year, and I just wanted to highlight two of the things on their agenda. Number 12, I'll translate this, it says "privilege the dispatch of CFE's plants and then private plants without economic merit." This is in their words and it was published in the newspaper. This is one of their policy goals for the next year. And the other one, number 14, is "stop the granting of permits or concessions to private parties." So this is the agenda for the next year.

I really love the Cheshire Cat cartoon because it reminds us to take a step back before we would decide what road we want to go to or try to evaluate what road somewhere else is going to. Let's ask the question of, where are

they trying to get to? Looking at all this, it's hard to figure out where they're trying to get to. What I've got on the slide is what we can surmise: the objective in terms of the end goal is to restore the state-owned electricity company to dominant market share generation.

By the way, for some reason they don't care if CFE invests in transmission, which I think is ridiculous. It would be totally non-controversial. Everybody in Mexico knows that the system needs transmission, it would be a great return on investment from a social perspective. It's a natural monopoly, but they don't want to invest in transmission, because a stronger transmission network would facilitate new private generation. So they just want to do investment in generation, put up as many barriers as they can, particularly to renewable generation. There's a big overlap, most of their renewable generation is private, because CFE doesn't have many advantages. They don't really know how to develop or operate solar or wind plants.

So it's kind of the same group, but it's not exactly the same. They're particularly against renewable generation, more so than private generation and gas plants. They're trying to weaken any independent authorities, really concentrate power in CFE, back before the reform started off, where, if we go way back, there was no regulator. CFE was the authority. And that's where they're going back to.

So, why? What's this about? I've got two boxes on the righthand side of this slide. If we want to be charitable and attribute these strategies to actual principles, this is what they say in public. This is the public discourse. One of their principles is that private companies foment corruption, that all of the scandals of the past can be linked to a private company behind it all.

Another principle that they've talked about a lot is that markets lead to disorder, markets lead to chaos. They have the idea that only a centralized planning and control can guarantee or at least advance the idea of order in a market. And finally, with regard to renewables, they're not really interested in listening to best practices for integrating renewables efficiently. They just believe that intermittent resources cannot be integrated.

So that's the charitable view. Maybe they believe these things and are not really interested in listening to alternative theories. The other hypothesis, which makes more sense to me, is those three bullets on top are just talk. This is really just about consolidating power, and they can consolidate power by getting rid of private participation and making the state-run company into the regulator. It's not really clear on which of these is in play. Maybe it's a combination of both.

This is the last slide. So what's coming down the pike? First of all, some of the measures that I've talked about have been at least temporarily stopped by private companies filing for and getting injunctions through the judicial system. Some of them, I think, in the long run will be stopped. But others, in the long run, the judicial system will not be able to put the brakes on.

That being said, that's the private reaction. The government keeps moving. The regulation continues to evolve in a negative way. Permitting has been frozen for at least a couple of months now. No new generation permits are being granted, also no new retailing permits being granted.

The other piece of the agenda that was on my slide in Spanish was about changing the dispatch roles. I'm a little bit more optimistic about that because it's just so complicated and

so far away from any logical criteria. I don't think that they can implement a rule where CFE's plants get dispatched more than private clients. To give a taste, one of the principles that they published in one of their official announcements was that they're going to prioritize hydro generation. CFE's hydro generation is going to be dispatched before anybody else.

That reveals a gross misunderstanding about how hydrogeneration is used. There's only so much water in the dam and it's all used. So dispatching hydro first either means keep doing what you're doing—use all the water at the best times you can all year. Or it means use all the water as soon as the rainy season ends and run out. I don't know which one they meant, but there's nothing coherent in that statement. And I don't think they can implement anything about it.

Now what comes next? The big fear in Mexico is what I presented so far takes things about as far as they can go without changing the law. But the law could be changed, and we'll have a midterm election next year. The rumors and the fears are that if the current majority party wins the majority in Congress after the midterm elections, then they might go after the law and try to undo some of the basic principles that we established.

Now, trying to be optimistic. What could stop this, short of the politics changing and then a new party coming into power? One of the things we used to talk about was, will there be blackouts if they scare away all investment? The system will wind up short of resources within a few years, and the public will demand a change in policy. Unfortunately, that doesn't seem to be on the horizon anymore, because economic stagnation, both COVID-related and policy-related in general, has bought the system a few years. We don't think we'll be short capacity until the end of the decade at this point.

What might come up as a crisis is financial. All of their policies are deviations from economic best practice. They're all oriented towards raising costs, they're oriented towards prioritizing the dominance of the government-run company, which is usually sacrificing economics. That could cause the financial weakness of CFE and the government to blow up and force a change in policy. But really, it seems like the first best chance to change directions here is when the people rotate. This is kind of a dark commentary, but it's what people talk about all the time when they try to be optimistic. It's that the CEO of CFE is an 84-year-old dinosaur from old times in Mexican politics. He just can't stay there too much longer. At least that's what everybody hopes.

So I hope I've been provocative, and we'll have lots to talk about in in the Q&A. That's where we are in Mexico right now.

Moderator: Thank you. I think we made a tactical mistake in not having you go first, so everything else looks better. But I definitely appreciate this. And we'll get into it more in a discussion. Finally, we'll have Speaker 4 from Belgium. He's an energy regulator there who also works with ACER in the Adequacy Task Force. We're looking forward to catching up more about [UNINTELLIGIBLE] and the capacity mechanism discussions in Europe.

Speaker 4.
Thank you. Yes, I'm working as the CREG director, and I'm an economist and engineer. I was involved in accepting or approving the methodologies by ACER on capacity mechanism.

In this presentation, if you look at the new regulation from 2019 and subsequent methodologies, you can, according to these methodologies, in my opinion, never assess if there is a resource adequacy concern. And so in the EU, in a member state of the EU, you cannot have a capacity mechanism, because there is no adequacy concern.

The next slide is a bit what I will talk about, the new regulation. Based on this regulation, there are two methodologies that have been approved by ACER. So, how to do an adequacy assessment in Europe and also how to establish a reliability standard. I will talk a bit about price caps and then about market revenues and risk aversion.

So the next slide is the regulation. It's a new regulation established in 2019. Regulation in Europe means that it's applicable in every country of the European Union. On the next slide, there are some details, but the most important one is the last bullet. It's article 10 and it says very clearly that there can be no price caps on the wholesale markets. We can have some technical bidding limits. But, as I will explain later, these technical bidding limits need to be adjusted upwards when you're close to or when you are reaching these technical limits. Basically, you cannot have price caps in Europe on the wholesale markets.

On the next slide are two methodologies based on the regulation approved in 2019. One is the ERAA, the European Resource Adequacy Assessment. Then on the reliability standards, on the next slide, you can see this reliability standards. It's a LoLE target based on the social optimization and it's defined as the cost for new entry divided by the value of lost loads. That is the standard for member states in Europe.

On the next slide you can see that, since you have this lowest target defined as CoNE divided by the VoLL, you can say that if your yearly expected revenue of a capacity is higher, it's got the capacity come to the market. During LoLE hours, when supply cannot meet demand, the scarcity, the market price will go to the price cap because markets cannot clear.

Then, during these LoLE hours, your yearly expected revenue during the scarcity hours will be LoLE multiplied with the price cap. If you know that the CoNE is identified as the LoLE multiplied with the VoLL, you know that if your price cap will be higher than your VoLL, then you will have sufficient revenue for your capacity. If you have sufficient revenue during the scarcity hours for new capacity, then you cannot conclude that there is an adequacy concern because there will always be enough expected revenue for new capacity.

On the next slide, if your price cap is higher than your VoLL, and this is the case, because, as I said earlier, based on article 10 of the regulation, you cannot have a limit to your wholesale electricity price. There can be a technical building limit. Currently, we have one of €3000 per megawatt hour on the day-ahead markets. But a decision by ACER, which is supported by the regulation, is that your price cap needs to increase, or your bidding limit needs to increase by €1000 per megawatt hour every time the market price reaches at least 60% of the price cap.

So when there is near-scarcity or scarcity, the price cap would increase by €1000 per megawatt. You can even state that as long as the LoLE is not zero, the price cap is expected to become higher than your VoLL. On the next slide, we know that very high price caps or very high electricity prices could be politically unstable so that politicians would

intervene and say that there should be price caps, anyhow.

But this is not regulated by politicians, so it's not governments or the European council that is setting these limits. It's ACER. So the European Agency for the Cooperation of Energy Regulators, with 37 national regulatory authorities. And this is confirmed by the regulation, which was introduced by the member states, by the politicians. On top of that, your price cap is not necessarily be very high. It's because your value of lost load is the willingness to pay to avoid first load-shedding during an emergency plan, but this emergency plan needs to be cost efficient.

So your value of lost load needs to be as low as possible. We are not talking about the maximum value of lost load or an average value of lost load. We are talking about the value of lost loads of consumers that can be subject to load-shedding during emergency plans. These are—for example, in Belgium—mostly households in rural areas and those households have an estimate, VoLL of about €3000-€5000 per megawatt hour, which is not that high.

The current price cap—for example, in Belgium—for real-time prices is already €30,500 euros per megawatt hour. We can expect that price caps will be higher than the value of lost load that is used to calculate the LoLE targets.

About market revenues and risk aversion, this is frequently used to advocate for capacity markets. So the LoLE is the loss of load expectation, a probability-weighted average of scarcity hours over all simulated scenarios. Due to the variability of wind and temperature cold spells and other things, and also the outage variability, it could be that you have a few years with a high LoLE and many years without LoLE,. An average of three hours can consist of nine years of zero LoLE hours and one year with 30 hours of LoLE.

Then you could say that a risk-averse investor will not invest in peak capacity because it will run the risk of never having peak prices. Why invest when you're risk averse? This is an argument that is being used a lot. If you look at the next slide, we know that this capacity, also peak capacity, but certainly base load capacity, is being hedged on the forward market, which reflects the expected spot prices.

That means that, in the example of the previous slides, also the exceptional year with 30 hours of LoLE is also reflected in the forward price. Of course, we did probability of occurrence. So you have these exceptional years with very high LoLE. They will result in a higher forward price. The second element is that there are always two sides on risk, of having price spikes or not having price spikes. Indeed, for an investor or a producer, the risk of not having price spikes is important because you will miss out on revenue. But for a power supplier, which takes the other side of the risk, it is the risk of having price spikes that are not being hedged. A power supplier risks to pay scarcity prices. So we know that both are willing to hedge this risk. And they do this on forward markets, organized or not.

Also, another important element is that big market players—at least in Belgium, it is the case—and also in other European countries are usually vertically integrated, meaning that they are a producer and an investor in capacity and also a supplier to consumers.

There are two additional important points. The automatic adjustments of the price cap will make the gap as high as needed to ensure market entry. It will eventually increase to

cover the risk premium. An important element also about risk aversion, if this would be an important element, this risk aversion. It means that also the cost of new entry for new capacity would also increase due to this increased risk aversion. If your cost of new entry increases, also your LoLE targets, your reliability standards, will relax because, as we've seen, this is defined as the CoNE divided by the VoLL. If your LoLE is increasing, then also your LoLE targets will increase. You will not need as much capacity to reach the reliability standards.

Based on all this, I would conclude that if you properly implement regulation, the new regulation from 2019 and its methodologies, like the liability standards and the resource adequacy assessment, you cannot conclude that is an adequacy concern because there will always be sufficient capacity that will come to the market. So you cannot introduce, according to the regulation, a capacity mechanism in a country in Europe. That was my presentation.

Moderator: Thank you very much. That also raises many interesting questions. What a range of these presentations from the depths of despair to a story about the triumph of economics. I think this is really quite amazing. And we'll look into to get into the conversation. We're going to take a short break here.

Discussion.

Question #1: As you know, the system operator in Brazil is quite sophisticated and they know a lot. One of the things that they could do **t**hat would be very helpful would be to publish on an informational basis the implied prices, locational prices that come out of the existing dispatch.

For example, PJM did this in the early days. Before they went live with the LMP program, they were just publishing what they were calculating so people would know how it worked. And I was wondering if the Brazilian system operator is doing this or is planning on doing this, or what's happening.

Respondent 1: It's not doing this already. It's not clear they plan on doing this, but we have a few new members on the board of the system operator. They are looking at the system from a modern approach. I think this is a possible evolution in this whole framework.

Question #2: Thank you. I have two open questions or comments related to the European framework. I work for the EU agency ACER and I was involved in adequacy. I think it may be interesting to raise these two elements relating to the European framework, as mentioned by Speaker 4. Indeed, we are going towards a more hopefully economically efficient framework. But it will take time to get there.

The two main questions which we may have to address in the coming years are the following. The first one relies on the trust of lawmakers related to, say, price spikes. We still have today, many regulator distortions independent from price caps, which are intended to mitigate the abuse of market power. So there will be a big issue of trust and market integrity and transparency to ensure that really lawmakers trust that when a price spike occurs, it is really reflecting system conditions.

With automated trading, we will have questions, because the ACER agency also tackles market integrity and transparency questions. How do you assess abuse of market power from an automated trading algorithm, for example? Do you do it *ex poste*? Do you do it *ex ante* by certifying some kind of competitive algorithm? This

question of trust will be very big. Because if we fail to deliver on this, then we may see a low price cap coming back very quickly.

The second question, which may also relate partly to interplay between states and federal government in the US, is the question of subsidiarity and interplay between European guidelines and national law. Member states in the European Union still have some freedom to deviate from the economic theory guidance from the European Union. The question is, how much would they want to deviate? How much will be allowed? And how will Europe convince them that mutual interdependency is really valuable? Because, in security of supply, usually, they will tend to like being on the receiving end more than on the sending end.

Moderator: Well, that was interesting. I was I was curious about the market power story in the European model. One of the things that we don't need to elaborate on it too much here, but one of things we could look into is the arguments in the context of ERCOT, where the operating reserved demand curve, one of its attractions is it provides a straightforward means to make a distinction between people exercising market power and just real scarcity in the system. It makes it quite clear what's happening. And you don't have to exercise market power in order to get high prices. So that's just something that was worth looking into. I don't know if any of the speakers want to respond to that.

Question #3: I have a question for Speaker 2, and it's related to one of the last points that you had on your slides: the possibility of a market for inertia response. And my question was, does a demand for frequency response, which obviously would be ideal for inertial response, exists in the national electricity market? I remember I think last year I looked into this for PJM a little, and I understand that the existing PJM regulation market does accommodate inertial response resources as a fast regulation product. So fast regulation is a subsection of the existing regulation market, but obviously it's smaller than the regulation market itself. I understand that, at the moment, is a segment that is saturated with supply. So it's not clear that there is a demand for now. I was curious whether this is different to the conclusions as to whether market could emerge for inertial response could be different. Thank you.

Respondent 1: Thank you for your question. It's right to say that quite a lot of the time the market is saturated in Australia with inertia, and that's because synchronous generators always, typically on the system, quite a lot of the time. It has become the case, in South Australia in particular, where they have closed down more thermal plants anywhere else in the NEM, that it's increasingly becoming a problem that they simply don't have enough synchronous generation. So much so in fact they've investing in network access synchronized condensers to provide the services in a sort of a personal network type approach. It is becoming a real issue. You could conceive of a world where quite a lot of the time the price of inertia is zero in a year.

But not all the time. And when it's a shortfall, you can imagine the price rising to quite high levels. And you could also conceive of a scenario that you have less and less synchronous generation connected to the system that the number of hours with a price of zero reduces as you have less and less synchronous generation. So that is the concept. But I think the point was having a market for it and a demand curve for that service, you actually get to reveal the price, you reveal the scarcity or plentifulness of the

product at any particular point in time that you wouldn't have, but only through some long-term contracts and provisionaries. That's why we thought of trying to develop a real-time price and the real-time market for this particular service, has some merit relative to longer-term ad hoc contracts, if you like.

Question #4: Thank you. Very interesting presentations. In regard to Europe, I want to make sure I understand this properly or not. Overall, I take it, there's just an energy, and then I guess ancillary markets, but there's no capacity market in any way that exists, for example, in the ISOs of the northeast of the US.

So the generators really are looking to just the energy market and then whatever they can arrange? More like ERCOT, I guess, in terms of bilateral contracts to give them more assurance of revenues.

Respondent 1: There are already capacity mechanisms in a few member states in the European Union. Other member states, other countries will not go for capacity markets. Then there are some members, some countries that are applying for capacity mechanisms. But since capacity mechanisms can have an impact on the internal energy market, it's the European Commission that needs to approve this. For this approval, there are new rules in the new regulation from last year.

In these rules, you need to show that there is an adequacy concern before you're allowed to implement a capacity mechanism. To show that there is an adequacy concern, you must conduct an adequacy assessment. This adequacy assessment and the results are then compared to certain reliability standards. This adequacy assessment is model based, it’s the probabilistic assessment that looks 10 years into the future. So it has to take some assumptions into account also on, for example, the cost of new entry in the system.

My statement is, if you look at how this reliability standard is being set and this adequacy assessment in Article 10, with the provision that you cannot have price caps. Then, in my opinion, a properly implemented adequacy assessment will result in the conclusion that there is no adequacy concern. And so you cannot introduce a capacity mechanism.

Questioner: May I ask a follow up? Very interesting, but it sounds to me like you've got a real checkerboard of underlying regimes. I mean, there must be some places where the assets are in some sort of rate base and earn some return from that. And others were there more purely merchant, if you will. How is all that reconciled?

Respondent 1: You have energy markets and ancillary markets, so the system operator buys ancillary services on a kind of capacity market. It has become week-ahead auctions for that. And besides that you have forward markets—one year, two years, and three years ahead, you can hedge your capacity. You can buy and sell base load and peak load capacity. Also, in Germany, there are option markets where you can sell and [UNINTELLIGIBLE] your options, which is very convenient for peak capacity.

Respondent 2: So, British stuff. I still consider myself European. Seeing this story, it seems like a tension between the national level and the European level. The 2010s saw a big emergence of capacity markets and capacity mechanisms, primarily in response to the increase in renewables generation to meet policy objectives. Obviously, national governments quite like a capacity mechanism in general, because it gives them comfort and

politicians have comfort that the availability is there. The Europeans obviously don't like them, European institutions don't either by virtue of a national type of product one versus something that's, if you like, global. So, to use your phrase, all of the governments have developed a patchwork of different capacity mechanisms to overlay the electricity market design, which has people who advocated and people who don't. But at least it was a single type of overall market mechanism. On top of that, you have all these mechanisms of a capacity nature, which, if you like, frankly undermined the sort of single European markets in electricity. I think what you're saying is that the latest policy proposals are in response, if you like, to capacity markets. That these ad hoc developments of capacity mechanisms are more a unified approach. I think I agree that it's been not been helpful to the European project where the probably the development of these ad hoc approaches hasn't been very successful.

Moderator: The way I understood the presentation is that you have done all this work in your task force and you have come forward to the conclusion you were trying to present. Now, where is this in the process? Has this been accepted and is now part of the European regulation? Or is it a proposal for consideration of the European regulation? Or are the advocates who are going to lose their jobs at CFE going to come into Europe and take over every state-run operation. Where does this sit?

Respondent 1: The methodologies for conducting an adequacy assessment and to establish liability standards have been accepted, I think, at the end of last September.

But as the questioner from ACER said, my reasoning is only valid, for example, if each member state will accept the definition of the LoLE targets being the CoNE divided by the VoLL. They can deviate from it, but we will still see if this will be accepted, that member states deviate from this and to what extent. Finally, that will be decided by the European Commission. So the department on competition will decide whether this is allowed or not. Then it's important to know that energy security or adequacy security is still a national importance. So there you have the principal of the subsidiarity.

But if they follow the adequacy assessment as decided, and if they implement the liability standards as being proposed by ACER and the regulatory authorities, then I think mathematically or technically it's very difficult or you must have some important market distortions where, for example, your electricity price cannot reach the price cap, which could be possible.

That is being addressed in the regulation, where it clearly states that if you want to introduce capacity mechanisms, then you should first consider remove your price caps, for example, that would be still on the market. And other regulatory distortions should be removed before you come to capacity mechanisms. But, in my view, if this all is properly implemented it will be difficult to assess that there is adequacy concern. But again, it will be the European Commission to decide on this.

Moderator: To follow up on this, in the United States we have this legacy of reliability standards. I'll use the shorthand of the one-day-in-10-years kind of principle. The earliest known papers in the industry that discuss this were written 80 years ago. And when you read, as I have been told—I haven't actually read it myself—but I've been told if you read those papers, they say, "Our standard is one day in 10 years, and we don't know where it came from."

So it's a legacy from some engineering rule of thumb that has been passed down and passed down and we have this path dependence. So now we have all these rules and regulations and organizations which are requiring you to do this. Then you go to the economic arguments and operating reserve demand curves and all the other kinds of things, valuable lost load, and you get a different answer. But we still haven't been able to confront head on the basic reliability standard. What is different about Europe, in this regard, did you not have the legacy, or did you somehow overturn the uneconomic way of looking at the problem and recognizing it was too expensive?

Respondent 1: Yes, we did have the legacy. For example, in Belgium, it was just a rule of thumb of three hours, like in France, In the Netherlands, it's four hours. In Ireland, it's eight hours.

So we did have an average LoLE. We did have this legacy, but it effectively got overturned. So it was based, also, what was decided in the UK as a liability standard, and it's based on a welfare optimization. So where additional capacity, once it's too expensive and the cost of disconnecting consumers will become lower than the cost for new capacity. So when there is an optimum there you set your LoLE targets With some assumptions—it's just economic derivation, mathematical derivation—you come to the definition of the LoLE to equal the cost of new entry divided by the value of lost load and importantly, because we had some discussions in the breakout room, which was very interesting. Importantly, the VoLL is not an average VoLL or the maximum VoLL is the VoLL of the consumers that are subject to forced load disconnection, which is logical. According to European legislation, this emergency plan when you force consumers to disconnect, this emergency plan should be cost efficient.

So you take the consumers with the lowest VoLL first, and this is mostly already done in most countries. You will not start disconnecting hospitals, for example, you will start with households and in rural areas, as is also being decided in Belgium and I assume also in other countries. That means that your VoLL is quite low compared to the average VoLL or to the maximum VoLL of consumers, industrial consumers and others.

That means that your LoLE targets, if you properly implement this, will be higher than the current three or four hours that is common in Europe. You will arrive to six hours, 10 hours, maybe even higher. Will this be acceptable for member states, for politicians? That we will see, because doubling or tripling your LoLE standards may be difficult, but this is what normally regulators will propose to their governments.

Moderator: And just on that point, I assume it's true there as, it is here that the standard applies to generation capacity of the high-voltage grid, but it doesn't apply to the distribution system, which is where most of the interruptions actually take place. And so the customers and the politicians will never notice.

Respondent 1: Probably. Maybe what's also interesting is that these LoLE targets are lower standard is only for market capacities, or for the markets. We call it the market LoLE. So in real time there will be other resources available like balancing users that are not exhausted. That, of course, will be used to avoid these forced disconnections.

So yes, indeed, it will be probably these disconnections will not happen that much as being simulated. Maybe also an important issue is that to define your VoLL, it's also to provide that you should do surveys with consumers that will be subject to this

emergency plan. So it's not just out of thin air that you come up with your VoLL. You should do some proper consumer surveys to get to know their VoLL. Also important in this case is that, according to European regulation, you need to use the willingness to pay instead of willingness to accept, which means normally to lower VoLL estimates.

Moderator: Thank you very much. It's fun to be the moderator. You get to learn something.

Question #5: Thanks, everyone. My questions pertain to Australia and Speaker 2's presentation. I guess I just have two questions. One is, I seem to recall Australia had an awful lot of high prices, maybe not this past winter, I haven't followed as closely, but the one before. I was curious how they're thinking about whether or not that had incentivized any entry or given any signals. As well, maybe you could comment, they put a mechanism in place, or at least a system they thought that would potentially cause for contracting, if they thought they were going to be short.

The second question is whether western Australia plays any role in that the NEM does? Or is there ever any kind of comparison across the two? I'm not sure if the market design's quite the same, but it has a real-time market, sort of a scheduling market. And they've also had some high prices as well, but I do understand people are arguing about it. I was curious if there was any linkage. Thank you.

Respondent 1: Yeah, so high prices. That is an interesting one. It's probably the number one political issue—energy—out there, and energy prices are that. The minister of energy has arrived, and he calls himself the "minister for low prices in energy." So, that is the plan. But you're right. So, in entering that climate, there has not been an abundance of new entry. But prices have come down quite a bit in the last year, anyway, potentially because more renewables generation has come onto the system and that's brought down prices on average. And the gas prices have also been a bit lower than expected. So prices are coming down and are anticipated to come down further.

So the question you also raised was about the new sort of resource adequacy measures that have come in. They have been introduced, only in the last eight months or so, over one winter alone. So they're pretty much bending down. We did look at this issue as well as the central system services**,** ancillary services, did look at where that resource adequacy measures would need to be enhanced. We looked at scarcity pricing mechanisms and also capacity mechanisms. And the capacity mechanisms is also a very highly politicized debate on both sides of the equation.

I think the general consensus, they're not going to go down a capacity mechanism route, at least in the short term, but a scarcity pricing mechanism would be potentially something. An adder, if you like, a scarcity price adder. The spot energy price would essentially be a bit like the one that Bill Hogan and others developed for ERCOT.

At the same time, there's definitely a bit of a wait-and-see approach to see whether the other resource advocacy measures introduced earlier this year are going to play out well. So, essentially, watch and wait at the moment—no sort of big changes—just to see how things develop in that forum. There are price caps as well to get to the price cap points. But, again, they are reasonably high and also being sort of considered, as well, as part of that debate.

So that's the resource adequacy side. On the Western Australia side, we don't really hear anything about Western Australia in our debates on this. It's not really even included in the issues. They're not part of the game and they're a separate island system. They operate a separate market, they do. AEMO, the system operator, also runs the Western Australia one, but in the debate of the big issues, Western Australia has never ever come up in any of our discussions. So I can't actually tell you that much about it. I do know some of the people working on it, but nothing. Sorry.

Questioner: Thank you.

Moderator: Next.

Question #6: Right. Thanks. This is primarily for Speaker 2, but I'm hoping to make it a broader topic. I'm also curious about Speaker 4 says. It's related to how one thinks about organizing these various ancillary service markets, and under what circumstances to move them into spot markets.

I might be wrong, but I think the US is probably the place, of the places discussed here, where there is the most kind of organized spot markets for ancillary services. Then, in other places, I think this is true in Europe, a lot of these services are organized at the TSO level, a lot through bilateral procurement. So I'm curious whether you and your analysis of Australia had thought about issues such as how thick or thin these markets ultimately are, on the one hand. Then also barriers to entry, once you establish spot markets that may be pretty complex relative to a provider of some ancillary service being able to participate in more of a bilateral procurement, as you think about moving from the left to the right on your chart.

Then I'm also I'm curious whether Speaker 4, you have any thoughts about discussions in the EU about a future design in ancillary services to accommodate the move towards much higher shares with variable renewable resources. And, again, whether there is an argument for organizing spot markets for these or keeping them more in the bilateral realm.

Moderator: Who wants to go first?

Respondent 1: Yeah, thanks for your question. Essentially, I guess there are two cited barriers to entry into these new spot markets that are potentially evolving. The first one was the sort of volatility point I touched on in my presentation. There's concerns that these prices—inertia, for example—quite a lot of the year the price will be zero. Then, very infrequently, the price would go high. Over time one could conceive of that changing, the number of hours when inertia is more in demand, potentially increasing, the prices going higher. That itself might drive entry. But the feedback we had very much was the volatility of the actual real-time price of these things might deter entry and that you can't make the project bankable.

Obviously, the one solution to that—in our view, anyway—is that you can still have long-term contracts running alongside the real-time market. Perhaps with a CFD leaving off. We thought that might be a barrier to entry. But it might be solvable if you wanted to go down that route. To do that, you would have to have the system operator, frankly, rather than participants contracting all those services.

So it wouldn't quite be the nice, dynamic market you would imagine. This is a single buyer for these particular products as and when it's sort of fit. That brings in the second

point and the regulation of these markets, not only AEMO and how you regulate the system operation that delivers best outcomes. But also the barrier to entry, which I think is a bit of a market failure. We started to address it, but I think we need to think about it a bit more. Some of these services can be provided by market participants with generation generators, if you like.

But also, they can be provided by network assets, the obvious one, using inertia, is synchronous condensers can also provide inertia. That's, in Australia at least, a network asset and receives a regulated revenue stream. So when you have that into playing against a market providing the service in a real-time market, you get a bit of a mix. That I could see being a bit of a problem. I don't think we fully solved that issue yet. I could see that being a sort of a barrier to entry that we need to think about more carefully. I think anything that's inertia it's related really. I think probably quite a few of these markets, a lot of the time, there's nothing around. Obviously, it's quite a lot of it. There's lots of inertia in these markets every now and then it will disappear over time.

So I think that's a constantly evolving picture, as the generation evolves across the system, I think that's how to answer this question.

Respondent 2: OK, about Europe. It's an unprepared personal view, more like an opinion. But I think we are less concerned about flexibility than we are about adequacy. Also, our system operator did a study, was very worried about adequacy, but not on flexibility. It's also what we see in the market is that we managed to lower the barriers to entry, for example, for demand response and aggregators. So there is already some flexibility for, for example, the distribution level participating to ancillary services in France, but also in Belgium. That's also something that we see. So it's going more in the good direction and it will develop much more capacity than we have now.

And then the last point is that now these ancillary markets are being organized on a national level. With a new regulation, with a new legislation, this balancing markets and markets for reserves need to become much more European. Also, there will be some efficiency improvements which will probably address the higher need for these results when we have a lot of intermittent generation and renewables and. Maybe a last point. In Belgium, for example, we didn't see an increase by the TSO of the use of this balancing energy and these reserves, just because we also improved the price signal in real time. And also, even for Belgium, we are looking at scarcity pricing in the future. We will probably implement this in the course of 2022.

Moderator: Next question.

Question #7: Hello. I think exciting developments, in general. I had questions about Speaker 1's presentation. In particular, you mentioned how storage in reservoirs has been declining. I just wondered maybe why**.** Just because that's a fixed capacity and the system is growing, etc. You also mentioned, I think, that you had six months going down to four months storage. That seemed, at face, quite a large amount of storage, which likely means that the system is very different than most countries', in the sense that that probably hangs on volatility quite a bit, it would probably dampen things quite a bit if it had that kind of storage in the system. So I was a little surprised by that set of comments you made. You also talked about taxation, which I think you pointed out that Brazil has probably higher just direct taxes. Are those just consumer taxes put on the very end at the

consumer bill? And is it more of a consumption-like tax?

Those are some of the questions I had about your presentation, which I thought was interesting. And then, as you said, Brazil may be thinking about making some changes, perhaps because of the centralized contracting doesn't necessarily get new entry. There may be a connection there with all that storage-making volatility very low and making certain types of assets really not economic at all, like peakers. But I'm just curious about what kind of a system are you thinking? And at which part of the world would you be looking for your inspiration?

Those are the questions I had, and I'm putting you on the spot twice. Thank you.

Respondent 1: Thank you. So as per the storage capacity in the last 15 years, it's been very hard to develop new hydropower plants with reservoirs, because there are increasing social and environmental constraints. So even the larger power plants that have been built recently were run off-river. It does not exactly add to storage capacity.

There are some efficiency gains, though, that could emerge in this hydro platform, because even though we have this large storage capacity in the hydro system, we did not have pumped hydro storage. Some estimates report that we could easily develop something like 20 gigawatts of pumped hydro storage. So, in the sense we would be optimizing, and this inefficiency could partially be explained, because we do not have price variability to be exploited. So what is the sense of investing in this? So there is a lot of command and control that does not create incentives for these power producers to improve their facilities.

Considering taxation, it's not only consumer taxes, but also corporate taxes, as well. This is one of the major discussions there is in the congress right now. This presidential mandate has been able to approve so far a pension funds reform. This is very important and it's not targeting an administrative reform and a taxation reform. So this could significantly improve the business environment.

There was another one—

Questioner: If you were to make changes. I got some sense that your centralized contracting process wasn't necessarily achieving the ends you thought. Where would you look for inspiration?

Respondent 1: I think a nice way to start would be to move in the direction of energy markets, energy and ancillary services markets, starting with standard market design. This is something that some people are already trying to assess. The government in this reform is setting some guidelines for it to be assessed, investigated, and something to be in place in the next three to five years.

This is not easy, though, because we have a lot of legacy contracts that emerged from the last 15 years. Some of them that are very long, and so the challenge would be to adapt this framework. There are some proposals on the table. The government has one that is very complex, is related to the one that I described. Also, even though there are some reforms pending approval in the congress, there is no clear guidance on where to move forward on the proper design. That's why it's hard to give you a very clear answer to your question.

Moderator: Okay, next.

Question #8: The discussion today has mostly been obviously about supply side, but

with the view towards the segue to the next HEPG session, perhaps from each of the panelists some notion of what's going on in those markets in terms of any changes in retail pricing and, adding to that in particularly, focused on demand response into the marketplace.

The question is twofold. One is, what efforts are there looking towards retail pricing reform? Then related to that is looking at demand response playing a bigger role in the market.

Respondent 1: About retail prices—I know that from the European level, it's very clear that they don't like these kind of price interventions on retail prices, but I'm not an expert. I know that, nationally, there are different provisions, for example, in Belgium, you have some social tariffs for consumers. But they are based on market prices. They are just receiving the lowest market price or something like that.

But I'm not aware of all the provisions in other countries. So it is allowed, but it should be as much as possible market based. I think this is more or less the line that is being followed in Europe, but this is more just a general opinion from my side.

Then about demand response. This is something that in all countries, and certainly also in Belgium, is being pushed a lot. A lot of provisions are being taken to lower this barrier for the market. For example, in Belgium and other countries, there is a system setup that is called the transfer of energy, so that aggregators or other flexibility service providers could develop flexibility with consumers, without being their suppliers.

For that, you need some rules about transfer of energy, if you want to keep the prices between consumers and suppliers confidential, which is commercially sensitive information. Then you need some rules to manage this transfer of energy and this is being done, for example, in Belgium. I also think in other countries.

This means that you can lower your barrier for developing more flexibility. And on the side of capacity mechanisms, it's very clear that your capacity mechanisms should be technology neutral, so it cannot exclude certain types of technology, certainly not demand response.

For that, for example, if you do some auctions for your capacity mechanism, you also need to provide auctions, for example, one year ahead. So not only four years ahead for the power plants to be able to be built, but also one year ahead, because it's a market or a time horizon that is much easier for demand response to offer capacity.

Respondent 2: I think the retail pricing, ideally you would want prices to reflect the cost of what's being consumed so that you can incentivize the consumers to consume efficiently. Now that's happening on the unregulated retail side in Mexico. And I apologize if I was just too apocalyptic about what's going on in Mexico. There are some successes.

The retail side has been one of them, because it's kind of under the government's radar. There is a dynamic private retail segment and that's where there's been a lot of innovation. Incentives are aligned, the retailer doesn't want to take on any risks of being in the middle of a commitment that it can't keep. So most of the contract structures have passed costs through to the user as a function of what it actually costs to serve them.

On the other hand, the majority of retail in Mexico is still done by CFE. So those rates are regulated by the retailer. And that's why we've suffered from the regulatory weakening. The CRE in Mexico used to be considered a technically excellent group of people. Being a commissioner was a sign of reaching the pinnacle of your career. Not so much anymore. So we were we were hoping that there would be innovation on the CFE-regulated rates, but at this point in time, it's just frozen.

As for demand response, that can go in a couple of different stages. I think in the most advanced stage that we would all dream of consumers are seeing the real-time price and they're incentivized to respond to the real-time price. And in the most basic stage they might get a signal day ahead and react to that. What's happening to Mexico is definitely in the basic stage and only for the private sector.

Because the real time market, not only are prices not being transmitted to consumers, they don't exist. The retail market has not been fully implemented. It's kind of an after-the-fact adjustment period where the market operator considers any outages that happened unexpectedly or changes in load, but nobody has access to those prices as they happen, so nobody can respond to them.

The only thing that can be done is a retailer could tell their clients that they think prices are going to be high so please consume less and maybe try to work that into their contract. But they can't even bid into the market, offering to them a bid into the market. It's not possible in Mexico for a retailer to say, "I will consume as long as prices are below *x*." They would have to autonomously decide to consume less based on the prediction of prices. So it's in a pretty basic state in Mexico. We thought we'd be moving in the right direction, implementing better and more complete systems. But at this point, it's just frozen.

Respondent 3: Quickly on the retail aside, there is some competition in Australia and the retail market. Like many places in the world, most notably Great Britain, as well, there's been some concern about that over the last decade or so and increasing political intervention. So, in some states, Victoria notably, price caps have been introduced like we have in Great Britain.

But, nonetheless, there is a concept of having retail liberalization and competitive retail markets. Just on the wholesale side, if you like, on the demand side, somewhat nascent is the answer to the question. One of the big planks to the reform process they're thinking about is how to have "two-sided markets." Today, they've applied, and with good reason, on some volatility of wholesale prices to infuse demand one way or the other, on the way they go about managing the demand side of the market.

But they're very keen to move forward and to develop new tools to access more demand-side response, particularly as you get greater penetration of renewables. And I guess AEMO, the system operator, it will be up to them, as the procurer of ancillary services, to the extent they think they can make some ways to harness demand to provide some services over time. As we've done in the UK. So there's some developments, the retail market is good, but the wholesale market is still quite a lot of work to be done, I think, is the conclusion.

Respondent 4: I was laughing at the end of the Mexican story because he mentioned, we thought we were moving in the right direction and all of a sudden, it's all frozen. In fact, I was laughing, but it's very sad. What prevents something like this from happening again in

a country in which institutional capacity is not that strong? Our reality is a bit different because the state participation is lower and also you already have more diversity and private capital in the field. So I'm not so pessimistic about it.

When you consider what would be the next developments in terms of consumers, what is going to happen in demand response with the prices—so 70% of the consumers, as I mentioned, are on regulated tariffs. But this is changing because this amount of consumers is diminishing with the liberalization and all the policies to create incentives for distributed generation, be them wrong or be the right.

Of course, we're talking about net metering, a very aggressive net metering policy that is a very difficult change, very difficult to limit with perverse effects on low-income consumers. So, today, consumers are shielded from price variability. But this is not exactly a problem because price variation is not there already.

So if we move in the direction of markets, of course, this liberalization will create room for consumers to see prices that better reflect costs. And, to a certain extent, we already have companies, a lot of European utilities are there and are supplying a significant part of the market. They are discussing projects to deploy smart meters on a larger scale. Technology will be there to provide price information and proper incentives. The question is, will the regulator allow this to happen, to experiment on different tariff mechanisms that better reflect these costs?

I think the picture that I chose in which Alice is looking at different paths is very appropriate because we may witness, or we may experience several developments in the direction of markets. With technology and changes in regulations, consumers will be able to better experience prices that better reflect costs.

As for demand response, in the current framework this is a very nascent discussion. It's a little more than an intention. Some programs aiming to attract or targeting large industrial consumers have not been very effective, and part of this explanation is because we do not have price variability in the field. But, from next year, we are going to have hourly prices**,** we are discussing a move to bid-based. And so maybe we could, in one of those paths, keep on evolving to something that is more in the direction of a larger role for markets with efficiency gains.

Moderator: I impose on our next questioner because you're spending a lot of time worrying about issues in Europe, as well. I thought maybe you might want to supplement this—

Question #9: Speaker #4 talked about some of this. It's a mixed bag. We talked earlier about capacity markets emerging, a patchwork of capacity mechanisms emerging in Europe and, of course, they have a similar dynamic in terms of the extent to which they really suck the air out of the potential for cost-effective, flexible demand response.

Recently, we see the popular press in the UK treats every incident—there was a recent proposal from Scottish and Southern to implement a program of price-responsive commercial and industrial demand in their service area. They were immediately just pilloried in the press, advocating basically to be a failed utility not supplying consumers reliably, blah, blah, blah, blah. In other words, demand response as failure, as opposed to demand response as giving consumers choices as to how much they actually want to pay for reliability.

That’s not uncommon, that view in Europe. It's tied, I think, to a tradition in Europe of having insanely high reserve margins. I had a conversation with one with the utility executive a few years back from Endesa in Spain, who was the chair of the markets committee for Eurelectric. He recited the story of trying to solicit demand response from industrial customers, and no one seemed to be interested. I had to point out to him that at the time that they tried to do that Spain had a 45% reserve margin.

So where's the value that you could offer consumers, since you've already pre-determined that you’re going to have a 45% reserve margin of generating capacity? That's not uncommon. Germany makes a lot of noise about having no price caps and trying to develop sources of demand response. But Germany has three or four layers of reserves. They’ve got a [UNINTELLIGIBLE] reserve, they’ve got a strategic reserve. And so on and so forth.

So again, the pre-existing decisions—whether you're talking about Germany or Spain or the UK. The UK has today, partially due to their capacity mechanism, a derated margin three to four times the target level. So you're looking at a situation similar to what we see in PJM. So the idea that the scarcity pricing or price-responsive demand is likely to emerge at any time soon is difficult to envision. That's going to play out, unfortunately, at the distribution level in a very difficult way. Because, as you start to see more electrification—[FEW-SECOND GAP IN RECORDING]—additional capacity in the distribution system, which is unnecessary. But it could be very expensive.

The other thing I mentioned is, there are some member states in Europe who are certainly making a bit more of a good faith effort to include demand response as a resource. There is a tendency to see demand response as Demand Response 1.0, where demand response is seen simply as peak shaving to be used a few times a year. Unfortunately, even in that case, most European capacity markets have a minimum bid size for demand response of a megawatt or two-five megawatts.

As you know, in the US capacity markets—I think Matt White is on the call—have a minimum bid size are in the order of 100 kilowatts. So there are still significant barriers to entry for demand response and capacity markets.

At the retail level, Speaker 4 mentioned aggregation as an opportunity. But, generally, what's been adopted in Europe is the net benefits test as opposed to the LMP-G approach to paying for aggregate demand response. The context is quite different in Europe. You've got suppliers as balancing responsible parties. Whereas in the US, the system operator is essentially the balancing responsible party, so the dynamic is a bit different.

Europe at the EU level has mandated a withdrawal of regulated retail prices. That, again, is going to be slow-walked by a lot of member states, but that should improve the consumer access to dynamic tariffs.

And the final thing I'll mention is that there is no nodal pricing anywhere in Europe. There are smaller zonal pricing systems in place in Scandinavia and Italy, Poland is trying to implement nodal pricing. But, of course, to the extent that you're pursuing at the member state level this copper-plate pricing strategy, that again is going to suppress really beneficial price responsive demand, because you're not going to have a signal at the wholesale level that can then be passed

through to consumers at the retail level through various forms of dynamic pricing.

So it's a mixed bag, similar to what it is here in the US. I continue to look back to the proliferation of centralized capacity mechanisms with their mandated reserve margins that ultimately are going to militate against a sufficient level of exploitation of flexible demand.

Question #10: Speaker 3, one of the things that you mentioned only in passing in your presentation was the experience with the clean energy auctions and procuring renewables. As I recall, the prices that came in for those auctions for renewables were astonishingly low, at least from my perspective.

The way I characterized them to people was, "Either they're wrong—in which case, they're not real and there's something else going on, or the climate problem is over." Because we could just repeat this every place else, and we'll end up with such cheap renewables that the problem will be solved automatically. We don't have to do anything else.

What has been the outcome of all that, even though they've stopped these elections? What about the reality of the contracts and the reality of the investments? Are they really as cheap as they said?

Respondent 1: I think they were. There's one hidden, I guess secret ingredient that explains those low prices, which is the developers had a strategy of using the contract as an anchor, in order to be able to get financing and build their plant. But they were always going to build an extra *x* percent—30%, 40%, depending on how aggressive they were—and they had the expectation that that extra was going to earn a really high price as a merchant plant.

So that's how they got the numbers to come out. It wasn't a fraud. It wasn't a mistake. But it was a strategy. But the projects have gone ahead, they've been getting built. Everything's hard in Mexico, so there are a lot of delays caused by the government. But I don't think anyone would say, "Oh, those were just a joke," or some kind of moral hazard playing out, where they thought maybe they'd build it and maybe they wouldn't. Those are real plants, they're actual costs. Just to put everyone on the same page, by the last auction we were getting projects for about $22 a megawatt hour. They get to pass through transmission costs, so that's what their net income is, and it's inflation adjusted, but a little bit less than 100% inflation adjusted.

So I think it is pretty cheap, but probably in their financial models they were expecting income of 28 or maybe 30, with their expectations about windfall profits in the merchant market, which don't look so good anymore because of the demand destruction from COVID.

Questioner: Still, 30 is pretty cheap. Is it scalable?

Respondent 1: The big factor that made the developers' offer so cheap is that they really liked the counterparty. They thought that CFE was equivalent to selling to the government. It was equivalent to having a bond basically with guaranteed income as long as they could generate.

I think the contract was pretty good in terms of not leaving any incalculable risks on the table. So is it repeatable? I guess anyone can do a good contract if they put enough effort into it. But having a good counterparty that's perceived as completely solid, probably that's harder to come by around the world. Good, solid, almost monopolistic counterparties,

they have an inverse relationship with competitive markets. I'll admit that, to the degree that we would have or will transition to a more competitive retail environment with competition among retailers, the perceived risk of generators selling to those retailers is going to go up. They won't be able to get power for 22 bucks anymore.

Question #11: This is a follow-on question to what was just asked about Mexico. With the clean energy resources in the movement to wholesale markets, why would there need to be, one, a specific carve-out for those clean energy resources, especially given the process that you just quoted, with $22 and an expectation of $28 a megawatt hour?

The other issue is, how does the Mexican market, such as it is today, interplay with the Central American interconnected system? I know that CFE has had contracts with Belize Electricity Limited, and it has interconnections to the south. How does that play out as well within the market context?

Respondent 1: When we invented the clean energy certificate, at that time the renewables were much more expensive. It was commonplace that renewables would cost $50 or $60 a megawatt hour and gas was in the $30-$40 range. Both have come down, but renewables much more. So when we invented it, we thought it would be needed.

It's interesting, I think right now it's not needed. If the market were completely undistorted and we didn't have any noise coming from anywhere. The fair price for clean energy dividend in Mexico should be zero or close to zero. Because they don't need a subsidy. What they cost to pay for their financing and the variable cost that they have is less than the value of their energy.

But I still think it's useful to have the tool in place, because as the penetration goes up, the first thing we're going to see eventually is prices in the daytime are going to start getting depressed. There's no duck curve in Mexico to speak of yet, but there will be. So the solar might need a subsidy if we want to attract more solar. And prices will go up because the best resources, the best places and the easiest interconnections, are taken.

Finally, back to the topic a lot of us have been talking about here: if we do find a way one day to put a value on all of the ancillary services that are needed, and if that does lead to an assignment of the responsibility to renewables that sometimes cause it, or at least they can't contribute all the ancillary services, then that might be an extra cost.

So having the mechanism in place, I think, is great, even if it's a zero value for many, many years. Then, as soon as a subsidy is needed to keep meeting goals, you can send the money where it needs to be to keep growing your renewal penetration.

As from Central America, there are two interconnections. The connection to Belize is one 50-megawatt line. Belize is very small.

Questioner: I looked at those contracts in the past when I did some work out there. That's why I was curious about that.

Respondent 1: And there's a 200-megawatt connection to the SIEPAC line. I think, in both cases, the general observation is that it's much more important as part of the resource mix for them than it is as an any kind of ingredient in the Mexican system.

They both depend on imports from Mexico to be reliable. In theory, they're competitive, just as the ties with the US, in theory, are competitive. But in the US import/export ties,

the competition is real. There are a number of traders who either have companies on both sides, or they have a partner on the other side. That leads to daily bids and offers for the imports and exports that drive the timeline prices to equilibrium. Margins are thin. In Central America, not so much. That's because the markets on the other side are pretty hard to do business in, particularly Belize.

As far as I know, there's just one company doing exports to Belize. They capture the value by getting the contract with Belize, and they're just making a windfall. In Central America, it's a little bit more competitive, but much less competitive than ERCOT or CAISO. So there are a number of people doing trades. It's converged fairly well to not zero margins, but margins that just compensate the risk that they're taking.

Moderator: Next question.

Question #12: I would like to make a question about the renewal auctions. I think that in Portugal recently there was an auction with results that was even lower than Mexico. I think was 1.3¢ per kilowatt hour, so really very cheap. And Germany and others are doing auctions, too. How do those auctions fit in the general European market design?

Respondent 1: I think these are subsidized capacities that in most countries are excluded from, for example, capacity mechanisms. For the rest, it’s just to get to the target of a certain percentage of renewable energy. For that, they need subsidies.

So after the subsidies are given, that they are just participating in the energy-only market. Most of the time they are selling their produced energy with long-term contracts, with PPAs to market parties that then try to market this energy. But I don't see any big problems in the current market design.

Moderator: Am I to understand what you're saying is that the auctions for renewables in Portugal are auctions for the size of the subsidy for the renewables, and then they go and sell into the energy market on top of that.

Respondent 1: Yes. And you're going to have different kinds of subsidies, you can have a kind of feed-in. I think it's the case in Portugal. I'm not sure. And then you have other kind of substance like an LCOE, where the revenue is fixed and equal to the last cost of electricity. Then you try to measure or assess the market income, and the difference between this LCOE and the market income is then a subsidy. This is how, for example, wind offshore in Belgium is being subsidized.

Questioner: So 1.3¢ is not a PPA that they sign?

Respondent 1: I'm not sure about Portugal. But for example, in Belgium, there was offshore wind energy that had a LCOE contract and also a subsidy of about, I think, €78 per megawatt hour. It means that the guaranteed revenue is €78. If they can market their electricity at, for example, €38 per megawatt hour, then €40, the difference, is being subsidized by the Belgian electricity consumers.

That is the LCOE. But there are also other subsidy schemes in Belgium and other European countries, where it is just a feed-in tariff where you pay for example €20 or €30 or €50 per megawatt hour and then the markets revenue is on top of that. This leaves a market risk for the investor. The price risk for the investor. Normally, it's viewed from an economic point of view that an SOE subsidy scheme is better because you cancel out the risk. When prices are very high, consumers pay a lower subsidy.

And, the other way around, when market prices become very low, consumers can benefit from these low markets prices but have to pay more subsidies to the renewable energy. It's a bit cancelled out also for the other party. For the investor, it's also beneficial to cancel this risk out. In my view, from an economic point of view, this fixed-guaranteed revenue equal to the SOE is a more optimal subsidy scheme, than just the plain feed-in where you leave the price risk to the investor.

Question #13: We are down to close towards the end of our session and we have nobody in the queue. So I think what I'd like to do is to go back to the speakers and ask each one of them if they have any final comments they want to make for our benefit about what we should learn about both opportunities in their country or regions and the suggestions they might make for us in the United States.

Respondent 1: I think what is interesting in this system is that we already managed to achieve a high participation of renewables. The challenge now is in the institutional framework and, in this sense, the opportunity to move in the direction of markets can bring efficiency. That is a major challenge for the economy as a whole.

Respondent 2: Thanks. Two things. Firstly, the tension between the federal and national- or state-level regulatory policies are a very difficult beast to manage really in terms of the desire, at the local level, to have some handle on the market and security and understanding how securities apply, and how that tension plays out at a national level is a difficult one.

But nonetheless, I think Australia does suggest there may be a way forward with that. So that's point one—managing that conflict between the local and national is something that will carry on throughout in the foreseeable future.

The other one is, when we first started designing energy markets some years, the energy price with 20-odd years ago was all about getting the real-time price right. You get that right, and everything else will come from that. That is still, I think, the case, but also now in starting these ancillary services, getting the real-time price with those, I think, is also going to be the challenge for the next few years, as well. And I think Australia is probably going to have to grasp this a bit earlier than some. So we'll see how they do there.

Respondent 3: One of the things that made the reform so good in Mexico was that all the regulation is centralized, so we were able to adopt best practices without a lot of distractions from 50 different state regulators and too many different people with particular agendas. But that turned into a weakness, because politics are volatile, and governments don't always believe in science or economics or all of those basic principles that I think are pretty popular in this group.

Right now we're in that side of the cycle—a government that doesn't believe in science, basically. But we can't give up hope. This is a cycle, it will end. And I think we've accomplished a lot, first by putting in place the market. But I think, more important. we've created an ecosystem in Mexico of people who believe in power markets. That didn't exist.

When I came here 10 years ago, people, like the people in this group, weren't doing business in Mexico. They weren't asking about Mexico. There was nothing going on. And now they're here and I think that's what we've got to invest, while we can, during this unfortunate period—trying to maintain the

human capital, trying to make sure that people in Mexico don't forget how markets are supposed to work.

So, what can people on this call do? Maintain contact. Maybe one of these days we'll invite some of you to a conference with participants in the market so that we don't lose the knowledge that we've gained over the years. And when the politics turn back to a more favorable cycle then we'll be able to get the regulation and the market moving back in the right direction.

Respondent 4: We've got to explain that what I learned from these presentations and also the feedback is that, apparently, there is some skepticism from some participants about high prices and high price cap—that they will be sustainable, that they will be stable from a political point of view.

It was also very interesting to see the presentation about Mexico, because you see that it can be turned around by politicians very quickly. But, in my view, I always thought, "OK, what is the problem with very high prices in wholesale markets?" You can hedge yourself, you can enter into contracts with fixed prices, you can develop options." And if there is a need for that, if people don't like these high prices and price risk, these option contracts and other instruments will be developed so you can you can take this risk away physically or financially.

Maybe it's a too technical point of view from my side. Maybe I miss the political feeling that high prices will become difficult to accept by politicians or others. But from a technical point of view, I don't see any concern in very high prices, honestly. But, as I said, maybe I'm missing some political feeling in this case.

Moderator: Thank you. Just a point for the benefit of what you said here, if you look at the experience in Texas, in ERCOT, before they adopted the operating reserved demand curve, all of these complaints were heard. The prediction was the regulators wouldn't be able to weather the storm when the prices actually turned out to be high. Those predictions, so far, have turned out not to be true.

So they've gone through it. Many customers were hedged, and it wasn't affected, the ones who were not hedged had done so willingly. They weren't happy when the prices were high. But they didn't have any political standing to go out and get the situation reversed. I agree about the basic point, and I think it's the way we have to go and it's going to be even more important as we get into more intermittent energy and more volatility in the system. I think there's no way out of that problem. So with that, well, that was me again enjoying myself being the moderator.

I want to say thank you to all the participants, but especially to our four speakers. I thought it was very interesting. I learned a lot from this, and I really appreciate all the speakers taking the time and the effort to put together such an interesting and provocative discussion. So thank you and pay attention for the next HEPG session that's coming up.