Enhancing International Smart Grid Collaboration and Policymaking through the Smart Grid Maturity Model

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For more information, see the clean energy policy trainings offered by the Solutions Center.

Mackay: Welcome to the Joint Clean Energy Solutions Center and International Smart Grid Action Network webinar. Good morning and apologies for the technical delay. I hope that everyone can hear me.

Francisco: Yes. This is Francisco here.

Mackay: Hi, Francisco.

Francisco: Hi.

Mackay: I'm working to make sure that the audience can hear me. I think I need to hit star 1. Good morning. Apologies for the technical difficulties and welcome to the Enhancing International Smart Grid Collaboration and Policymaking webinar. This is a joint webinar of the Clean Energy Solutions Center and the International Smart Grid Action Network. Thank you for your patience this morning as we sorted out some of the bugs on our end. We will be respectful of time and will run for approximately 81 minutes. Right now, I would like to say a couple of words about the institutions that have organized this webinar, give a couple of housekeeping notes prior to the beginning and then we will get into the meat of the session this morning.

First on housekeeping items, you have two audio options. The first is to use your computer's audio, the second is to use your telephone. Hopefully the go-to meeting setup made those two options clear and you should be able to either listen through your computer or call the phone number on the screen right now with the access code. Regarding questions, we do expect a sizable audience today, so the way that we will be handling questions is through the typed question area on the right side of your screen. We will do our best to answer all those questions, so as we go along please feel free to ask questions in the question box, and those can either be logistical questions if you need help with the webinar, we will try to answer those questions, or topical questions, which we will be answering at the end of the session.

If you are having trouble viewing the webinar slide we have uploaded PDF's of the slides to the website https://cleanenergysolutions.org/training and after the conclusion

of the webinar a recording of the webinar and the slides will be available on that same website, https://cleanenergysolutions.org/training. Also at the conclusion of the webinar, we will be sending a link to all participants with a survey. We would very much appreciate your feedback, comments, or suggestions for improvement. Now a brief word about the Clean Energy Solutions Center.

The Clean Energy Solutions Center is an international effort to make available best practices in policy formation, public investment, and to track and share trends in renewable energy investment and really an international effort to improve the level of policymaking around clean energy support. One of the main activities of the Clean Energy Solutions Center is to provide virtual trainings including videos and webinars, and to build a user network of policymakers and technical experts. There are a range of platforms for sharing information on the Clean Energy Solutions Center.

One of the emerging offerings of the Clean Energy Solutions Center is an "ask an expert" service available to all countries. This is an effort to tailor technical assistance to a variety of end users around the world, and so beyond the static offerings of the website there is also this dynamic "ask an expert" service. I'm now going to hand the phone over to Russ Conklin who will say a couple of words about the International Smart Grid Action Network. This is a new effort in the past couple of years and so Russ, I will hand it over to you.

Russ: Thank you, Mackay, and I'd like to thank our speakers today, Austin Montgomery and Francisco Acosta for joining us to talk about the smart grid maturity model. My name is Russ Conklin. I work with the U.S. Department of Energy Office of Policy and International Affairs, and I currently serve as the vice chair of the International Smart Grid Action Network (ISGAN). Like the Clean Energy Solution Centers, ISGAN was launched as an initiative of the clean energy ministerial process, and the goal of ISGAN is to bring together governments and their affiliated institutions to bring high-level attention and action to accelerate the deployment of smarter electricity grids around the world. It is a smart grid focused action.

One of our principle initial activities is to look at the tools, the existing tools that are out there to measure the smartness of electricity grids and the readiness to deploy smart grids in different utilities and different countries. Hence, we are very happy to be sharing information today about one such tool, the smart grid

maturity model, both about the development and application of the tool, which Austin Montgomery will be talking about, and also a user experience in the case of Mexico, which Mr. Francisco Acosta will be talking about. I realize we're a little bit behind on time, so without any further ado I will turn it over to I believe Austin who will walk you through the smart grid maturity model.

Mackay: I'll give a brief introduction of Austin while we hand control of the webinar over to him. Austin Montgomery is smart grid program executive for the Software Engineering Institute at Carnegie Melon University. The SEI collaborates with government and industry to address security, architecture, interoperability, process improvement, and other software and systems engineering challenges of grid modernization. Montgomery spent the first part of his career as a mergers and acquisitions attorney, investment banker, and management consultant.

Prior to joining the SEI, he was a founder and senior executive of several startup companies developing innovative software and wireless communication technologies. He received a BA in economics from Harvard University, a jurist doctor from the University of California Hastings College of Law, and an MBA from the Simon School of the University of Rochester and the Anathemas *[spelling unknown]* University in the Netherlands. Without further ado, Austin Montgomery.

Austin: Thank you, Mackay. First I want to check to make sure that you can hear me and that you're seeing my first slide. Could you confirm?

Mackay: That's confirmed.

Austin: Okay. Thank you. Thank you, Mackay and Russ. I know we're running a little bit behind here, so I'm going to move fairly quickly. My job is to give an overview of the market maturity model and leave plenty of time for Francisco Acosta to talk about its application and then for some discussion about how it might be useful in the context of his scan. There we go. I should be on slide two now, Mackay, just checking one more time.

Mackay: That's right.

Austin: Okay. So just very briefly as I'm sure members of the audience know there's a lot going on in terms of modernizing the power grid, and some of the issues that utilities around the world have been grappling with are how do we develop a roadmap for this journey, how do we know we're making progress, how can we

compare ourselves to others and learn, share our lessons learned across markets, across countries, and that really is how this market maturity model came to be developed. I'll be talking primarily about how utilities have been using it and I think we'll have some discussion about how it can also be useful perhaps at an international level. Slide three just in a sentence describes what the model is. It's a management tool providing a common language and framework for understanding smart grid transformation, helping utilities develop a roadmap or a programmatic approach to track their progress. That's the essence of the tool.

Briefly a note on its history. It was developed by a group of utilities including utilities from Europe, Australia, and India, so global from its beginnings. This was back in 2007. This group realized that for this tool to really become useful to the community it might be best maintained by an independent party and given the SEI's history with work of this nature we agreed to take it on. The group conveyed the model to Carnegie Melon. The Department of Energy agreed to support us in taking on this task and improving the model, maintaining it, and making it available to the broader community.

This is slide five. It's just very briefly what is the Software Engineering Institute at Carnegie Melon. Don't plan to dwell on this, but we've been doing work in this domain around software and systems engineering challenges of smart grid whether cyber security or architecture, interoperability. The smart grid maturity model is part of that broader program. We refer to our role as steward of the model, really maintaining and evolving it on behalf of the community. This is slide six is what we mean by that, providing governance, making it widely available and useful to all types of utilities around the world and other stakeholders, evolving it, providing supporting documentation, infrastructure, training, that sort of thing.

The last point here I think is important for our discussion here today, building a community of users and stakeholders around the model and taking advantage of it as a platform for sharing of information. Slide seven just gives a high-level overview of what the model consists of. First there are eight domains as we call them of operating characteristics, and I'll explain those in detail in a moment. There are levels of maturity, progression of moving toward a smart grid, and then obviously this text is too small to read here, but a number of characteristics of what one might expect to find in each domain at each level. By the way, I'll give you a URL later in the presentation, but lots of information about the

model is available on our website including very detailed documentation behind this.

I'm on slide eight now, and I apologize if I'm moving too quickly. I just want to be sure to get through and leave plenty of time for discussion. These are the levels in the model. If you start at the bottom of the page, kind of status quo where we may be today and then work our way up at level one we're taking the first steps, exploring options, conducting experiments, developing vision, and sort of laying the groundwork, and move up to level two where were making the investments based on a clear strategy that will enable a modern grid. At level three we talk about integrating those efforts across the enterprise and starting to see some of the benefits of smart grid investments.

Level four called optimizing is really where the investments start to pay off and you're getting through greater visibility and control of the grid seeing optimized performance. Level five we call pioneering. It's really quite difficult to define at this stage, but just recognize that there's some cutting edge activities that may really be defining what the grid could look like years from now. Slide nine is a brief description of the eight domains in the model from strategy and management regulatory, organization and structure. Obviously there are profound organizational implications for this transformation. Grid operations, core to a lot of smart grid benefits, work in asset management, how work changes and the management of assets changes with the smart grid.

On the right hand side of the page looking more at the information technology and communications infrastructure that's being overlaid over the grid, the customer impacts. Obviously one of the drivers of smart grid is to put the customer at the center of this transformation, offer greater choice and control. Value chain integration refers to new ways of orchestrating the value chain, new business models, new ways of interacting with other stakeholders in the grid and of course the societal environmental drivers are an important part of this transformation around the world, and by societal we think in terms of things like affordability, economic development, some of those broader concerns.

Slide ten is just an overview of what the model really consists of, well the suite. The model itself is that overview matrix that I showed a few slides back, and then detailed documentation behind that that details each of the domains, each of the levels, each of the 175 characteristics. The way that utilities assess themselves against the model is through what we call the compass survey instrument

that basically contains questions for each characteristic in the model. I'll give an example of that in the moment.

The navigation process is a process we've codified, a way to apply the model that seems to really be beneficial to users and I'll briefly describe that in a moment. Then of course training, and in order to fulfill our charter of making the model widely accessible and useful we're engaging with industry experts to help apply it around the world through a partner program. Slide 11 is one example of how the compass survey works. On the left you'll see an excerpt from the model for the work and asset management domain showing the levels and characteristics of each level. The compass takes each of those characteristics and turns it into a question, and I just want to point out the way the levels build on each other.

So this example, work in asset management level two, talks about the characteristic is that you're developing an approach to track, inventory, and maintain event histories of assets to more effectively manage your assets, and there are options for how far along you are in that process. Then at level three the characteristic is that you have in place a condition based maintenance program for key components. So, there's a question that gets at the extent of your condition based maintenance program, but the point here is that in order to implement a condition based maintenance program at level three you would have to have developed the approach at level two for tracking these assets. So, that's just an example of how the levels build on each other within the domain.

I should also point out that the survey consists of these types of questions getting to the characteristics of the model, but also the first several sections of the instrument ask questions about performance and attributes of the utility. So as I'll explain a little bit later what we're hoping to see going forward is correlations going forward between that performance and the smart grid investments and implementation. Slide 12 is a very brief description of the navigation process, which essentially is built around a pair of workshops in which in the survey workshop it's step two, a team of experts from the organization gets together to go through the compass as a team and complete it on a consensus basis.

We've heard really in just about every case that that process itself is very useful, just getting the relevant experts around the table using a common framework and debating where they are today on this journey. It probably results in a better, more accurate picture, and it generates a lot of good discussion and consensus building. Then after some analysis there's a second workshop at which the

results of the survey are presented, so this is where the utility is today, and then they use the model to project a few years into the future and discuss where they want to be at that point, and importantly a lot of good structured discussion around motivations for those objectives, actions required, and obstacles. So very good input into their ongoing road mapping and planning process. I think Francisco will have some examples of using this process.

At the very highest level on slide 13 the output is a profile across the eight domains. This is the snapshot of where the utility based on its responses says that it is today and we'll talk about how to use that going forward. Slide 14 I don't expect to spend time on, but it's a little bit of detail behind arriving at that profile, and the only point I'll make here, in each domain where there's solid greens the utility can choose that level, but on the far right in societal and environmental you'll notice that while there's a green at level two the level was not achieved at level one.

So this utility would still be at level zero and the point here is to reinforce that cumulative effect of the levels. The idea is you don't want to skip a step and find that you've built something on a shaky foundation. A management team would look at this and say, "Well let's go back and look at what we may not have done at level one to be sure we haven't missed anything important."

So this is more output that shows that fictitious utilities results in the green boxes and I'm having quite a delay here on advancing, but basically in comparing itself to the range of responses and the average, which are the orange diamonds, and again there's a lot more detail behind this on a question by question basis allowing the utility to compare itself to the community. I think maybe if I'm going to continue to have these problems I should wrap up, Mackay rather than slow us down. I had a little more information on the community of users, so I'll just briefly say that it's about 120 utilities from around the world, many of them in North America but also most other continents and we are very interested in using this tool as a way to promote information sharing and sharing of lessons learned and potential best practices across that community. There we go.

Let me move to slide 16, which just briefly shows how you might, based on your today profile establish some goals for the future. We always emphasize there's no right answer, no correct target profile. It's entirely a question of the individual utility and its business goals and its environment. Slide 17 is just that picture of the utilities around the world who are participating. Slide 18 shows the distribution by size of utility obviously from very, very large to

quite small. Slide 19 again just a bit of demographics showing the different types of utilities that have participated by their degree of vertical integration, and you can see that it's a fairly broad array, but really the model is targeted at distribution or transmission of distribution operations. That's the primary focus of the model, but you can see there's been an assortment of types of utilities involved to date.

This is what the community profile looks like on slide 20. The bar, the blue bar is the range of maturity levels and then the diamond is the average in aggregate for the entire community. So you can see really the community is just starting out, just initiating this process on average around level one. Slide 21 you can see that smaller utilities here defined as having less than 250,000 meters are perhaps not quite as far along, at zero and one levels in aggregate. Large utilities a bit higher on slide 22, level one and some level two, but again I think the main takeaway from these aggregate pictures is that the industry is embarking on this journey and has a long way to go.

I mentioned that we're engaging with partners around the world to help get the SGMM out there. Slide 24 just shows where we have what we call certified navigators today. There's a training and certification process that harnesses the industry expertise of these folks and then marries that with the model to help utilities apply it. This is the last slide that I plan to talk about, just kind of backing up to the community view, which we may talk about here. We have utilities participating and our partners helping them. Department of Energy and other stakeholders using this as a tool to help the industry advance. We're very interested in SEI going forward and the data that will be collected here.

As I mentioned before we'll be looking for correlations between smart grid implementation and performance, improved performance. We will use all of this feedback to continue to improve the model, hopefully to demonstrate the benefits of smart grid, and perhaps to identify lessons learned or patterns of implementation that are particularly effective. So, again as we build this community the more and more participants we have, the more data there is, the better we'll be able to segment that data for comparison purposes and to draw inferences insights from the data. We think this will also be a useful platform for sharing information, lessons learned on utilities but also potentially as we're talking about here today among nations as we all move forward on this path. That's it for me, Mackay.

Mackay: Thank you, Austin for that great overview and to give us a clearer picture of user experience of the smart grid maturity model. We will now be hearing from Francisco Acosta. Francisco is the chief modernization officer for the Commission Federal de Electricidad in Mexico. Before joining the CFE Mr. Acosta was involved in the banking sector providing his expertise in the creation of financial instruments for mortgage-backed securities. In the energy sector he began his professional career in the Mexican Energy Regulatory Commission in 1994 after which he became a consultant for the Trade Ministry on Energy and Deregulation of natural monopolies.

In 2005 Mr. Acosta was appointed general director for generation transmission and transformation of electricity in the Mexican Energy Ministry as part of the professional civil service. In this position Mr. Acosta was involved in the authorization of the investment programs related to generation transformation and transformation of electricity, which currently provides electricity to 35 million clients throughout Mexico. In generation he was involved in the development and supervision of geothermal, wind, coal, and gas fired projects. He was appointed the chief modernization officer by the board of CFE in March of 2011. In this position he's in charge of the commercialization of telecom services through CFE telecom, information technologies, and all modernization initiatives. We are very happy to have Mr. Acosta with us today and I will turn it over to you.

Francisco: Thank you, Mackay. Just to check, do you see my slide?

Mackay: Yes. Your slide is up.

Francisco: Thank you. First I would like to start with a brief overview of Commission Federal de Electricidad so you can see where we're coming from in terms of how we implemented the smart grid maturity model. CFE is a single operator of electricity in Mexico and is owned by the Mexican government. We're a vertically integrated utility with close to 35 million customers. I would like to point out that being vertically integrated put quite a challenge to us in terms of seeing how we could implement the maturity model because as Austin pointed out it's mainly focused, once you look at each of the domains and the characteristics you can see there's that real focus on distribution, however we've managed to bring together a group that's looking at the model in a broader sense especially for transmission and commercialization services.

One other thing I'd like to point out is the fact that we have close to 93,000 employees. This is a very large organization. It's quite difficult to get a clear message of these types of initiatives to such

a broad organization, which is also a challenge in terms of all stakeholders are involved. In terms of the structure of the energy sector I would say we have a very streamlined organization. We have the Ministry of Energy; we have the two national monopolies, one for the oil industry and one for the electricity sector. We have three regulators, one which is directly involved in the electricity regulation, and we have three research institutes.

Here I would like to point out as you probably saw in one of Austin's slides, one of the domains is related to regulators in general and here we saw that most of the focus here was really based on the U.S. regulatory structure. So for example in our case we saw that our regulator didn't really have a lot to say about any of the strategies or the vision that we would have in terms of implementing a smart grid. The other stakeholder that I think has been very important here is both the research institute in terms of being able to look into the challenges we've been facing in terms of systems and in terms of interacting with the industry, which has to be a very important part of this process.

We in CFE have a very vertical organization. We have five directorates: operation, finance, administration, finance investment, organization, and the comptroller's office. We worked while I was back at the Ministry of Energy around a year and a half ago when we implemented this market maturity model. We mainly worked with the operations department because we were focusing mainly on seeing how we could map the whole process and look at the projects that they were implementing for the smart grid and although we manage to talk with the rest of the organization back then, once I managed to come to see this other side of the table we tried to take all the work that was done back then and really put it up to the decision makers, especially our CEO and our board, and see how we could establish a roadmap for the next 10 or 15 years, which I'll be talking later on.

Mexico as you probably know, most of you, it's a relatively large country with 2 million square kilometers. So in terms of the way we are organized we have 16 distribution editions, which to give you a very rough idea, each of them has to serve around 2 million customers. So by themselves each of them could be considered utility, and that's also part of the large challenge that we faced in terms of seeing what everyone was doing back then and the way they were seeing themselves in terms of how they would be positioned in terms of the model.

So what did we find a year and a half ago? These divisions were investing on scattered projects and these projects were not aligned

to strategic objectives within the organization. I think that was part of the reason, which we saw that implementing the model was useful in terms of aligning these different projects for our overall strategy. We also noticed that there was limited business from a service perspective. Most of these projects were focused just on the technical side and looking at specific problems within each division instead of looking at the broader strategic picture.

There was a weak definition that led to poor project management. There were a lack of indicators in metrics revelation and there was almost no follow up to the benefits of some of these projects, and especially when you manage to have some benefits be quantified you couldn't really compare to any other project because you didn't have the same base or metrics for the revelation. There were also poor communication in results and conclusions. We found there were a number of initiatives in some divisions that were very productive or very useful for the organization, but sometimes some of that information just didn't make it up to the organization or up to the decision makers. There was also no structure for replicating success or standardization.

In terms of the information context we still face a number of challenges, which some of these we've found specifically through the application of the smart grid maturity model. So there's a change in the definition of the enterprise architecture. We don't have within the structure a chief information officer, which although you might think that it's only ready to one of the domains which might be technology, when you find that these two pieces are not within the organization it's quite a challenge to get some things rolling. You have an incomplete business intelligence structure, business processes are not integrated, and most of the operation processes are not business oriented. This focus is mainly on the technical side and we have a mandate by law to ensure liability of service, but sometimes we miss some of the business orientation disregard.

Multiple sources and low quality of information, thousands of non-integrated Legacy systems. This is something that's very important because once we found that we have all these initiatives across the whole organization it's very difficult to integrate the successful ones because you have to be able to plug in that specific initiative into a broader enterprise architecture, which as I mentioned we don't have, but we're working on that. The governance model and structure is something that we've been improving the past few months, but we have still yet to get to the point we want to be.

So as I mentioned we were working back then with – I was at the Ministry of Energy and we were working with Commission Federal de Electricidad and the U.S. Department of Energy and through their bilateral cooperation between Mexico and the U.S. we see support from USAID back then if I remember correctly, Austin, I think it was USAID, and we started with the compass survey, which Austin and one of his colleagues came down to Mexico and we had a large workshop where we included staff from both the corporate office, the central office of CFE, and three divisions so we could see whether we would have a different perspective at the local level in terms of having someone look at themselves in a different way to what we usually see in such a large organization when you come to the corporate offices.

So with regards to the characteristics of maturity Mexico was in with the majority as the slide says because one of the things that we had back then or which we didn't have was the smart grid vision. I think the first stepping stone before any initiative that you might have within your own organization is having a clear vision. You might not have the whole roadmap of how you want to get there in terms of ten years from now or other types of initiatives that you might want to implement, but you have to have that vision.

So after we had that survey we had that support directly from the software engineering institute and the navigators. Like I said Austin was directly involved in this process. We then had a follow up meeting for the aspirations workshop where we established these aspirations for the next three years. So that was almost a year and a half ago.

We're still on our way into trying to get up to these levels in terms of the model, but going within each one like I said, the first one, strategy management and regulatory, it was quite the challenge to see where we would fit for example in that domain. Why is that? We have a very small, concentrated you might say, energy sector, so when we were talking or having discussions with Austin and his team in terms of how the regulator gets involved in our vision or in our implementation process we decided that we didn't really fit into the model in some of those characteristics. So you have to be very clear on what the type of regulatory structure that you have and how the model was structured to see that not all characteristics really applied directly. It's something that is facilitated by the navigator that is going with you in the whole process or along the way.

In terms of organizational structure we found that it's probably the case with most of the utilities that are just embarking on this smart grid initiative that you usually have people who already have you might say a day job and then they have tools to participate in this initiative. Although the most healthy way to go forward implementing smart grid vision would be to have your own structure that is just focused on that, most of us don't have the resources for that. So you have to be very clear that it doesn't mean you have to be up to level five. You might decide I want to be in level two because I do have a number of other functions, which I have to put attention to, and I might not have additional resources. So you have to make those types of choices.

It doesn't mean that you're better or worse than any other utility. So the comparisons across the board with the domains is really kind of tricky. I would say that we don't look at it a lot as a benchmark because you have to look at the numbers and then look at the type of utility that is implemented it and what type of environment they are facing. In terms of real operations, back then we found that we were at a relatively high level. I mean not having really a vision or a roadmap we were at level two back then, so it's something that we feel comfortable with going up an additional level, and it's part of our broader strategic initiatives that we already had a couple of years down the road.

Work and asset management, I think this is the type of domain that sometimes when you look at the specific characteristics it gives you a better feel of the types of things that you might not be really thinking that something like this might be part of smart grid, but with the help of Austin and his team we had a number of discussions where we saw the value of looking at work and asset management and how it's part of the broader smart grid initiatives. So once you're looking at the 175 questions or characteristics of the survey that gives you a very good idea of what the smart grid is really about. Usually the way the smart grid is looked at it's a different definition if you ask a different person.

Like I said, these 175 characteristics makes you think it will be harder about what it's really about and we had a number of discussion were we thought some of these things didn't apply to us, but I think that part of the process is being open to different types of issues that from the day to day you might think you are doing correctly or you're attacking a specific problem, but you have to look at the broader picture. Technology I think is something that is – well in my case in particular because here at the modernization office we are in charge of all technology initiatives, it's something that is maybe not looked at in the right

way in terms of the challenges that you will have down the road in terms of managing information and the communications issues that you will be facing further down the road.

But again it's something that through the navigation process you're able to see at the different issues that today on a day-to-day basis you might not be thinking that for example, something that's very specific in terms of automated meter management. If you're receiving all that information from your meters, there's going to be quite a challenge in terms of managing that information or in terms of seeing what's the most useful information that you will have or how you will be storing that data. I think the model does quite a good job in tackling some of those issues and giving you a better perspective of what you should be doing today in order to face those challenges tomorrow.

Customer, that was something that if I remember correctly was something that, being a national monopoly, we were not really thinking about that because, well, the customer doesn't have an option, and again it's something that is built around the U.S. regulatory environment, but a number of things have changed since we've had this aspirations workshop. Right now the new administration is really focusing on the customer in terms of seeing that although they don't have a different option in terms of electricity supply, they're going to compare you with the telecom industry or the home TV cable providers. I mean it's a relationship, a long-term relationship that you have to manage and you have to improve the service when they compare you to other service providers.

Value chain integration was something that we struggled a lot in terms of looking at that domain and I think something that is also related to a regulatory environment, the business environment within the electricity sector. Then in terms of societal or environmental goals, well we have a strong focus here in Mexico in terms of our energy policy and we saw how we at smart grid would contribute to all the goals that are part of a broader government initiative. Now after looking at all the characteristics and aspirations we drafted and identified initiatives that would allow us to be able to build on what we already have and see how we could face those challenges and achieve those goals that we set for those three years.

So like I said, the smart grid maturity model is mainly focused on distribution and that's why we have a number of initiatives, but we look at the other parts of the process for generation, control, and transmission, and we are currently in the process of looking how

all those initiatives are part of our strategic pillars. So like I said, the new administration is focusing a lot both on clean energy, the central zone modernization, I will elaborate on that, and then customer satisfaction.

So a change that we made was that we were looking at the vision, as it would impact our balance sheet. So how can we discuss or how can we have a better return on investment, but with the new administration we decided to have a more customer-centric approach to this market, which we're currently reviewing and aligning to the aspirations that we set up a year and a half ago. Now the clean energy although we have mostly very large generation projects, especially wind and solar, we think that in the end having a customer-centric vision we had to be able to bring the clean energy option down to the end customer and it's something that's part of the whole process.

As some of you might know or I will describe a little bit, back two years ago in Mexico we had two electricity companies, however by presidential decree the electric utility that served the central area of Mexico City and its surroundings was liquidated and CFE took control of that area. This meant that from one day to the next CFE took over close to six million customers and all the infrastructure that was involved. So major investments are taking place in this area. We are looking into leapfrogging probably most of the rest of the infrastructure that we have in the rest of the country and have state of the art infrastructure in this area in terms of automation and modernization.

Our largest smart meter project is currently being implemented in Mexico City where we have already installed close to 26,000 meters in the Central area of Mexico City and we will be extending that prior to close to 60,000 meters in the next few months. Like I said, we have that vision, which we were working on after we received the input from the smart grid maturity model and now we are working on the roadmap for that smart grid model. So we have right now within our governance structure we have been working within our corporate transformation committee, which is made up of the highest hierarchy within the organization. It's something that's very important in order to be able to push forward most of these projects.

So a number of specialized groups within their different processes, be it distribution, transmission, or generation, are going to be working in aligning that vision and policies to specific strategies and projects so that we can integrate this roadmap, which we will also align to our broader investment program that we currently

have for the next 15 years. So with all this input we'll be identifying the options for technology solution structures and systems for the short, medium, and long-term projects, and perform cost benefit analysis for selected alternatives.

One thing that you have to take into account when you set up those aspirations during the aspirations workshop is that independently of the regulatory environment that you might have or the business environment we're working within a constrained budget. You have to pick the best price which makes sense to you in terms of the vision that you have, but you have to prioritize because you might see a lot of value in terms of the different domains that you might want to tackle in terms of increasing your level in each domain, but you have to pick your battles you might say.

Then we will be verifying the scalability, interoperability, and adaptation of these initiatives to refine the roadmap and consolidate all these into a global timeline for smart grid deployment. One thing also that I would like to point out, which is I think it applies to most cases with all utilities is that the smart grid is something that didn't start a couple years ago. It's something that you might have a number of initiatives, a number of projects that three or four years ago you did not label as part of the smart grid, but you already have that. So you have to be able to see from the application of the smart grid maturation model that a number of those initiatives are already contributing to increasing that – to being able to increase the level at each of the domains, but when you really get to the foundations of the model you see that you have to have the vision in order to see how that priority in particular, which you already might have a couple of years working on or putting resources into, it has to be part of a broader strategy.

So the message I want to convey here is that we found that we had a number of projects, we had a number of people involved in smart grid, but we didn't have a vision. So that implied as Austin mentioned you have that default level where you're starting at zero, and that's a difficult sell when you go to the people who are out on the field. You are telling them, well, you might have something, but because it's not part of something that's broader or that's part of a strategy it's really not contributing to that aspiration. So the fact that you are starting in most of the domains in zero is not something that you would have to think of something that's discouraging at all.

I think it's just being able to say that, well, there are some very specific steps in the process you have to take. You cannot skip

parts and try to achieve some levels like level three or level four if you do not really have a good foundation. I think that looking through the whole navigation process that's something that we manage to learn with the help of our engineer institute. That would be all from my side, Scott.

Mackay: That's great. Thank you, Francisco. We will now move into the question and answer phase of the presentation and as we wait for questions from the audience I will lead off. Francisco, it sounds like the smart grid maturity model has definitely informed the way that your organization plans for investments over the next couple of years. I'm wondering if it has changed in any way the conversations that you have with regulators and customers, specifically are there benefits that you've seen from going through this process on the regulatory front and has that changed the way that conversation unfolds?

Francisco: Well like I said, our regulation, the way our regulatory structure is set up, we don't have to bring these initiatives to our regulator by itself, but we have to take it for example to the Finance Ministry because all our projects are financed through the government budget. So it's a good communication tool in terms of explaining what you are doing or what you want to get. So in that sense it's been quite useful in terms of being able to communicate with that stakeholder in particular. In terms of the customer because we still haven't finished a roadmap we haven't really gone out. We only do it through very specific forums, mostly with the academia, but once we have that roadmap we will be sure to have a very broad description based on the maturity model.

Mackay: And Francisco, would you wager a guess about where you will be in five years given the knowledge that you've gained through this market maturity model?

Francisco: Well I think we would have to go back to once we assess whether we manage to achieve our current aspirations. I think that we're working with a relatively tight budget; we are trying to see also how the industry is evolving. Let me give an example, looking at electric vehicles we have a discussion within the organization whether that's going to be a short term or medium term challenge, so we would have to adapt if we see that electric vehicles in Mexico City or elsewhere within Mexico are trying to take off, and we would have to adapt to those types of specific situations.

So we would need to see also how the customer reacts for example to smart meters, because we are currently just embarking on that. We haven't had any feedback from them, so instead of saying that

for example we will have millions of smart meters deployed, we're still going to have to see how the customer reacts. So I would be very cautious on saying that we will be increasing any of those levels unless we have that assessment in a year and a half.

Mackay: Great. Thank you. I know we may have some questions from the audience.

Male: Hello, Francisco, this is David Alazinga *[spelling unknown]* from the International Energy Agency. I'm curious to hear what the status of your road mapping process is in Mexico and also are you focusing on any areas in particular or are you planning to try to broadly look at smart grid in general?

Francisco: Well because one of our strategic pillars is the customer, like I said with the change of administration we decided that we shouldn't look at ourselves just as a monopoly when we have that client out there. So we're focusing a lot on distribution and most of the resources that we're bringing into looking and having that roadmap set up is looking at distribution. One other thing that we've found for example within transmission a number of initiatives have already been implemented that really are very state of the art, but they were doing it by themselves. It wasn't part of looking at the process with generation and with distribution. So transmission was working by themselves.

We know, David that the IEA has a document on the smart grid roadmap. We have it. We are also looking at it and it's part of a broader process where the smart grid maturity model will provide us with that foundation, but we're looking at a number of other inputs that we will have in order to elaborate that roadmap.

Another thing that maybe I didn't point out is there are a number of vendors out there that also have their models. We have also looked into that, but I think that what we like about the smart grid maturity model is the fact that it's neutral. It's not something that a vendor puts out there in a way they also want to sell you something, so we have focused a lot on expanding into the application of the smart grid maturity model. So maybe a short answer is we're focusing a lot on distribution.

Mackay: There is another way to ask a question besides typing it into the question pane and that is to raise your hand and I can un-mute your phone. If anyone would like to ask a question at this point I'm happy to open the floor. Raising your hand is just a matter of clicking the "raise your hand" button in the control panel. If there are no further questions I would like to just ask one final question

of both Scott and Francisco and that's I guess if you could pick one thing that you would like policy makers, finance ministers to know about this process of modernizing something as complex as an electrical grid, what would it be? What would be that one idea that you would like to catch hold amongst the folks who aren't directly connected to the utility industry but do have a stake in how it develops? I'll let either Francisco or Austin go first on that one.

Austin: Go ahead, Francisco.

Francisco: Oh, Austin, you go first.

Austin: Actually I was gonna get a clarification of the question while listening to your response. Could you restate the question, Mackay?

Mackay: Sure. I was just hoping that you could take a high-level view of this effort of modernizing the grid, which is a massive task, and here we've got this tool that provides a window and a structured way to look at this task, but at the same time it's a complex process. I was wondering if you could pick one idea that you would hope that policymaking stakeholders would come away from this smart grid maturity model understanding, what would be that idea that you'd hope would take hold given the complexity of this process?

Austin: That's a tough one and I'm not sure I have a silver bullet answer. I think it is obviously complex and it's rapidly changing and evolving. I think that's one thing we need to be cognizant of is that it's sort of a moving target. We hope to track that evolution in the model and evolve that as time goes on. I guess from a policy standpoint perhaps communication and clarity.

I guess there is uncertainty and there is rapid change, but to the extent that there can be clarity about the policy environment for the foreseeable future, I think that helps regulators and asset owners make decisions. We all acknowledge that things will change, but I think there needs to be some predictability in terms of the overall direction and the kind of pace of change so that people can make decisions that will have a useful life of at least some years, 'cause these are major investment decisions and I think there's some concern about making the wrong ones. So any predictability that can be communicated I think is helpful.

Francisco: I think that from my perspective something that was very useful having been on the other side both as a regulator and as a policymaker in the Ministry of Energy I found very useful

participating in the COMPA survey. I'm an economist by training, so having the discussion, an open discussion with the different participants was very productive and it gives you a better feel of how they are looking to this challenge and seeing where the people who are out in the field want to focus on. I think it's very important for policymakers to not just have the utility apply them all but to also be directly involved through the whole process. It's very unlikely.

Austin: One other thought, Mackay if I may, Francisco pointed out that they had to make some adjustments in their thinking to effectively translate the model to their environment. We hear that time and again not just internationally but even across different states in the U.S. or different types of utilities but certainly internationally that there are always differences and some have asked can we develop a country specific version of the model to capture those differences. We think there's a downside to that, which is you lose the benefit of comparison across geographies. So I guess the thought would be whereas everybody does have a different regulatory environment, different policy objectives, there's still a lot to be learned from each other and to the extent that we can work with a common framework to share that information it could help everybody. Then you can follow other models, other approaches, and learn from them. That helps everybody.

Mackay: Thanks. Those are great insights. We did receive a question from the audience. I believe this is directed to Francisco. Did the SGMM bring you closer to an implementation strategy for your smart grid, and can CFE issue a business case for implementing different components of the smart grid, for example telecom infrastructure, IT energy storage by using the SGMM or what role did the SGMM play in writing the business case?

Francisco: Well I think that we want to get there like I said on my last slides. We are looking at the different business cases, so getting to that business case I think this market maturity model gives you a clear vision. Again I would really encourage everyone to look at the questions, as they are part of a survey, because once you look to each of those questions and the way they are arranged it really changes the way you look at the whole issue of the smart grid. So the business cases are currently being developed as part of the roadmap. Like I said, if you are looking at a customer-centric strategy working within a tight budget, we need to see how we're going to allocate our resources.

As part of that we set up those aspirations back then. So it's a moving target because you have to get all the pieces, but we'll be

sure to be able to share those business cases. Something that I think I remember I participated in a forum with David L. Singer a couple months ago, and I did mention that it's hard right now to see cost benefit analysis of specific initiatives of different utilities. I think that part of having this network of the utilities that are implementing this market maturity model, something that might be useful is also sharing the knowledge that's already out there in terms of the specific projects, so maybe take it a step further.

Mackay: I think that's a really important point when all the technology and regulatory issues are put aside. The value of bringing people together to share the knowledge of what has happened in the past five years and what will happen is really crucial, and we're seeing that in the United States certainly. I know we have another question from the audience. Go ahead.

Male: Hi, this is Steve Himan *[spelling unknown]* from the International Energy Agency from the IEA speaking and I was just wondering how you see the whole indicators moving along and if you think that some indicators might be more important than others. So what is your experience on that side?

Francisco: Is that directed to Austin?

Male: Either of you. I mean one has probably developed this, so you may give me an answer on that point what have you heard from the utilities, which are the most important indicators in the planning and then also from the Mexican experience what are the relevant indicators for you?

Francisco: Well there are a number of issues here. We have a number of challenges right now here in Mexico City. For example in Mexico City we need to build a new infrastructure that would allow us to have better metrics or better service to clients in terms of interruptions or in case of non-technical losses. So for us looking at the whole country we have different issues depending on what we're talking about. Like I said, you have large division, which might be serving 2 million customers in the Yucatan Peninsula, which have very different challenges in terms of what someone else might be looking in Baja, California close to U.S. border.

So what we want to do with a roadmap is have these broad strategic guidelines, but each division will have to look at their own challenges that they have weaving that regional area or that geographic area that they have. So in our case something that's very important for the corporate office is being able to reduce non-technical losses. So we're looking very keenly to all the issues and

being able to control those technical losses through a number of different initiatives. So I think that's part of our priorities, and also being able to provide the customer with the options in terms of integrating distributed generation or renewable energy, which is something that still hasn't taken off in Mexico, but we are looking with both the Ministry of Energy and other stakeholders to providing the tools to have that.

So that's something that we will have to be adjusting along the way to see if that takes off well. We need to have a different infrastructure as you know in different utilities; the penetration of intermittent energy sources is having a specific impact on the grid. That's looking at the end customer. At a higher level, for example for transmission, we have very concentrated wind resources in a specific area in Mexico. We're currently building more than 2,000 kilowatts of wind capacity in the Oaxaca region, which will probably increase to close to 5,000 in the next few years. So that's a different challenge in terms of being able to work with that intermittent energy source, but we are working with a transmission process and see how we can strengthen the grid at the medium and high voltage.

Something that I think was also a decision that we took back when we applied the model was not taking more than three years down the road. We have to adapt and we have to see what changes we might be facing, so going further than three years in the case of Mexico is probably not the best way to go about planning all these things. We have to work within short timeframes. I hope that answers your question.

Mackay: We have one more question from the audience again directed at Francisco. You mentioned that you're going through a major smart metering installation in the Mexico City area. Can you list the advantages of having these smart meters both on the short term and the long term?

Francisco: Sure. Well I wouldn't say that's a large deployment 'cause it's close to 6 million customers within the Mexico City metropolitan area, so we are installing close to 60,000 in two phases. We are finishing the first phase, which is 26,000 meters in a relatively upscale neighborhood, which is Polanco, for those who know Mexico City, and taking over the operation in Mexico City meant that we didn't know what we were really going to have in terms of infrastructure. First of all we had those 6 million customers, but most of them were using electromechanical meters, well you know those types of meters, and we found that a lot of them were more than 30 years old.

So as part of this process we decided to start applying this smart grid training initiative to see what the actual benefit would be in terms of reducing both technical and non-technical losses specifically, and also being able to start looking to how we could better manage our workforce. So we're trying to give some value added services to that initiative, being able to see how people react to having access to the information of the meters, either through a smart phone or through the Internet, which is probably something that in the U.S. is very common right now and you have a number of utilities doing that, but here in Mexico it's a different culture.

We want to get feedback from the customers and also see how much we can save in terms of operating costs instead of having people go out and take a look at the meters every two months. So we're in that process right now. We will be finishing that project if I'm not wrong probably in the next couple of weeks, and further down the road we'll be happy to share any information from that project.

Mackay: Well I've spoken to a lot of folks who've been in the utility industry for a long time and they say that it's one of the most exciting times to be in this business that they remember, and it very much sounds like that from what we've heard today. I'd very much like to thank our panelists for this very enlightening presentation. We will be making the entire webinar available on the Clean Energy Solutions website and we will be sending an email to all participants afterwards with a couple of items.

The first is an email address where they can send further questions and I can pass them along to the panelists but also a survey. We would very much appreciate your feedback and we hope to see you at future Clean Energy Solutions Center webinars. I'd like to thank our panelists again and all of our attendees for participating and this concludes—

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