

Jeju Island Smart Grid Project

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Webinar Panelists

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This Transcript

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Sean Esterly

Hello everyone. I'm Sean Esterly with the National Renewable Energy Laboratory and welcome to today's webinar hosted by the Clean Energy Solutions Center and the United Nations Foundation's Energy Access Practitioner Network. Today we are very fortunate to have Bruce Lee and Hans Kim, joining us. This outstanding group of panelists would be discussing the Jeju Island Smart Grid Projects.

And, one important note I've mention before we begin our presentation is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is featured in the Solutions Center's resource library as one of many best practices resources reviewed and selected by technical experts.

Now before we begin, I just want to go over some of the webinar's features. For audio, we have two options. You may either listen to your computer or over your telephone. So if you choose to listen to your computer, please select the "mic and speakers" option in the audio pane. Doing this eliminate the possibility of feedback and echo and if you select the telephone option, a box on the right side will display the telephone number and an audio PIN that you should use to dial in. Panelists you just have to please mute your audio device while you are not presenting. If you have technical difficulties with webinar, you may contact the go to webinars Help Desk at 888-259-3826.

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posted to the Solution Center Training page within a week of today's broadcast.

And we have a very exciting agenda prepared for you today that is focused on the Jeju Island Smart Grid Project, one of the world largest smart grid communities. And before our speakers begin their presentations, I'll provide a short informative overview of the Clean Energy Solutions Initiative and then following the presentations, we will have a question and answer session, followed by some closing remarks and then a very brief survey.

And this slide provides a bit of background in terms of how the Solution Center came to be. The Solution Center is an initiative of the Clean Energy Ministerial and it's supported to a partnership with UN Energy. It was launched in April of 2011 and is primarily led by Australia, the United States and other CEM partners. Outcome to this unique partnership includes support of developing country to enhancement of resources on policies relating to energy access, no cost expert policy assistance and peer-to-peer learning and training tools such as the webinar you are attending today.

And there are four primary goals for the Solution Center. The first goal is to serve as a clearinghouse of clean energy policy resources. Second goal is to serve, to share policy best practices, data, and analysis tools specific to clean energy policies and programs. And third Solutions Center strives to deliver dynamic services that enable expert assistance, learning, and peer to peer sharing of experiences. And then lastly the center foster dialogue on emerging policy issues and innovation from around the globe. And our primary audience is energy policy makers and analysts from governments and technical organizations in all countries. We also strive to engage with the private sector, NGOs and civil society.

So in marking feature that the Solution Center provide is the Ask an Expert Policy Assistance. So Ask an Expert is a valuable service offer to the Solution Center at zero costs. And we have established a broad team of over 30 experts from around the globe who are available to provide remote policy advice and analysis to all countries at no cost. So in the area of demand and policy evaluation, we are very pleased to have Bruno Lapillonne, the Vice-President and Co-founder of Enerdata serving as our expert. So if you have a need for policy assistance on demand and policy evaluation or any other Clean Energy sector, we encourage you to use this useful service.

Again, it is provided free of charge. So to request assistance, simply submit your request by registering through Ask an Expert feature at <http://cleanenergysolutions.org/expert>. We also invite you to spread the word about this service to those in your networks and organizations. So in

summary we encourage you to explore and take advantage of the Solutions Center resources and services including the expert policy assistance, subscribed to our newsletter and participate in webinars like this.

And now I'd like to say some brief introductions for our distinguish panelist today. Our first speaker that we'll be hearing from is Mr. Bruce Lee, the Deputy Secretary General for the International Smart Grid Network where he deals with smart grid and renewable energy projects that are related to global climate change. And following Mr. Lee we will hear from Mr. Hans Kim from Korea Telecom and as a Director of Smart Grid Department in KT. Mr. Hans is responsible for leading the business and technical strategy for Smart Grid in Korean Micro Energy Grid. And with those introductions, please join me in welcoming Mr. Bruce Lee to the webinar.

Bruce Lee

Hi, good morning everybody. Welcome everyone for joining us today. I'm Bruce Lee, from ISGAN Secretariat. I am the Deputy—you know, the ISGAN where it started in 2011 and we are try to facilitate government to government. First of all, I like to thank you for the people from Clean Energy Solutions Center and our ISGAN and excellent for preparing this wonderful webinar session. And I assume that Jeju Smart Grid Project is nearly a first smart grid project in the world and it well known as the project many to test into operability among the technologies and utilities for Smart Grid and to verify technologies. So today, I like to deliver a very brief introduction of Jeju Smart Grid Projects first and then more detail information shall be followed by Mr. Hans.

Next slide please.

Yeah, as you see here, the target is to develop and verify the Smart Grid technology and business model. Actually, the period was started in 2009, December and the first phase was finalized in May 2011. That is to enough to facilitate all the operation among the concession. There is you can call the first phase. The second phase started from June 2011 and finalized by May of 2013 last year. So that means this Jeju Smart Grid Project is now ready finalized and then that we have interim reports for the government. And if you look at the budget, the total budget investment amount is 230 million US dollars. Out of them are common investees around 30 percent of total investments up to 70 million US dollars and private sectors, they invest their own, 160 million US dollars. It's compost of 70 percent of total investment.

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Yeah, what is done during this period is that first, we can see, we have verified some technologies. Mostly we have seven categories. We verified

to test technologies. Among them, the most important step AMI areas, another is the EMS, the other one is EVCI, and Interconnections and ESS. So mostly recognized that AMI, and EMS, and EVCI, these areas would mainly test these during these project areas.

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And then another research we can get from this Jeju Smart Grid project is that we just verify some business model. This business model we can categorized into main three or main categories. The first area is customer domain areas. The second is that transportation domain and so the other one is that the other ones. So, mostly a total of nine businesses. We have recognized to verify during the project period and these business model now there are already reports to be come in and to verify and we are going to transfer these business model to new Korea Smart City project which will be started on early 2015.

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So, one of our very famous Korea research institutes they repaired and they require some reports this project leads us during last year so if you look at very briefly we have 153 technologies developed and is verified. Out of them 111 IT has been registered in Korea government and we think that what we need more in smart grid, the business is that, the architecture and interoperability standards. As you all know Smart grid architecture is very, very complicated. And we also need some consensus from global society that's why we need more complicated architecture system we think. So expert there agreed they just give some the great based on the SGMM for five—these five category areas. So probably we think each category, the final and this phase is—the figure is generally with being the higher than 3.5 point, above less than 4.5 grade. So, generally and everybody we think the final I think is based on the SGMM model it could be around the 3.5 grades.

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So as I mentioned on the previous slide, we just recognized the big research with big returns from this project is that we recognized. We got this nine business model from this project. So, this 9 business model, that's based on this three business categories mainly on the Smart Consumer Domain and second is based on the smart transportation domain and the energy usage consulting service and the load leveling and power quality improvement, et cetera. So these 9 business model now we're are going to adapt in view of Korea Smart City Project which will be started early 2015.

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Yeah, so now what's next? As I mentioned, the Jeju smart grid project already finalized on the May 2013 last year. So during last second half the Korean government and KSGI, they prepared some next project which will be lasted for another two years during last year with that [inaudible] [00:14:19] our candidates companies in the local here. They prepare application. And then now from this year we are doing some feasibility study through some Korean, some research institutes among [inaudible] [00:14:42] Korean government. So this feasibility study shall be finalized with that to around this year August to September. Then after we got some results from that research institutes where the feasibility study then probably we can expect that the project will be studies from early next year 2015 and we also expect that the duration for new Smart Grid City project will be lasted for 3 years. And the timing and the schedule can be subject to change. But this is very brief introduction of Smart and Jeju Smart Grid project. And the more details or information's shall be followed by Mr. Hans. Welcome Mr. Hans please. Thank you.

Hans Kim

Thank you very much. This is Hans Kim from KT, Korea Telecom. It's a great pleasure to introduce the Jeju Island field trial on Smart Grid. Well actually my role in Jeju Trial was project leader of KT consortium. So, next slide please.

My talk this day consists of three parts. In the very first part, I will introduce the three aspects off Korean economy including power market and then I will show more details on actually what's going on Jeju field trial. In the final part, we'll summarize some what we learned in this Jeju field trial.

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Well, the slide shows the brief introduction of South Korea economy. Well, actually South Korea is quite small country, less than 115th in world lies maybe the country but regarding on economy they had, let's say as GDP and the volume of trading, it's quite high level, around number 10th over the world and another key, some industries, the semiconductor, and the ship building, automobile et cetera also positions in around top 5 level over the world.

Next slide please.

Now this slide shows that Korea, the system overview in 2008. In right-hand side, there are some indices, especially the rate of the transmission and distribution loss is around 4 point—at 0.1 percent, the number one in the world. And blackout duration is around 16 minutes a year, the annual indices, top two of the world. And also load factors around 76 percent, the one in the world.

Next slide please.

Regarding on this environment, energy dependency in Korea is a very immediate issue nowadays because Korea is one of largest energy consumption countries in the world so we have around 97 percent out of foreign energy dependency. So, how to manage of this energy dependency is one of the mission or agenda.

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This slide will show the overall structure of power market in Korea. Actually before 2001, Korean power market was not privatized and still a part of public sector governed by Korean government but from 2001, this structure of power market started to restructure into very competitive environment but this figure shows a little bit disrupted the aspect 'cause in generation part area a fully and privatized market. So there are more than 80 generation company but in transmission and distribution and including sales part—sales part, there's only one big giant company KEPCO. So the next part of this restructuring, a project will be a competitively environment in T&D and Sales. So this restructuring process is here ongoing issue in Korean power market.

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Here is why Korean government and private sectors tried implement Smart Grid environment in but actually the level of electric circuit consumption in Korea is around number 10 and reconsider Korea to choose this point but the volume of power consumption per capita is around 1.7 comparing OECD average around issues in some grid in right-hand side. So how to reduce or manage of this energy usage and consumption aspect in Korea is—are the issue that's one of the reason of smart grid project in Korea—actually from some survey, economy survey in Korean government mention that if the situation is raised from the very low price and easy access for electric usage in Korean economy.

Next slide please.

Okay, in this second part. I will explain more detail in Jeju field trial.

Next slide please.

Jeju is—how to explain. Jeju is quite lovely island for honeymooners in Korea but why Jeju was selected for this field trial is quite isolated environment, as an island so the system over Jeju Island is quite independent on the mainland and another issue was Jeju Island is quite windy and sunny environment. So we expected at the addendums renewable energy source and another issue is the foreign issue, what makes for strategy but—first of all, the Jeju local government shows that

they have very strong intention is joined Smart Grid environment—Smart Grid project or their future as common free island for the tourism department that's why in Jeju Island was selected for the Smart Grid Jeju trial.

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For this field of trial, we identify five domains for the business model development and the application of technologies 'cause Korea has stable economy but it is very independent on the export trading system. So identification of domains is based on business aspect, not the technology at point. Do the first domain, it is Smart Power Grid. The main purpose of this Smart Power Grid is to upgrade the ecosystem power grid network. Second domain was smart renewable for the operation of stable and clean energy from renewable resources. The third domain was smart transportation and to build electric vehicle infrastructure. The fourth one was smart place, is to build energy efficient, build energy efficient, infrastructure. The last one is the five was the smart electricity service based on Smart Grid infrastructure, we expected a new and very—are the best services. Those five domains were identify and implemented in Jeju field trial.

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Lastly in Jeju field trial was planned only four the public sector members and the original but based on very long discussion between public and private sectors, we agreed the Jeju field trial will be joined from private sectors as well to show our ability and competency in Smart Grid, to share the list of accept consortia including KEPCO and any other private firms. There are more than 170 firms from private sectors especially smart place; there are four consortia, SK Telecom, KT Korea Telecom and LG Electronics and KEPCO. Those three private firms SK Telecom, KT and LG Electronics are very dominant player in the consumer market on communication and wide appliances. So those three private firms intended to find new—there are [inaudible] [00:27:15] for business aspect that's why they embark the smart place domain. And regarding on smart transportation domain, there are two interesting private firms—private consortia, SK Energy and GS Caltex. Those two consortia planned to develop the electric vehicle based business model because they are legal business—their legal business is gas station and oil related business. So when electric vehicle will be fully implemented they worried the closing of legal business model that's why they have interest on this smart transportation domain. The second are—so the area smart renewables, there are two another private firms, Hyundai Heavy Industry, KOSPO as Chair Company, they making company. Those two conforms consuming around the 10 percent of overall Korea power usage. They expected to develop their own distribute their energy resources from renewable

technologies that's why they are interested on this smart renewable domain. And regarding the remaining two domain smart power grid and smart grid service. There are only existing [inaudible] [00:29:13] I Korean power market and Korea Power Exchange, KPX. Those are brief our review of the embark, the consortia in Jeju field trial.

Next slide please.

One of the key, the interesting aspect of Jeju field trial is this project implement very wide they appeared is called [inaudible] [00:29:45] architecture in Jeju Island so smart place, smart transportation, smart renewable and this smart power grid and smart services are implemented and is wide and broad areas in Jeju Island.

Next slide please.

We're more detail on domain. Regarding and smart grid main objectives was to increase energy efficient and reduce energy use via AMI technologies and control energy usage via two-way communication energy management system, so building energy management systems or factory energy management systems and home energy management systems. So, the key technology on the smart place was AMI and another automated real-time was identified and implemented.

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Domain two, smart transportation. There are two objectives. First one is establishing the charging infrastructure for electric vehicle and second one was to allow customers to charge during low-demand and low-rate hours and re-sell during peak hours. Regarding on key technologies was to develop electric vehicle system and charging infrastructure and another issue was how to develop smart grid technology with the collaboration of ICT aspect.

Next slide please.

On smart renewable domain. It's planned to create large-scale renewable generation power plant to build green homes and buildings that are energy independent using renewable energy resources. Key technologies was to for a stable connection of renewable generation to the grid and then how to develop ESS or Energy Storage System for a bulk renewable generation system or the shifting of fluctuation from bulk renewable system.

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Regarding on fourth domain, smart power grid objective was to establish bidirectional power grid that allow new integrated complex business. Those are mentioned in previous three domains. And, the second objective

was to increase energy efficiency and quality through self-automated recovery system.

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And the last one was smart electricity service. The objective was to encourage a TUO pricing including the real time aspect with consumer participation and to promote on-line system for power exchange and derivatives. Key technologies were development a real time pricing and demand the response system. Actually a real time automated demand.

Next slide please.

Here is the field architecture of smart place domain from KT Consortium aspect. In home and building/factory area, you can see many required devices and technologies. Those are smart meter, and renewable resources, and energy storage, electric vehicle charging system, smart appliances and smart box et cetera. Those are implemented in home and building/factory aspect. And from those devices, related data and information was collected into operating center to communication network. Those were storage generation, a mobile communication and IP based network in fixed communication technology. And also added technologies [inaudible] [00:35:44] home. And based on this communication network, the gathered data are stored and processed for the—to develop new business model and identify the very near future, and new—the regulation, defined ones.

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Well, actually these slide was already introduces in Bruce's presentation so I will skip this slide. Next slide please.

And here are some aspect of what technologies were verified. Lastly, if my knowledge is correct, there are more than hundred technologies were accepted and verified but in this slide not covers all of them but you can see some key technologies and what we did. For example AMI, EMS, and Smart Appliances, were everywhere and verified in Jeju field trial. So most of them are already implemented in the leading of Korea government and private sector of all countries and if we're talking about infrastructure, it's already verified including energy storage system. And regarding on grid integration technologies, I don't have much knowledge on this aspect 'cause I'm working for KT putting on smart place aspect but from the message of KEPCO, the dominant company in Korea power market mentioned that they achieved a very distributed research from this Jeju field trial. The last one is Demand Response. Actually the demand response was not the additive technologies and market in Korea in the past but nowadays they're very high technology and business in Korean market based on the verification of those technology in Jeju field trial.

Next slide please.

The last part of my talk, I will explain what we learned Jeju field trial briefly. Next slide please. This slide shows the smart grid roadmap in Korean is identified in 2009. Before Smart Grid Jeju trial project—another the R&D project was researched and developed in Korea from 2005 if my memory is correct. At that time, the project is called [Power-IT Convert] project or intelligent grid based on the achievement on and experience of Power-IT Convert project in Jeju field trial started from 2009. And at 2010, Korean government runs a smart grid promotion law or the very tidy promotion of smart grid issue in Korean economy and based on this promotion law, the other scheduled that are ongoing in Korea. For example the Metro-wide Smart Grid project already started. So in this Metro-wide Smart Grid Project and private consortia involved in Jeju field trial has a new business opportunity in specific area. They involved in Jeju field trial and the end of 2030 Korean government as of May Korea will be a fully Smart Grid deployed a country in the world. So this is very brief roadmap identified from Korean government.

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Before, I introduced the lessons learned, we are now on this Smart Grid Promotion Law. Well, actually the background of this law was three aspect. First one is need for systematic and consistent smart grid business promotion because of the—a little bit disruptive in Korean power market it's not fully competitive, so how to encourage deployment of smart grid is based on the current regulatory aspect. That's why the smart grid promotion law was launched. The second component was the limitation of current regulation and system, is already I just mentioned and how to promote integration of power infrastructure with the IT technology for co-growths. From our experience in Jeju field trial in convergence with other industries are very important aspect. So the last background I mentioned this point. Regarding on legislation, there are points. First point is set up smart grid implementation action plan for over 5 year. And smart grid service provider registration, and subsidies for smart grid project investment, and dedicate areas for smart grid implementation. And the last one is certification and standardization of related technologies and product.

Next slide please.

From our experienced in Jeju, I share some aspect of what? Obstacles we experiences. First one regulation. When the Jeju field trial started with the private sectors, the existing Korean regulation for impact, the private sectors cannot manage any technologies or the business even though it's a part of the micro treaty aspect, the out of cause of demarcation point from existing company. So regulation was very hard but unfortunately Jeju

province government demand to refine their regulation in the local province. So, we could join the project. The regulation was a very big aspect at that time. And others, for example, the skeptical eyes of a stakeholders, low consumer participation. Actually I believe most of you understand why a consumer's participation is quite important issue and very seriously required in smart grid but, it was very, or, we feel it's very difficult to interact with customers. So it was another our new start point in nowadays. And the lack of business model. Even though we developed many business model based smart grid environment, we couldn't find the exact confirmation. The new business model will be a big volume of private sectors, next business engine. Another point was reluctance of market player with vested interest and lack of private investment attraction—excuse me. And another intimate point was I already mentioned in the very first part of my presentation, low and uniform pricing. They didn't make any interest from the consumer's participation and including low incentives for private investment. And regarding on technology aspect, at that time—from 2009 to 2013, there were too many available or a template for technologies and sometimes there's no—the relative of appropriate technology. Those were obstacles.

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Even though we got many difficulties from Jeju field trial, we find and identify some solutions for early deployment of smart grid. First one is that deregulation for market entry and competition. Based on the restructuring program of Korean power market by Korean government, the regulation aspect is ongoing nowadays and the second point was dedicated organization for smart grid planning or public and the private sector. Unfortunately, the Korea Smart Grid Institute govern by Korean government was established. It's still there I'm sure at the moment. And another issue was government consistence will and driving force, and promotion to provoke participation, and R&D competition and incentive was also a very serious issue to be [inaudible] [00:48:10] and from business point of view, discovering demand response resources and setting of utilization plan is considered. And introduction of various pricing is also mentioned and is depending on the education or the public information process. So even though we felt that regarding on the finance aspect of the project and how to make a new business model was also should be considered and the last point is network security and data privacy issue from technical point of view most of the communication technology for smart grid is based on IT practical based but IT mentioned the lack of security issues. So those are another hot R&D issue nowadays. Next slide please.

This is another key point of national smart grid roadmap in Korea but anyhow based on the national roadmap, the Korean government and private sectors are having a research and develop some technology

business model and those are still ongoing datas on Korean power market. But based on the experience and achievement of Jeju file trial, this national roadmap is here, very well operating now from my personal point of view. These are all my presentation. Thank you very much.

Sean Esterly

Thank you Mr. Bruce and Mr. Hans for those outstanding presentations. And I do just want to remind the audience that if they have any questions on any aspect of the presentation, they can submit those questions to the question pane in the GoToWebinar box. And we did receive a few questions from the audience. So I will go ahead and read those and give Mr. Bruce Lee and Mr. Hans Kim the opportunity to address those. And the first question that I received is what are the objectives of the Korea Smart City initiative?

Hans Kim

Okay, where the next title of smart grid—smart city should be replaced by Korea Smart Grid City project. Well, actually smart city is a little bit different, the vocabulary or definition read by another industry. So, Bruce focused on smart grid city initiative. As I mentioned, Bruce also introduced the Korean and smart grid roadmap mentioned that in 2030, the smart grid will be a fully implemented in nationwide. So for this final goal, the—in the state of the middle phase Smart Grid City will be deployed through smart grid technologies and business aspect. That's why some metropolitan—metro areas—metro city, our selected for this smart grid city project for the last year and for the, in the next specific years. So relative, the technology and devices will be implemented around 10 metro cities in Korean economy and then the other areas, small cities and the countryside will be deployed on this year, at 2013. So the main—the proposed over of this smart grid city initiative is to deployed smart grid technology and business, this year, 2013. That's my understanding. Thank you very much

Bruce Lee

Here, I am Bruce Lee again. If I add some more comment on this, yes. I agree with Mr. Hans. That means that the objects that—they're the smart grid project is to we need to get something for the—some technology and that [inaudible] [00:53:44]. So, now as Mr. Hans also mentioned that currently as far as my understanding, that taskforce people for the Korea Smart City project, now ready and very actively and it's also it is by the Korean government and the KSGI as well. Now seven cities in Korea now really involved in this new project and total of eight consortia for this Korea Smart City project are already applied application and that's why now it is on the—under that feasibility study by the Korean government right now. So, probably from last year, that this project initiative then some of the any other foreign stakeholders will be added to this project as well. Thank you.

Sean Esterly

Thank you, Mr. Kim and Mr. Lee. Yes, correct. And the next question, I'll read through and let me know if you'd like me to read it again. It's a little

bit longer. The question is what is the average percent reduction in energy consumption realized from the Jeju trial? What are the top three factors contributing to the reduction?

Hans Kim

Okay, this is Kim. Regarding on the first question. What is the average percent reduction in energy consumption realized from the Jeju trial? The overall average percent was around 10. Actually it's depends on the home and building because there has been a customer and the efficiency officers are chosen on a different level of reduction but average there are 10 percent. But from our—depending it's quite clear resource cut 'cause Jeju Island is very, very countryside. They're our not efficient law to reduce, but anyhow the 10 percent is answer. And regarding on the what are the top three sectors contributing at the reduction well actually we expected some very advance technology that says automated, the control algorithm or the inside home and building. It was our personal, very, very expectation. Well, actually based on technology, only less than 5 percent—only 5 percent reduction on energy consumption and from our survey, others depend on how change uses behavior on energy consumption. For example the how true there are energy consumption taken through the display, for example, smart from app or specific channel at TV and the tablet PCs. We shows specific parameters and indices for example the comparing with the neighbors or it's just their average of times. So how to touch their—the competitive mind. We say these are kind of touch their jealousy in comparing their friend or their neighbor was another good approach. So, the as a conclusion, technology is not the major meter on this how to reduce the energy consumption. The how change uses behavior on energy consumption is should be very seriously taken into account. Thank you very much.

Sean Esterly

Thank you Mr. Kim. In addition to your—the last comment that you made their about behavior changes, have you seen a greater acceptance of smart appliances by consumers during and after the trial?

Hans Kim

Regarding on acceptance of smart appliances is depending on the age or generation of consumer because very old generation taking care of the any technologies but young generation is already adapt to the new technology. They are very interested to manage and control the energy usage through smart appliances and with management system. So the answer, some people are very accepted but others are not. It depends on their generation. That's my experience. Thank you very much.

Sean Esterly

Thank you. The next question talked a little bit broadly about the nationwide smart grid goal. Do you think that the completion of the nationwide smart grid by 2013 is achievable and could you discuss some of the main barriers toward achieving that goal?

Bruce Lee Yeah, I'm Bruce speaking. Yeah, it depends on goal on how they very strong, strongly proceed with the—many stakeholders in Korea and also, you know, during that the project in Jeju, there are some issues so for that's we could afford a private stakeholders. That's why you cannot give clear answer about the issue right now but I can say first we must be based on the how they come and have strong [inaudible] [01:00:54] and this smart grid in Korean society and second how can we do something for private stakeholders stay. They feel they have some more strong benefits in case they involved in smart grid business or not. But, personally I think current we—from the rest of the staff, the peak of course they study their gain that's why right 8 consortia they already applied project, that's why we assume that and based on current institution we can assume we can do this at the pocket of by 2030. Thank you.

Sean Esterly All right, thank you both and that was the last question that I received. So, at this point I'd like to just give you both an opportunity if you'd like for any closing remarks, final statement that you might have.

Hans Kim Yeah, okay. Thank you very much for everyone to joining us today and we are very much pleased to deliver a presentation for the Jeju Smart grid project. As you know Jeju project was as I understand it's very, very long to some many people's involving the smart grid worldwide and we hope that we can deliver some very valuable research to somebody who has interest in the Jeju project. So we already announced that the new Korea Smart City project will be initiated from early next year. So if any foreign companies or some stakeholders could have some inputs then it's very welcome to involve together, that's why we can develop a new project in Korea's very successfully, thank you.

Sean Esterly All right, thank you again to both of the panelists, Mr. Bruce Lee and Mr. Hans Kim. And now we'd like to just ask the audience to take a quick minute to answer a very brief survey that we have. Your feedback is very important just allows us to know what we are doing well and where we can improve. So, Heather, if you won't mind displaying the first question. That question is webinar content provided me with useful information and insight? And the next question please Heather. The webinar's presenters were effective? And the final question, overall the webinar met my expectations. All right and thank you for participating in that survey and on behalf of the Clean Energy Solutions Center I just like to send a thank you to our, all of our expert panelists and to our attendees for participating in today's webinar. And we very much appreciate your time. And I invite our attendees to check the Solutions Center website over the next week. If you would like to view the slide and listen to our recording of today's presentation as well as previously held webinars. So, additionally you will find information on upcoming webinars and other training events. And then we would also invite you to inform your colleagues and those in your network about Solutions Center's resources and services including the no-

cost policy support. I hope everyone has a great rest day and we hope to see you again at future Clean Energy Solutions Center events, and this concludes our webinar.

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