# Hawaiian Electric Companies' June 2017 Draft Grid Modernization Strategy

# Customer and Stakeholder Engagement and Feedback

AUGUST 2017

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## Customer & Stakeholder Feedback to Hawaiian Electric Companies' June 2017 Draft Grid Modernization Strategy

On June 30, 2017, the Hawaiian Electric Companies' submitted their draft Grid Modernization Strategy to the Hawaiian Public Utilities Commission pursuant to Order No. 34281.[1] Included in that draft filing was an invitation for public comment made to an email address established by the Companies.

In addition to the opportunity for comment via email, the Companies held public town hall style meetings on Oahu, Maui, and Hawai`i islands. The public meetings were held in the evening in an attempt to enable greater public participation. At each public meeting, the Companies provided a brief overview of the grid modernization strategy and then invited written comments and questions.

Participation counts are included in Table 1 below and full transcripts as well as written comments from the public meetings are included in in Sections I.A - I.D. Each comment submitted in these town halls is presented below in its original, unedited format. The name of the person submitting the question or comment is included with their submittal but their personal contact information has been redacted or removed.

Table 1 Public Meeting Participation

| Island | Date | Participants |
|---|---|---|
| **Hawai`i (Hilo)** | July 31, 2017 | 16 |
| **Hawai`i (Kona)** | August 1, 2017 | 13 |
| **Maui** | August 2, 2017 | 37 |
| **Oahu** | August 7, 2017 | 48 |

In addition to the public meetings, customers and stakeholders were invited to submit comments by email through August 9, 2017. The public comments received through email as well as a set of in person meeting feedback in included in Section II.

[1] The June Draft Grid Modernization Strategy, this document containing Customer & Stakeholder Feedback to Draft Grid Modernization Strategy as well as the August Final Grid Modernization Strategy have been posted: https://www.hawaiianelectric.com/about-us/our-commitment/investing-in-the-future/grid-modernization-strategy

# I. Public Meeting Documentation

## A. HILO – JULY 31, 2017

### 1. Hilo Transcript

TRANSCRIPTION OF
HAWAII ELECTRIC LIGHT TOWN HALL MEETING
HELD IN HILO, HAWAII
AUGUST 2017

TRANSCRIBER: TERI HOSKINS, CSR #452

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(Video was played.)

NARRATOR: Hawaii is the first in the nation for rooftop solar systems per customer. To integrate all this clean renewable energy, our electric grid now has to operate as a two-way system instead of a one-way system. In the past, energy would be generated at power plants and flow in one direction to homes and businesses. Today, homes with rooftop solar are not only getting energy from the grid, they're sending energy back into the grid. This two-way flow has its advantages and challenges. When they are generating energy, homes with rooftop solar can provide clean power for neighboring homes and communities across the islands.

As rooftop solar energy flows into the grid, other forms of energy need to be continuously adjusted. These adjustments are necessary to safely and reliably meet the demand of everyone connected to the grid. Ongoing grid improvements will help us manage the two-way flow of energy and that will allow us to integrate even more renewable energy.

MS. LEE-MOKU: Thank you, Kristin.

Now it gives me great pleasure to introduce to you Jay Ignacio, who will cover some grid basics and also some specific Hawaii Island informations. For

those of you who don't know Jay, he was born and raised in Hilo and graduated from Hilo High School, and then he went on to college at the University of Hawai'i at Manoa and got his electrical engineering degree. Jay has over 25 years of service with Hawaii Electric Light, and since 2008 he's been our president.

Jay?

Wait, I have to move the mic. Hold on.

MR. IGNACIO: Thanks for your help.

Thank you for coming, spending time with us this evening to talk about grid modernization.

I started in the company back in 1990 and, you know, been very familiar with this picture that you see here, the traditional grid. And we spent many years actually modifying and actually modernizing the grid that we have today, but this presentation is about taking it even a step further, doing even more modernizing, in order to incorporate all of the renewable energy that we anticipate in the future.

So if you look at this slide, you'll see a power plant, and in this particular picture -- sorry, Colton -- in this particular picture, we saw, actually, one of our older fossil fuel plant was the stack. In actuality, currently, we have a mixture of fossil fuel plants; we also have wind; we have hydroelectric on our

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system; we have geothermal. So that represents the power plants that we have on our system.

Traditionally, the power plants would be larger units, would be located centrally, so you have a larger unit located centrally. On our island, the maximum use is about 185 megawatts. A typical unit size, a large unit like this on our system, would be about on the order of 20 to 30 megawatts. So we build the units in that size increments.

So from the power plant, we then step up the voltage from the power plant so that we can bulk-transmit large amounts of power through our transmission system. On our island, the transmission is at 69,000 volts, so we step it up to 69,000 volts, and we distribute, or we transmit, the power across the island, our transmission grid across the island, and it ties in all of these central station generators.

When it gets closer to the neighborhood, then we lower the voltage through our substation transformers, and then we distribute the energy along the streets or neighborhoods, in our subdivisions, downtown Hilo. We distribute it in a lower voltage, a distribution voltage, but it's still a much higher voltage than most people are accustomed to.

In our distribution system, it's 12,500

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volts. It's in that range. It's much higher. It's still, you know, the voltages that most customers cannot handle. But when it gets closer to the customers' facility, their dwelling, their houses, their businesses, we then lower the voltages to what the customers are more accustomed to and can manage. So it will have another transformer that takes it down from 12,500 volts down to 120, 240 volts, which most customers are accustomed to; and that's what you use in your outlets day to day.

That system has worked very well. It actually was a simple diagram, but actually having the grid and operating the grid is much more complex than this simple diagram. We have specialty engineers to make sure that if you have a problem on the transmission or on the distribution, it gets removed very quickly. We build a network where, if you have one problem in one part of the system, it will automatically transfer to another part of the system. So it's still a very complex and sophisticated grid, but what we need to do is make it even more sophisticated, because today the customers themselves can generate energy, so it's not just the central station power plants; it's also the customers.

So we have about 85,000 customers on our

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system, and currently we have about -- the group there does a lot of the interconnection -- we have about 11- to 12,000 self-generating customers, primarily photovoltaic. So you can see 85,000 versus that 11- to 12,000, that's a significant amount of customers that are self-generating today. And going forward, when we looking going forward out to 2045, we anticipate that amount to actually double, so we can actually have 24,000 or more customers actually self-generating. So what we need to do is we need to upgrade the grid so that we can monitor and manage that self-generation. We no longer can just connect and not monitor and manage that generation. So part of this grid modernization is for that component.

While we're doing that, we might as well add other improvements. And I don't want to take Colton's thunder later, so I'll just leave it at that.

Next slide, please.

So we're currently at 54 percent renewable, and like I said earlier, it's a combination of geothermal, wind, photovoltaic; and we need to take it to 100 percent renewable. This chart shows by 2045, but we anticipate that we're actually going to get to 100 percent even sooner than that.

Part of the grid modernization is to help us

meet that goal, because it's going to be a balance; we're still going to have a combination of central station generators but then also a lot of self-generation, and we're going to have to manage that combination, and we're going to have to do it through grid modernization.

So we are Hawaii Electric Light Company. We're part of the Hawaiian Electric Company. Hawaiian Electric runs the utility on Oahu, Maui Electric runs the utility on Maui, Lanai, and Molokai, and then Hawaii Electric Light Company operates the utility here on Hawaii Island. We combine many of our services and partner with our other utility employees. In the grid modernization effort, our power supply improvement planning effort is coordinated, and a lot of it is driven from Hawaiian Electric.

So here tonight we have Colton Ching, who is the senior vice president of Planning and Technic- --

MR. CHING: Technology.

MR. IGNACIO: Technology. That's right, Technology.

So Colton actually leads the group that does the planning for all of the Hawaiian Electric Companies; so I'll turn it over to Colton.

MR. CHING: Okay. So if you guys don't mind,

I'm going to try to do this standing up.

Okay, thanks Kristin.

So Jay talked about a grid modernization strategy, and that's something we have been working on now since January of this year. And we started the development of the strategy not by having a bunch of smart people come up and do some design or architecture; we actually started this process off by meeting with our customers, big and small, residential/commercial customers here on the Big Island, Maui, and on Oahu. We met with energy stakeholders, people who, you know, are involved in the energy space, as well as government agencies at the County level and at the State level, to get their thoughts. We asked them "What do you think the grid needs to be?" "What do you think are the objectives that a modern grid needs to achieve functionally?" and "What are the parameters, the factors, that are most important to you?"

And through this range of conversations that we had over the prevailing months, what came to us as a really strong message from those interviews and discussions was that our customers want a grid that will result in a grid that delivers affordable energy to them; they want that electricity supply to be

reliable; they want to have a say in how they consume electricity; and our commercial customers in particular said they want to have information provided to them on their consumption of energy so that they can make good, informed decisions to help them save money and operate their business more efficiently; and then our customers also said they want to achieve the 100 percent renewable energy goal. It's a legal requirement for us, but we heard it very strong from our customers that it's important to them as well. And for a lot of our customers, they combined affordability with 100 percent renewable energy, right?

And some of you may have your own rooftop solar systems. Some of you may have your own battery system. And a lot of our customers, as Jay mentioned, have already made the decision to make these kinds of investments, yes to be renewable, to reduce their carbon footprint, do the right thing, but they're also doing it to manage their electric bill and save some money. And so they came back to us with the strong message that achieving these renewable energy goals are very, very important. So it's these four parameters that really started our work.

We took this information, this feedback, and we said, "Okay," as we design a strategy to modernize

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our grid, we have to make sure that not just the end point of the strategy, but how we implement, how we go from where we are today to that modern grid that is done in a way that supports these four elements in here.

Okay, Kristin.

So, you know, I brought a handout. I'm not sure if anyone has had the chance to actually read the draft of the strategy. It's about 90 pages long in the body. There's some appendices that go along with it. It's not too long of a document, but it's pretty dense, with a lot of technical information in the draft. So I'm going to cover -- try to attempt to cover the really key elements in a couple of slides, but, you know, this is why we're holding this venue tonight. If you have clarifying questions or if you want to discuss any of these subjects more deeply, by all means, let's have the discussion as we transition to an open house setting. But I'll try and use this slide here to cover some of the main components.

The first thing I want to cover is, you know, this diagram here just shows an illustration of some of the technologies and elements that will be part of our grid modernization strategy in the draft that we file. But before I cover any of those elements, I want to

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actually spend a minute talking about how we plan to roll this out.

And so what was behind how we would approach the deployment and utilization of these new technologies? Because it's probably the one thing that makes our grid modernization strategy different from most electric utilities, makes it a little bit different from what Kauai did as well. And that is our strategy proposes to deploy various flavors of these technologies that I will be covering in a bit on what's called an opt-in basis, right? So if you choose to participate in a demand response program or if you choose to invest in distributed energy resource, a PV system, a battery system, if you choose to participate -- we're talking about time-of-use rates. If you choose to participate in a time-of-use rate program, then we will deploy the technology that will enable and facilitate those energy choices.

We heard very strongly from our customers that they want to have these kinds of choices, and so we need to deploy some of the capabilities with these technologies to make these programs and technologies work well with the grid, but we also didn't want to overinvest. We didn't want to deploy these technologies where perhaps a customer may choose not to

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participate in a program, right? And so we'll only deploy these technologies where we know that they will be utilized. And that actually helps keep the cost of the infrastructure, of what's needed to modernize the grid, down rather than doing things everywhere with the hope or presumption that all customers will participate in various programs. The strategy is built around a deployment that's called proportional, where it gets deployed as customers elect to participate in one of these programs that I described, right?

And so this diagram here just showed every single technology or capability. It doesn't mean that every home or every neighborhood or every circuit will have all of these technologies. We just put it here on this diagram just so that you could see the range of technologies that we're looking at.

And, really, these technologies that we're looking to deploy to modernize our grid is done sort of with two objectives. One is to provide customers -- which I'll give them a choice. So like I said, if a customer makes a decision to participate in a program or invest in a technology on their side, we want to make sure that the grid is able not just to interconnect and accommodate that system or that technology or the customer participating in a program,

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but it also operates in a way that that resource is well-utilized.

So it doesn't make sense to have a customer invest in a PV system and the grid is only able to accept a small portion of the power that it generates, right, or allow it to operate in sort of a restricted way, right? Really to get the best utilization of that resource means that that connection of that PV system or that battery, when it's connected to the grid, really makes the best use of what the capabilities of that system can be. That creates more value to customers, and it creates more value to the grid when it's operated to support the grid, right? So that is one of the key objectives of deploying these various technologies.

The other objective is to use some of these advanced technologies in lieu of more costly and more traditional circuit upgrades. And so one way to, for example, accommodate more distributed solar and distributed storage systems is to make the grid fatter, right, put in more capable, thicker conductors, larger transformers that can take more power. And that can work, but we think, with the use of some of these technologies we're going to be talking about, we can get to that same point, or nearly the same point, at a

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lower cost, right?

So let me focus just in on a couple of items on here. You see in -- see, my vision is bad.

So one of the things that I want to focus on is you see on the far right, you have a customer with -- the house has a rooftop solar system, right? So I kind of use it as an example where our grid modernization work will accommodate the adoption and interconnection of more rooftop solar systems. The same thing holds true for battery systems. You can see that on the left side is a fixed battery system. Those resources, distributed solar and distributed storage, will absolutely be a part of our future.

In order for us to cost-effectively achieve our 100 percent renewable energy goals that Jay described, we need a combination, like he said, of distributed resources like this as well as central station and grid scale resources. And it's only through the combination of those things can we achieve our goals in a cost-effective fashion.

So the grid modernization includes things like advanced inverters, which is -- an inverter is a device that, actually, customers either purchase or they lease or install on their home along with the PV system. An inverter converts the DC, direct current,

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power from a PV system and converts it to alternating current that our outlets in a grid is operated at. It's also used by battery systems.

So we said part of our grid modernization work, to make it cost-effective and work well, really should leverage the capabilities of these devices called inverters. A lot of them today, the really advanced ones, are like small computers; and so they have capabilities to actually help run the grid in their area. It doesn't control the entire grid, but it can sense what is happening locally and make adjustments in how it operates to help do things like manage the voltage in your community.

And so if customers are going to make that investment in an inverter as part of their distributed system, let's make the most use of that investment and use its capabilities to actually provide some of that functionality. And this is where Hawaii is actually, along with California, leading the industry on identifying and really creating the capabilities in inverters to help actually run the grid.

Another example that I want to talk about are things like electric vehicles. There's a car in the garage there, right? An electric vehicle is probably one of the best examples of something called demand

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response. So demand response is this notion or idea that when the utility is operating the grid -- Jay talked a little bit about this -- that to operate the grid reliably, the utility must always keep in balance from moment to moment the amount of electricity that's being consumed on the Big Island with the amount of generation on the Big Island. They always have to be in perfect match. If they're not matched, then things can become unstable that could lead to outages.

And so traditionally, the way that we kept things in balance was to simply allow the electric load to change -- as we all come home from work and we cook dinner, we take a shower, right, watch TV, or whatever it is that we do -- and adjust the generators to accommodate those changes in load. Demand response is the concept of actually subscribing customers with an incentive to actually have some control over that load. So if there's a sudden increase or decrease in load and there's a need to suddenly increase or decrease our generation, we can also have the option of adjusting some of the load that's under contract for demand response.

That's really important in an increasing renewable energy grid that relies less on what's called dispatchable power plants or power generation that have

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a very predictable or commandable level of output, right, basically a car with a gas pedal that you can control, to renewable generators, whether they are distributed or grid scale, that don't have the corresponding gas pedal, right? They produce the amount of power based upon what's happening with the sun or what's happening with the wind or what's happening with the river; and they don't have the same kind of control.

But we always have to keep the grid in balance, and we think demand response in conjunction with generators that do have a gas pedal that you can control is a more cost-effective way to run a grid and avoid having to make investments in a new dedicated power plant that may not get a lot of utilization.

But for demand response to work, it means that the grid now needs to be able to see what loads are doing; it needs to be able to understand what utilization we have on those sets of customers that are participants in demand response program; and we need a communication network that provides the visibility back to the control center and provides the ability for an operator to say, "I need a 10 megawatt reduction in load because I'm having a problem with this power plant. Our load is ramping up much more quickly than I

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projected."

And so that grid now isn't just a one-way electric power grid, right? It becomes now a two-way power grid where power flows down to homes, like it always has for the last 100 years, but power can now flow from homes back up into grid at a much greater scale than it can today.

And then layered on top of that is a communication infrastructure that knows what's happening with distributed generators, knows what's happening on our grid throughout it, and has the ability to control and effectively dispatch these distributed resources when they are under contract by us to do that.

And that, we think, will create more value to customers in their investments. It gets used in multiple ways. It's not just for that one particular business or household; but then it also creates value to the utility and the rest of our customers, because if we can contract for that function at a cost less than building something new and dedicated, then all customers win out. But that only happens if the grid is actually able to perform that function that today it's not or not able to do so universally.

And so those are kind of functions that we're

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looking to do as part of our grid modernization strategy.

But I'll go back to what I said at the very beginning, that this is not just -- Kristin, you can switch to the next slide -- this is not something that we're just going to say, "Okay, this is our strategy, and we're going to go ahead and deploy it throughout the Big Island" or throughout Maui or throughout Oahu. Right? Our plan in our draft is to deploy it as customers participate in a program.

So you may have one customer -- talking to a couple of folks in the audience tonight that are very interested in some of these programs, time of use rate, demand response, maybe greater utilization of your PV system or your electric vehicle; and you can elect to participate in these programs, and we'll deploy the technologies that facilitates your participation and helps to facilitate the operation of your local distribution system wherever you may be located.

But if you're a traditional customer -- and I'll use my father-in-law as an example, right? Retiree, has no desire to participate in any program, doesn't want an online electric bill, wants the paper copy, doesn't want a bank withdrawal, just wants to write a check every single day. If you want to

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continue to be sort of a full-service traditional customer and get all of your power from Hawaii Electric, that's fine too. It's your choice. And everyone will have that choice to make and opportunity to make that choice; but if you're my father-in-law and you choose not to participate in any of these programs, then we won't deploy a Smart Meter or a sensor, right, to your home or to the pole in front of your home because there really isn't that need at this point for that. And so we think that that's the way to make this affordable as time goes by.

And so, for example, to bring it to a close, if you look in our strategy, we've done a very, very rough high-level cost estimate of the strategy; and for all five islands -- Hawaii Island, Maui, Molokai, Lanai, and Oahu -- we think, based upon an estimate of customer adoption of some of these programs, that the modernization effort across the five islands will cost about $205 million. That's a real rough estimate, and it's really ultimately going to be driven by what customers choose to do. But to give you that comparison, although $205 million is a lot of money, it's 40 percent less than our earlier proposal, which was to do a smart grid deployment on these same five islands at a larger scale throughout the network.

And so we think we can get alignment with our State energy policies, alignment with what our customers are telling us what they want from a modern grid, and to do it in what we call this proportional way on an opt-in basis that results in a modernization effort at a lower cost, especially within this six-year period that we're looking at.

So that's kind of a very high-level overview covering 90 pages in a few minutes, but those are some of the key elements.

Kristin, if you can -- oh, thank you.

So if you haven't done so already, you can go to our website. We have a website dedicated just to this grid modernization strategy. On this website, you'll find the Hawaii Public Utility Commission orders that intructed us to develop a strategy. You'll find a copy, a downloadable copy, of the draft strategy as well, and you'll see that public comment e-mail address where you can e-mail your comments to us.

And we're at the phase now, as Rhea mentioned at the beginning, where we are taking our draft that we published, taking input from our customers like you, and going to incorporate that as we refine our strategy from its draft form to the final form.

We ask that you provide us comments in

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writing. You can do so in the hard copies today. You can do it online. You want to do both, that's even better.

At the end of the day, one thing we have committed to is, you know, we're not going to be able to incorporate every single person's comment in our final, but what we have committed to do is to take every written/e-mailed comment that we receive from our customers; we'll provide it as an appendix and submit it to the Public Utilities Commission so they have full visibility to all the range of comments and input that we receive in the foregoing weeks and months.

So with that, I'll turn it back over to Rhea to bring us to a close.

MS. LEE-MOKU: Thank you, Colton. Thank you, Jay.

So now we are entering our question-and-answer period. So for those of you who have filled out question forms, please hand them over to either Darin or Jane. They're going to be walking through the aisles.

In the meantime, I have a few questions that were submitted early, so I'm going to go ahead and get started with them.

Okay, question No. 1. I think this is for

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Colton: If we were designing a power generation and distribution system from scratch, how would it look?

MR. CHING: If we were designing basically the grid from scratch, how would we do it? You know, I think it would definitely look different from the grid that we have today. I think it would use a lot of the technologies that we identified in the draft of the grid modernization strategy into that grid. I think what -- you know, it's a tough question to answer, because no one has that luxury, but it would still -- you would still recognize, I think -- even if we were to design it from scratch, still see a lot of the elements that we see in our grid today. It may be configured differently, right, because people today live in places that people didn't live in 100 years ago, and we grew the grid out, right? If we have the luxury of knowing where everyone was going to live, then we'd probably make some adjustments there. We would probably do things -- for one example, we would probably do things in terms of space and in terms of communication differently. So if we designed the grid today, I think I would argue that we would incorporate into the core design of the grid the ability to communicate, right?

And a lot of these technologies that we're

looking to do, they take a little bit of space, right? And here on the Big Island, space really isn't as big an issue as it is on, say, Maui or Oahu, but sometimes having enough space locally in a community for the right size volt VAR device or the transformers or the switch really becomes a big challenge.

So like if we were designing a house, if you could custom-build a house today for the family you have today, you would probably design the space and layout a little differently.

MS. LEE-MOKU: Thank you, Colton.

Okay, question No. 2. Don't sit down, Colton.

MR. CHING: Don't sit down.

MS. LEE-MOKU: How will the new grid be paid for? There are fewer customers to chip in as many go off grid.

MR. CHING: Okay. That's a really good question.

So when it comes to affordability -- and that was a very important element in how we develop the design of a grid modernization strategy. There will be a cost to do the modernization of the grid. I mean, that's unavoidable. One big element to make it more affordable was to be very deliberate on where we make

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the investments, like I talked about before, around this notion of deploying these technologies only where the need exists and not in places where the need isn't there today.

Although it will take an investment to do that modernization, the other thing we need to keep in mind when it comes to the question of affordability is that we are looking to unlock additional capability and value out of the grid as a result. And so from a customer standpoint, there may be a need to pay for the upgrades in the modernization work, but if it means that your investment in an electric vehicle or investment in a PV system can be further utilized, your value that you see will be greater.

And one of the more unique things about electric utilities is that we make investments for the long term, right? And so for things like modernizing the grid, this is not an investment that we are going to recover the cost in five years or ten years, right? Our recovery period is 40 years long, sometimes 50 years long, depending upon the asset, right? And so that helps make the investments affordable as well because we're going to be recovering it slowly over time rather than in a short period. But at the end of the day, that investment is being designed so that it

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unlocks more value to our customers than the cost of that investment. And that's how we hope and really feel that the grid will become actually more valuable and remain for our customers.

And so, you know, to keep in mind, unlike most utilities in the mainland, the utilities in Hawaii -- this also includes KIUC -- the bulk of our electric bill actually comes from the cost of generation; it's not the cost of the grid itself. And this grid modernization work is really there in place in part to enable those renewable resources that will actually help us get off of oil but also help to reduce the cost of generation. And that's where we think the value lies.

MS. LEE-MOKU: Thank you, Colton.

I'm going to get a little closer to Colton.

Okay. Next question: Does the plan assume centralized control of power generation and distribution or decentralized individual or small group control or a mix?

MR. CHING: One question will be for you, Jay.

MR. IGNACIO: Oh, yeah.

MR. CHING: The answer is a mix. The grid modernization strategy is linked to the Power Supply

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Improvement Plan that we filed at the end of last year, that the Commission accepted a couple of weeks ago. And in order for the State and for the Hawaiian Electric Companies, including Hawaii Electric Light -- in order for us to meet our renewable energy goals that Jay covered, we actually need a combination of distributed resources as well as central station or grid-scale resources. And it's really the combination of the two that gives us that economic combination that allows us to achieve the goals that we actually are mandated by law to achieve.

MS. LEE-MOKU: Thank you, Colton.

Okay. So we'll give one to Jay, but he may pass it on to you.

So, Jay, next question: How will customers' security and privacy be protected?

MR. IGNACIO: So when we deploy these new technologies, part of the strategy is actually to use communications right to the meter and collect that information and, you know, download it into a central storage location. So I think there's two components of, you know, customer information, privacy and security.

One of them we addressed already today, because even if we manually read the meter, we take the

meter and we put it in an information database, so we have certain -- you know, we have controls; we have laws/rules to control the privacy of customer information today. I think the concern going in the future is how secure would the information be if you're going to a wireless system, right? What if someone tries to intercept that?

The systems that we intend to use, they're encrypted so that, you know, you would have to have the encryption or the decoding in order to use the information that you -- even if you intercepted it through a wireless method, you would have to know the coding and the encryption. So there's protections planned into the system.

Hopefully that answers the question.

Colton, do you want to add to that?

MR. CHING: The only thing I would add to it is that Jay and I are not the experts on security, so we have some of our team members that are here. So for those of you who have an interest on this, as we go back into an open house session, I encourage you to talk to Sherry and others who can talk on this at a level that Jay and I just absolutely cannot. They're far more knowledgeable on this.

MS. LEE-MOKU: Thank you. We actually had

two questions that were very similar, so thank you for answering that.

And the next question I'm going to give to Jay: Can a customer refuse a Smart Meter?

MR. IGNACIO: As Colton said several times, the grid modernization strategy going forward is an opt-in strategy; so a customer who wants the meter will opt in and choose to opt in; but there are certain programs that require the use of a Smart Meter, so if you are going to participate in that program, you are going to have to also participate in the use of the Smart Meter. So "Yes" and "No" I guess is the answer.

MS. LEE-MOKU: Thank you, Jay.

So this one, I think, is going to go to both of them. We'll see.

So given that distribution equipment and improvement systems, grid maintenance and management are expensive, how does Hawaiian Electric project to maintain its profitability when so much of the power will be generated by its customers?

MR. CHING: Want me to start off with that?

MR. IGNACIO: Yeah. I'll be the color man. How's that?

MR. CHING: That's a good question. So one of the --

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MR. IGNACIO: The traditional grid.

MR. CHING: -- misperceptions of a utility is that we make more money by selling more electricity. Most companies, that's how they work, right? You sell more popcorn or razor blades, right, what have you, the more of it you sell -- produce and sell, that you tend to be more profitable. But for the Hawaiian Electric Companies, including Hawaii Electric Light, the way we're regulated by the Hawaii PUC is a bit different. And so -- and that different way of regulation means that when our electric sales go up or go down, we still don't have the -- it doesn't mean that we're going to earn more money, right? It means that they're going to make an adjustment (unintelligible) to readjust what's called target revenues around either higher or lower sales.

It's super complicated. It's a very intricate program, but at the end of the day, that mechanism for regulation of the Hawaiian Electric Companies was done specifically to move that disincentive that would otherwise be there if we were to do things that would facilitate programs like customer generation or customers doing more energy efficiency. It makes us effectively neutral from that from a revenues perspective.

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Now, it doesn't mean there's a guaranteed earnings -- earnings is a completely different issue from revenues -- but it resets our revenues around that same target regardless of sales.

MR. IGNACIO: So earlier, I didn't want to steal Colton's thunder, but he didn't even talk about some of the other benefits of grid modernization; so I'm going to cover it, and I think it's linked to the question, because what we want to do is we want to make full value of the investment we're going to make. And part of the value is -- the customer may not see it directly -- it's actually using some of the improvements on the grid itself to make the grid more reliable, and we can improve the reliability and the service to our customers. So that's one way we can get more value.

I went through the traditional grid, you know, from the power plants transmission to our distribution system and down to the customers. Traditionally, we don't use a whole lot of communications. We minimize the amount of communications because we put a lot of sophistication in the devices that monitor the power system.

So we will put communications to each one of those central station power plants. And we don't show

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it in this picture, but there's a transmission switching station right next to the power plants, so we will put communications there, so we will monitor and we will be able to control the power plant and the switching station. We will put communications to maybe, on our system, about 60 percent of our distribution substations.

So we actually have communications going to the distribution substations, but not all of them, because over the years, we have been very good at putting devices at the distribution substation that actually can monitor and sense any kind of problem out on the system and actually record/clear the problem automatically; but going forward, since much of the services, whether it be demand response or self-generation, because you are going to have a lot of those customers out there, part of the grid modernization is to put communications all the way down to the lowest level, and probably at every distribution substation, and still at the transmission switching station and the power plants.

Since we have the communication there, part of the plan is to put more devices out on the system. We don't put devices now because we don't have the communication, so if you put the device there, then

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someone has to go out and read it, and that will increase labor costs; but since we're putting in the communications and we have the communication system deployed, part of the strategy is deploying more monitoring devices. And I think we brought some samples here that you can see.

So some of the devices can actually sit out there, and if you have like a tree branch touching the line, but maybe not -- hasn't fallen and broken and actually damaged your infrastructure, but you might have indications that something is happening, that device can report to a central computer station, and it will alarm and give us a signal saying something is happening on the system, so we can proactively go out and address the problem. We may cut that branch. We may address that tree. And in that way, we can use some of the modernization to lower costs, to fix the problem before it actually causes a much bigger problem. And we can do that for many different type of examples. We can sense when voltages are not within bandwidth, and we can go out there and actually address the problem even before customers even detect that.

So those are the kind of things in addition to what we talked about earlier that we plan to do with grid modernization.

MS. LEE-MOKU: Thank you, Jay. Thank you, Colton.

The next question I think is for Jay: Shouldn't choices for opt in be proportional to expected life of the device? For instance, Power Wall Z versus a ten-year warranty versus time of use a two-year program.

MR. IGNACIO: I don't know. That's something we probably would have to work with the Commission, with the stakeholders, with -- we would probably have to have better information. You know, that's one particular case, but you're going to have, you know, hundreds, if not thousands, of these cases; so we will have to look at it across the board and make a decision kind of collectively what is the best approach to do? So, you know, it's really hard.

I think part of what we're doing today is collect information, so if you want to, you know, submit that as one of your comments or suggestions for us to incorporate, then that will be a good one. But we need to -- when we formulate these programs, we need to incorporate all of that and do what is fair and what is best for, you know, the majority of customers.

Do you want to add to that?

MR. CHING: Yeah, maybe just one thing to

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add. You know, the example given was a Power Wall; and maybe that's a good example to talk about. You know, the warranty period for the current gen. 2 of the Power Wall is about ten years. And that's actually pretty much in line with what other battery suppliers are offering today. But batteries are just one really good example of how new technologies are completely changing the electric utility industry. And the technology for batteries is improving very, very rapidly. It's getting much cheaper. The cost is still kind of expensive, but the costs are dropping very, very rapidly, and while the costs are dropping rapidly, the quality and the surety of how a battery will perform over the long term continues to get better.

So part of what we're trying to do in the strategy is not develop a strategy based upon what we know of today but also create flexibility in our plans to accommodate changes, like the expected improvement and economics of battery systems, right?

So I think it was a really good question or comment that was provided. I definitely want to include that. But that's one of the things that we're facing, so if you have comments or suggestions around how we should be thinking about technologies like this, not just in the static form of what they present to us

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as an option today, but your thoughts about how you think they're going to change over time, or if you have a concern about how things are going to change over time, provide that to us as input, because we need to develop a strategy that can be flexible to change when the world changes around us.

MS. LEE-MOKU: Thank you, Colton.

Okay, this is our last question of the evening. What percent of typical residential bill is dedicated to grid -- I think it means grid costs -- and what percent was it 10 years ago and 20 years ago? And will it grow as more go to home sources?

Colton? Jay? Let me -- no --

MR. CHING: Jay will get it.

MS. LEE-MOKU: -- I'm just joking.

MR. IGNACIO: I don't know it offhand, and it does change over time. Back in maybe 2008-2009 time frame, the breakdown between the cost of energy degeneration, back then it was like 65 percent versus 35 percent. And then 35 percent, you have a further breakdown of, you know, other services. And to that question what percent is for these, you know, grid services, I'm kind of guessing maybe half of that, 35 percent.

Today the cost of oil has gone down and the

cost of, you know, generation has also gone down, so it's no longer in the order of 65 percent; I think it's more on the order of 40, 45 percent. So maybe about half of your bill is for the energy from the power plants, and then the other half is from, you know, grid services, including, you know, some of the -- like the meter reading costs or administrative costs. So that's kind of the breakdown.

Now, these numbers are just coming off the top of my head. I think we can supply much more accurate information in a breakdown. I'm not sure how we're going to get it to the person who questioned.

MR. CHING: If the person comes up to us later, we can get your e-mail address and we can respond to it.

MS. LEE-MOKU: Actually, I have the contact information, so we can get back to the person who asked.

We have one more question regarding the security of grid modernization, but I believe that was already answered through another question.

Do you want me to read the other?

MR. IGNACIO: Yeah, maybe Colton -- the first question was security of customer information. The other concern is, you know, you might have some

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malicious behavior, people trying to actually impact the power system. So maybe Colton can address that.

MS. LEE-MOKU: Okay. So this question is what considerations are being made to protect a more intelligent grid from hacking and possible disruptions caused by people breaking into the system?

MR. CHING: Okay. That's a great question. This is an issue that's on a lot of our minds. It's in the TV and media a lot, not just on the energy space, but on many different avenues.

You know, as we build more intelligence and as we build a communications capability, along with that, it does raise this question about well, how secure from malicious attacks or intrusions is that system?

So there's a couple of things I want to maybe just mention specifically. In our grid modernization strategy, we do have a section where we talk specifically about if and when we build a communications network, that that network be either physically or logically separate from other communications networks. So it doesn't mean it has to be a utility-only owned and operated network. That's definitely one option, but we also talk about the use of cellular, for example, to bring data back from

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various points. It's a cost-effective way to do communications, but we want to make sure that that communication signal back is logically separate from other cellular traffic. So that's one.

Second, the latest thinking today around providing protection against cyber attacks is not to build the tallest and thickest wall to separate things out. That sort of was the approach in the past. The approach now is -- we talk about it in our strategies -- that you build security capabilities inherent within every device at every layer, so you're not dependent upon one impenetrable layer of defense that may ultimately be penetrated by someone, but you create the security within all devices. So even if the unlikely event occurs where there is entry into a network, the entry is just at one point, and it's very limited to that one place.

The other element that we've actually been gaining experience on, on our deployment on Oahu -- we have about 5,000-plus devices installed on parts of Oahu -- is to not just architect into the communication network the most current cyber security functions, but to also actively manage and actively look for vulnerabilities within your network, right? So it's basically stay ahead of the curve by looking for

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weaknesses on your grid. And we have been deploying a third party on our network to actually -- that's their job, right, to look at our communication network that we have on Oahu and actually look for points of weakness before they get discovered and exploited by someone malicious.

So it's all of that combined that provides a greater level of protection.

MS. LEE-MOKU: Thank you, Colton.

I'm really sorry. I know there were a couple hands up, but we've run out of time for the formal question-and-answer period. We are going to be here for another half an hour. We invite you to come up, especially if your questions haven't been answered or you have questions that you just thought of.

Also please remember to provide your written comments either by filling out the comment form this evening or by contacting us through e-mail. And I really again thank you for being here this evening.

UNIDENTIFIED MAN: Can I ask a question? The reason I didn't write it down is because it's a little bit detailed, and it's really important, I think, for everybody in this room --

MS. LEE-MOKU: Sir, do you want to come up -- can you come so we can --

UNIDENTIFIED MAN: I'd rather speak from here if you don't mind. I'll try to speak louder.

I applaud you for having an opt-in program for the Smart Meters. I know you didn't want to do that last year when Nexterra was writing your plan, that you were going to do their type of plan which was going to force it on everybody. I appreciate you doing an opt in, although I know that it was the PUC that was the reason that you actually did the opt in. They told you to. I read the -- I read the comments.

Okay. So there's something in your new plan that -- I want to read this little sentence in there, and I'd like you to explain to me what this means, if you don't mind. It says -- okay, my question is their policy is going to be for those who want to keep their analog meter and not accept a digital meter or a non-transmitting meeter on their home. Eco's application states the following in Section 8.1.1 concerning Smart Meters. And I'm quoting. "Additionally, they will be made available for new customer service requests and as part of inventory for replacing old or failed meters as part of a transition to the new business as usual."

I don't know what that means, but I want to know if I own a analog meter, which I have and a lot of

other people have, and I don't want a Smart Meter, and I don't want a digital meter or a non-transmitting meter, what are you going to do when you come out to put one on my house?  Because I know you want everybody to have these new digital meters because they're more accurate, and you're going to make more money, and it's going to cost us more every month.  This has already been noticed all over the country.  It doesn't get a lot of press, but people know this; it costs more when you have a Smart Meter.  And the answer from a lot of utilities is, "Well, you've been getting by with," you know, "a meter that is not that accurate, so it's payback time."  That's really doesn't fly with a lot of people.

So what I want to know is if you come to my house and I tell you, "No, I want to keep my analog meter," okay?  They have been around 100 years, they're tried and true.  If I don't want to go along with your program, and you tell me, "Oh, yeah, you've got to have one.  You've got to have one of our non-transmitting digital meters," and I say "No, I don't want one.  You're not going to put one on here," are you going to do what all the other power companies in the mainland do and shut my power off or threaten to shut my power off until I comply with you?  Is that the kind of aloha

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you're going to use? Because people need to know this. They may not be here asking this question now, but they need to know. What's the deal about the analog meters? Are we going to be able to keep them, or are we going to have to bend to your rules?

MR. IGNACIO: So you had a long question in there. This issue with respect to electronic versus electromechanical meter is not unique; it's not new to grid modernization. It actually is a situation that exists today. So the whole industry is actually moving away from electromechanical. You know, electromechanical is a unit that spins. It's essentially like a motor.

The industry is now saying, well, it's actually cheaper to manufacture electronic meters. So from a -- you know, we talked about cost. From a decision for the utility, we don't even buy those meters anymore, so, you know, eventually what I see is yes, that, you know, we're not going to have electromechanical meters. It's going to be obsolete. You're going to have to move to a different form of metering.

UNIDENTIFIED MAN: What about the shutting off the electricity if you don't comply?

MR. IGNACIO: If we have to move to a

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different metering, we don't even have the old meter available, that might be a requirement for service. And, you know, we're sorry about that --

UNIDENTIFID MAN: They're available.

MR. IGNACIO: -- but the whole industry is moving that way. We are not going to be manufacturing our own electromechanical meters.

UNIDENTIFIED MAN: You can buy them. I can buy one right now.

MS. LEE-MOKU: Okay, thank you very much.

Again, we'll be here for about 20 more minutes. Please feel free to come up and ask any questions that didn't get answered yet. Please fill out your comment cards and submit them or contact us by e-mail.

Thank you again. Please drive safely. I hear some sirens out there.

Thank you again.

(The meeting concluded.)

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STATE OF HAWAII )

) Ss.

COUNTY OF HAWAII )

I, TERI HOSKINS, a certified court reporter in the State of Hawaii, do hereby certify that the foregoing pages are a true and correct transcription of the proceedings in the above matter.

Dated this 11th day of August, 2017.

___________________________________

Teri Hoskins, CSR No. 452

## 2. Hilo Comments

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

**July 31, 2017 | 5:15 p.m. · Waiakea High School**

Thank you for attending this evening's Grid Modernization Strategy (GMS) Public Meeting. Please provide your name and organization you represent (if any), along with your comment(s) on the Draft GMS. This information will be included as part of the final submission of the GMS to the Public Utilities Commission at the end of August 2017. Comments are also being accepted via email at gridmod@hawaiianelectric.com.

FIRST NAME:* Chuck LAST NAME:* Barker

ORGANIZATION (IF ANY): Hoku Kai Biofuels LLC

(*required)

COMMENT(S): What is genuinely engaging, interesting and important to customers is the inherent advantage of local generation and efficient "sharing" of electrical power that we produce here; a) weaning away from the volatility and persistent unpredictability of fossil fuels, b) the elimination of that substantial component of total cost / kwh, and c) the stabilization of potential for lower cost per delivered kwh to households.

This is what will be the factor that creates public support, and HECO/HELCO should present this as the pre-eminent feature for the contemporization of the grid and power management systems.

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

July 31, 2017 | 5:15 p.m. | Waiakea High School

Thank you for attending this evening's Grid Modernization Strategy (GMS) Public Meeting. Please provide your name and organization you represent (if any), along with your comment(s) on the Draft GMS. This information will be included as part of the final submission of the GMS to the Public Utilities Commission at the end of August 2017. Comments are also being accepted via email at gridmod@hawaiianelectric.com.

FIRST NAME:* RICHARD LAST NAME:* KOVAL

ORGANIZATION (IF ANY):

(*required)

COMMENT(S): IT SEEMS THAT LENGTH OF AN OPT IN PROGRAM SHOULD BE IN LINE WITH EXPECTED LIFE OF A DEVISE THAT A CUSTOMER PURCHASES. IE TOU PROGRAM V.S. BATTERY LIFE.

## B. KONA – AUGUST 1, 2017

### 1. Kona Transcript

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TRANSCRIPTION OF
HAWAII ELECTRIC LIGHT TOWN HALL MEETING
HELD IN KAILUA-KONA, HAWAII
AUGUST 2017

TRANSCRIBER: TERI HOSKINS, CSR #452

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MS. LEE-MOKU: ...for giving us your time this evening. Thank you for being here.

Before we get started with tonight's program, I'd like to go over some housekeeping matters. First and most importantly, we do care about your safety, so if you hear an alarm, that means we need to exit. Please exit through the doors in the back and then cluster out in the parking lot, just to make sure everyone's safe.

Second, if you need to use the restrooms, they are located right outside to the right, to my right -- well, when you're walking out, it will also be on your right. So it's on the right there. And we want you to be comfortable and happy, so we have some water, coffee, and cookies outside. Please help yourself.

The purpose of tonight's meeting is to collect public input into Hawaiian Electric's draft grid modernization strategy, and this will help us update our energy network to achieve our renewable energy goals. We publicly announced our draft plans on June 30th when we filed our draft grid modernization strategy with the Public Utilities Commission.

Tonight we will provide a general overview of the draft strategy, and then we'll open the floor to

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your questions. This is an opportunity for you to give us some feedback. And this is important for us, because we're going to provide your feedback, your comments, back to the Public Utilities Commission when we file at the end of August.

So little procedural things: We have two forms, and they're available outside, but if you need a form you didn't get, just raise your hand, and one of our employees can get them for you.

The first form is a half sheet page, and this is the question form. So if you have questions, please write them on this form and then give them to one of our employees. They'll collect them, and during the question-and-answer period of tonight's program, we'll read off the questions.

The second form is the full-page form. This is the comment form. And we do want your comments on our draft grid modernization strategy. Please fill this out and hand this back in at the front table. There's an envelope for your comments. So these forms will be turned over to the Public Utilities Commission at the end of August as well.

It's not your only opportunity to comment. You can also e-mail your comments, and at the end of tonight's program, the e-mail address will be up on the

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screen. Comments must be received by close of business on August 9th. So just for me, I like to say well, what day is that? That's next week Wednesday. August 9th is next week Wednesday, so if you have comments, please make sure that you send them and you submit them by next week Wednesday.

Let's see. I have all my notes. Let me see if I missed anything here.

Some of you may have questions that are not related to the grid modernization strategy, and that's fine too. You can go ahead and fill them out on the question form, but we'll respond to your non-grid modernization questions later. We'll contact you. There is a place where you put your contact information on, and we'll contact you that way.

So before I introduce our esteemed panel, I would like to help us get started on the topic of grid modernization. And we have a short video that we're going to show, so if you'll look over here on the screen.

(Video was played.)

NARRATOR: Hawaii is first in the nation for rooftop solar systems per customer. To integrate all this clean renewable energy, our electric grid now has to operate as a two-way system instead of a one-way

system. In the past, energy would be generated at power plants and flow in one direction to homes and businesses. Today, homes with rooftop solar are not only getting energy from the grid, they're sending energy back into the grid. This two-way flow has its advantages and challenges. When they are generating energy, homes with rooftop solar can provide clean power for neighboring homes and communities across the islands.

As rooftop solar energy flows into the grid, other forms of energy need to be continuously adjusted. These adjustments are necessary to safely and reliably meet the demand of everyone connected to the grid. Ongoing grid improvements will help us manage the two-way flow of energy, and that will allow us to integrate even more renewable energy.

MS. LEE-MOKU: Thank you, Kristin.

So you know how you go over your head and repeat your mistakes over and over again? So I did this last night in Hilo. I did it again tonight. I forgot to introduce myself. I'm Rhea Lee-Moku for Electric Light Company, and it's nice to be here tonight.

I'd like to introduce to you Jay Ignacio, who will talk about some grid basics. He'll also talk

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about some Hawaii Island-specific information. And for those of you who don't know Jay, he was born and raised in Hilo, and he went on to the University of Hawai'i at Manoa after he graduated from Hilo High School, and he got his degree in electrical engineering. Jay is our president of Hawaii Electric Light. He's been there for over 27 years, and he's got a lot to say.

So Jay, take it away.

MR. IGNACIO: Thank you, Rhea.

Thank you for coming this evening. I think you're very fortunate we have a relatively small crowd, so we can get through the presentation, we can get through the question and answer, but you have a very good opportunity to meet much of the staff from Hawaii Island, Hawaii Electric Light Company, and also from Hawaiian Electric; so I would welcome all of you to take advantage and to meet as many of our employees and ask as much questions as you want on a one-on-one basis.

So I'm going to explain the traditional grid, what we are accustomed to power operating today and how we have been doing it for many years, almost 100 years.

This slide over here to your left shows a diagram of the power flow and a simple diagram of the power system. So on the upper right of the diagram,

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you'll see a picture of a power plant. That depicts the power plant. On our island, 54 percent of our energy is actually produced by renewable resources, so this power plant shows more of a depiction of one of our fossil fuel power plants, but on our island, we have a mixture of fossil fuel plants, but we also have wind, we have solar, we have hydroelectric facilities, and we have geothermal. So that combination is -- you know, more than half of the energy is actually from renewable resources.

So it starts at the power plants, central station large facilities. The total load on our system is about 185 megawatts. That serves approximately 85,000 customers. And a typical size of one of our units would be 25 to 30 megawatts. You can kind of have that figure in your head. So the power plants on the right would be facilities across the island, all interconnected with our transmission systems.

So the next part of the diagram, in the green, that's a depiction of our transmission system. That transmission system ties in all of the central station facilities. On this island, the transmission system is at 69,000 volts. So we take the power from the power plants, we raise the voltage up to the transmission-level voltage, 69,000 volts, we put it

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into our transmission network, and then when you get closer to the users, closer to the load, we then take transmission connections to our distribution substations. So that's the next block. That's the gray block in the middle of the diagram. That converts the voltage from the transmission voltage to the distribution voltage. So you may recognize some of these substations around the island. That will take the 69,000 volts and it will reduce it to 12,500 volts.

Now, typically, most customers can't use the distribution-level voltage. It's still too high, 12,500 volts, but that's the voltage that is distributed in your neighborhoods, and in the streets you'll see many of the overhead lines. It's a little lower. It's about, you know, 40 feet above ground. That's distributed at 12,500 volts.

But then when you get closer to the customers, when you get in front of a customer or residence, you will have another transformer, and that transformer will reduce the voltage once again to a more -- to a useable level that most customers are accustomed to; so it will reduce it from 12,500 volts down to 120, 240 volts. And that's what most customers are accustomed to when you plug into the outlet.

So that's the general gist of how power is

generated and then taken to the customers' homes. We have been doing it this way for many years. It's generally one-way power flow, from the central stations all the way down to customers.

What most people don't realize is mirroring this whole network of electric facilities, we also have a lot of communication facilities and a lot of devices out on our power system to help operate it. So we have a central operating center. It's actually in Hilo. We have a network of microwave. We use telephone lines. We have fiberoptic cables. And we take information from the power plants across the island, we take information from our switching stations, from our distribution substations, and we take it to our central operations station that we actually monitor and we actually control the power system from our central operating. So most people don't realize that on top of a very visible power system, you also have a robust communication system.

Now, moving forward -- and we've seen it, you know, over the last six or seven years -- more and more customers are generating their own power. So on the lower right of the diagram, that shows the customers. And customers are primarily generating their own power through photovoltaic systems. So now the power system

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actually has to accommodate power flow from the central station power plants, but also going the other way, from the customers back into the grid and actually up into the transmission itself. It's more complex, and we need to be more sophisticated. And a big part of the grid modernization that we're doing is to accommodate the self-generation.

Now, the communication and control network that I talked about, most of it stops right at the gray box, that distribution substation. A big part of grid modernization is actually deploying more communication capability in that red lines, in the distribution itself, so a lot of the communication upgrades is going to be on the distribution system.

So we have this challenge to go from where we are today, 54 percent, all the way to 100 percent. By statute, we need to achieve this goal by year 2045, but with the addition of more resources and a recent approval of a biomass plan, there's a high likelihood that we can achieve this 100 percent goal even before year 2045.

Next.

So we're Hawaii Electric Light Company. We own and operate the electric utility here on Hawaii Island. The electric utility on Oahu is Hawaiian

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Electric. We're actually a wholly owned subsidiary of Hawaiian Electric; and Hawaiian Electric also owns Maui Electric, which operates Maui Island, Lanai, and Molokai. We partner with Hawaiian Electric and Maui Electric to develop a lot of the studies, to do a lot of the engineering jointly. We get, you know, gains and reductions in cost by partnering in that way.

So the grid modernization strategy is actually a work from the three different companies; and leading that effort is actually Hawaiian Electric. And tonight we have the senior vice president of Planning and Technology, Colton Ching; so he will give you more of the details included in the draft strategy.

Thanks, Colton.

MR. CHING: Thank you, Jay.

Thank you for having us over this evening and coming down here to allow us to share with you the grid modernization strategy that we've developed thus far.

Before I begin talking about the strategy that we've actually developed in draft form, I want to spend some time talking about how we came about to develop a strategy. This started off at the beginning of this year. The Hawaii Public Utilities Commission, which is the state agency that regulates all the utilities in Hawaii, issued an order instructing us to

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develop a strategy for grid modernization that would give them some perspective and context in understanding more broadly how all of the Hawaiian electric companies -- Hawaiian Electric, Hawaii Electric Light, and Maui Electric -- will plan to develop grids out into the future.

We took that order, and before we took a pen to paper or, I guess, fingers to keyboard and began developing a strategy, we actually spent quite a bit of time sitting down with customers on the Big Island, on Maui, and on Oahu as well as local and state agencies, some of our largest customers, and really sat down with them and asked them what they wanted -- as customers, as users of the electric system, what they wanted from a modern electric grid. What did they want as an objective of a good modernization effort to accomplish?

And what we heard consistently between the islands, as well as between customers that represent large companies and large businesses and individual homeowners that are individual customers of ours, were very consistent in some sort of key objectives. And this slide here kind of encapsulates those sort of four sort of pillars of feedback that we got or received from customers:

Our customers want affordability. They want

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a modernization effort to result in electric supply that is affordable to them.

Second, they want that electric service to be reliable, to be very reliable.

Number three, bottom left, is that our customers said they want to have choices, right, in how they consumed energy, in how they interacted with their electric utility, in particular as customers adopted technologies themselves, like photovoltaic systems, like battery systems, like electric vehicles. They wanted to have choices in how they interacted with each of their electric companies.

That takes a step further with our larger commercial customers, who really wanted to have visibility into how they consumed energy so they could make smarter, more informed decisions of how they consumed energy in the future, with the objective of managing and lowering their costs and making their business operations more efficient.

And then lastly, our customers -- I think this is no surprise -- strongly resonate with the state renewable energy goal of 100 percent RPS. And customers described both achieving the renewable energy goal from the perspective of doing the right thing and decarbonizing the state and weaning us off of fossil

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fuels; but customers also connected 100 percent renewable energy with the first square on the upper left of affordability, because a lot of our customers have already made decisions to invest in a renewable resource that helps them to either reduce their cost of energy or to obtain more certainty in the price of energy in the future. And as much customers as we have today who have already made that decision, there are a lot of other customers -- and this came back in our feedback -- a lot of other customers who may not have made the decision yet who expressed some interest in doing so in the future. All right. So that was a very strong bit of sort of feedback we got from the customers.

The very next thing was that it was very consistent. We didn't get sort of different ideas from different customer classes. We didn't get different ideas from different islands. It was very consistent across, including customers that we interviewed here on the Big Island.

So we took that information -- and, Kristin, if you can move on to the next slide -- as a starting point for us to develop the strategy that I'll be talking about.

So very much at the heart and at the core of

the grid modernization strategy draft that we've developed is around creating capabilities within a modern grid that allows customers to have choices in how they interacted with the utility, how they could use their own technologies and their own investments to work not just for the benefit of themselves, but to create additional value by interacting with the grid itself.

And this slide here gives some examples of some of the customer choices that we identified as things that need to be enabled as an objective in our grid modernization strategy. So on the right-hand side, you will see this list. All right? The most obvious thing, the thing that's been most adopted thus far, is customer-sited solar. Whether it's on your home or on a business that you visit, solar is a big part of the renewable energy portfolio that we have today; and it will serve an even greater role in the portfolio of renewables that will take us to 100 percent that Jay talked about earlier.

And so a modern grid absolutely needs to be a grid that can interconnect, integrate, and operate with a lot of distributed solar systems. And as Jay talked about in his introduction, the electric grid that we have today was really never designed from the onset for

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a lot of generators to be distributed on individual homes and businesses that produce electricity, not just for the consumption at home, but electricity that actually flows back into the grid in a direction that's actually the opposite from which the grid was originally designed. And so clearly for our grid modernization strategy, the grid that we need to build to is the grid that's needed to operate in this two-way fashion.

In addition to solar, though, there are a lot of new technologies that are being adopted today, maybe not at the scale of solar yet, but clearly are technologies that will become much more common on all of our islands into the future. And it's things like solar storage. I heard some folks during the discussion before we started talking about a Tesla Power Wall and distributed battery systems. Those are good examples of distributed batteries combined with solar. That's just starting, but I think there's a lot of investment and there's a lot of interest in this technology.

And then there's also a series of technologies that can be used in something called demand response. So the notion of demand response is the idea that when Jay and the employees of Hawaii

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Electric Light operate this island's grid every single day, we always need to keep the balance in check between the total amount of energy being consumed across the entire island with the amount of power being generated here on the Big Island. And there's no cable that interconnects the Big Island to another island, and there's no cable that connects the state of Hawaii to another state. So it means that the employees of Hawaii Electric Light, like the employees on Maui and Oahu, they each have to maintain a perfect balance of load or consumption and power that's generated. And traditionally, the way they kept that balance is we let the load be what it is, right? Since all of us made our individual decisions of turning on lights and doing laundry and taking a bath, whatever may be that changes our use of electricity from moment to moment. The electric utility would adjust the output of the power plants that are running so that it would always be in balance.

Demand response takes that idea, adds basically another means for a utility to ensure that balance is always existing; and that's by subscribing customers or certain loads from customers to, you know, receive an incentive, some form of payment, in exchange for the utility's operator to actually control some of

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that load. So, for example, if there was, say, a large cloud cover that appeared over Kona, right, and the solar production that's currently at full blast during the day drops down quite a bit, the traditional approach is for, as the video described at the beginning, is that the other power plants operating in the island would have to increase.

Demand response now gives us an option to say rather than increasing generation or, in longer-term periods, building a new power plant to accommodate a year-over-year increase in load, that we can actually reduce the amount of power being consumed when that solar drops out or when a fossil power plant trips offline, right?

That ability to control load allows us to keep things in balance and gives us another sort of gas pedal or lever to keep things in balance; and that can allow us to keep things in balance more efficiently and at lower cost. But in order for that to happen, customers need to be willing to participate in a demand response program. They need to be willing to make some of their loads available for control by the utility. And for many customers -- not all -- many of the customers, that means making an investment in something like that battery system, that Tesla Power Wall, right,

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or making an investment in a water heater in which the utility will have the ability to turn off for short periods of time, while still keeping the water warm, right, controlling the thermostat on an air conditioning system, and then, into the future, being able to actually control individual devices; so to delay the starting of your dishwasher when you have it set to start at 7:00 p.m. or to temporarily interrupt or decrease the charging rate of your electric vehicle, right? Those are the kinds of things that customers may invest in and, therefore, make available participation in a demand response program.

But for all of that to work, the grid that we need to have to make all of that happen and to happen on kind of a near realtime basis so we can keep things in balance requires functions in the grid that we don't have today. But at the core of it, this grid modernization work is designed around giving customers the option and the choice to make these kinds of investments in technology, participate in these programs.

You know, another set of response programs that I forgot to mention is -- on the list -- called time-of-use rates. So even if you choose not to make an investment in a battery system or a grid-interactive

water heater or electric vehicle, you may just say, you know, "I would change my behavior," right? And so I'll take a pricing signal to say that I will shift my energy use from those times of the day where maybe it's harder or more expensive for the utility to serve that load to other times in the day where we have an abundance of solar and wind power, right? That's a great benefit for that customer who can make those behavioral changes, but it's also a great benefit for the entire island because now the entire island's load can be served at a lower cost.

But even for something like that, where there is an investment by a customer to participate, making time-of-use decisions really is aided when that customer has good information on a somewhat near-realtime basis of what they're doing, what their electric consumption is, so they can make informed decisions, then, of how to change their behavior. So all this requires functions and capabilities that the grid that we have today just does not provide.

And so one of the elements -- and Kristin, can you jump on over to the next slide -- is that the grid that we have today really clearly isn't the grid that we need. That's not to say that the grid that we have today is not working. I think the team from

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Hawaii Electric Light and all of the teams have done an excellent job taking the grid that we have today and making it work with distributed system at levels that leads the nation.

I just came from a conference in Washington DC, initiative conference, and, you know, the state of Hawaii got a lot of recognition and accolades nationally from many different utilities and regulators from across the country and Canada for the amount of distributed solar that we've all elected to incorporate or add to our homes and our businesses and ultimately integrate/interconnect to a grid and still maintain a reliable electric system; but we've kind of gotten to the point where the grid as we have today is reaching the limit of what it can do.

So I think all of you may have gotten one of these handouts, 11 by 14 sheets of paper. I'm going to be still speaking to this slide but also referring to this, and hopefully this will help make some of the things I talk about a little bit more memorable.

So as Jay mentioned, the grid really was designed for this -- Jane has some copies if you don't have one and you want a copy. As Jay mentioned, the grid was designed from the very beginning for one-way power flow, from the few large central station

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generators one direction to each and every home and business on this island. It's clear that the grid that we need, the modern grid that we need, needs to not just do that but, at the same time, needs to allow for power to flow in the opposite direction. And that's the two-way power flow on the right-hand side. I'm looking at the list, sort of the top section of the diagram.

That means that today, the grid has a limited capacity for things like distributed solar. And even at the levels that we're at today are leading the nation, we sort of are reaching what our grid, in its current state, can accommodate. But as I mentioned, you know, what we're hearing feedback and in the design of the grid modernization work is really to provide customers choice to make those kinds of decisions to add a PV system or add a PV and storage system as part of their home or business.

Because distributed renewables will be such a large component of our ability to get to 100 percent renewables here on the Big Island, but even more so on islands like Oahu where the land is so much more scarce, right, and the opportunities for large renewable energy projects are so much more limited than here on the Big Island, but even with that, many more

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opportunities here on the Big Island, rooftop solar and other distributed systems will become -- is today and will become a bigger component of our energy portfolio; so the grid needs to be able to match that, allow those resources to be part of the system and actually work with the system. And so that's a critical element of grid modernization strategy. It's a critical element in order for us to be successful in getting to 100 percent renewable energy.

I talked about customer choice. And one additional bearing on that is that we want to transform the grid, not just to be the electric system that moves electrons or power from one place to another, but what we describe in our grid modernization strategy is this concept that the grid needs to evolve and transform into a platform. And the idea of a platform really brings in the communication system that Jay talked about, right?

For all of these new technologies to work, for a PV system and a battery system and an electric vehicle that's connected to a grid and all of these different technologies that our customers are choosing to adopt, they can all work by themselves in isolation, but really for them to work at their best, to maximize the value of that investment for our individual

customers who own them as well as to the island in total, that maximization happens when these devices are able to communicate with each other and work together in a coordinated fashion. And that's where the grid becomes its platform not just to move electrons, but to move information so that all of these devices are able to work better in unison.

And lastly, you know, I don't know how well this is known, but for those of you -- those of us -- that own rooftop solar systems, for a lot of us, you're able to log into a website and get to see how much solar was produced in the last week or the last day or the last month; but for Hawaii Electric Light and the system operators, right, they aren't able to actually see how much solar is being generated -- solar power is being generated on any given day at any moment in time, right? And so part of our grid modernization strategy is if we want to efficiently utilize and incorporate distributed generation systems as an integral part of the system itself that operates the grid, then we need to have a better understanding, better insight, better visibility into what these systems are doing. And that sensing function is also a big component.

Right now, we have very limited sensing capability, but having that sensing capability is

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really, really critical, right? It's really we've become blind to what these systems are doing anymore. And so that grid that we're going to need in the future are all those elements on the right-hand side of the sheet here, right? And so I'd ask you to sort of kind of focus on that and think about that. If you want to sort of recall what happened tonight and what we discussed about as you assemble some comments, you know, think about that contrast between the left and the right.

The other element that I want to focus on is sort of the process and how we plan to deploy our strategy. And I cover that a little bit on the bottom of this handout. I've talked about some of the different sort of objectives we're looking to achieve. The strategy that we developed uses some newer technologies. It uses actually the advanced inverter or the advanced functions in inverters that customers actually deploy as part of a rooftop solar or battery system. It uses some brand-spanking-new devices called volt VAR devices that help to manage the voltage on a local system in your community that allows them -- in turn, with that greater managing capability, allows us to incorporate more solar and more battery systems onto their grid, right, at a cost lower than if we were to

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just simply increase the size of conductors and increase the size of transformers, the more traditional devices. And a whole bunch of other technologies that I probably don't have enough time to go into, but we have some of the devices there.

But these devices include things like fault circuit indicators and these automatic switches with intelligence built into them that can make very smart and informed decisions on actually operating the grid without human intervention or a person needing to be sent out on dispatch to different parts of our system to operate. And so things can happen more efficiently, things can happen faster, things like power restoration, in the event of a tree falling into a line, or getting PV systems back into operation faster in case there is a problem with the grid.

So there's always different technologies that I don't have, unfortunately, enough time to get into, but if you have a moment to read our grid modernization strategy, one of the key implementation elements that we have is this idea that we're not going to deploy a meter or a sensor or volt VAR device or an FCI or Intellerupter just sort of widespread across the island everywhere, right? That may be a very efficient way to deploy things, but we wanted to make sure that in our

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strategy, that what modernization efforts we invest in were investments that would result in benefits to customers; and no one will benefit from an investment if it's not utilized. So we're not going to put a Smart Meter everywhere. We're not going to put a volt VAR device everywhere.

We're going to put it in when we need that sensing capability, when we need that measurement and verification functionality from a meter, right? When a customer chooses to invest in one of the technologies that I talked about earlier. When a customer chooses to participate in a demand response program or a time-of-use rate, right? Customers have the choice, which is the core of our strategy, the choice to opt in to one of those programs. And when customers choose to opt in and make those kinds of decisions, then we will match our deployment on grid modernization work in conjunction with them.

Now, we can't just do it on a purely reactionary basis. We're going to have to do it hand in hand with solar contractors and battery contractors, and, you know, whether it's the utility or third party that implements the demand response program, we're going to all have to work hand in hand to make sure, as all of you make these decisions around participating in

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programs, that the modernization is taking place with it.

The big advantage and really what drove us to this strategy is that it ensures that these investments that we make actually get used, that the purpose for them being in there results in these investments really benefiting those customers that they were invested for, and it's not something that is invested and installed and gets little or no use, right? And that's what really helps with the affordability aspect of the strategy that we developed. It's going to be very complicated and challenging to implement, but we think this is the right way to build a strategy and move forward with these investments.

So the affordability element is really driven in part by this notion in our strategy around what we call in our strategy a proportional deployment of these technologies. So I want to make sure that all of you understand that all of these technologies that Sherry and Dave and the story boards and all of us have been talking about tonight is not going to just be deployed everywhere, right? This will be deployed proportionally as customers make choices.

So I've gone on, I think, longer than I should have, and Rhea is giving me that look. She

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always gives me that look, by the way.

We, again as I mentioned, filed a draft of our grid modernization strategy. That link in the first bullet there, www.HawaiiElectricLight.com/gridmod is a website where you can actually download an entire copy of the strategy. And it kind of looks like this. So if you have an interest and you have the time, you know, by all means, you can download a copy from that site. At the same site, you also have the related filings from the Public Utilities Commission that are related to this effort.

We are taking, as Rhea mentioned, comments from the public. We are actually taking it from all of our customers on all islands. We've actually opened it up to folks outside of the state of Hawaii. We actually, in developing this strategy, reached out to the entire electric utility industry to get the best and brightest folks who are on the leading edge of some of these new technologies and programs to all come to Hawaii and share with us some of their ideas. And that is one of the inputs and resources that we used to build our strategy. But we are also taking comments from those folks from across the mainland, actually across the globe, on it as well.

But we welcome and really, really appreciate

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comments that you have. You can send it to that common e-mail address. There's a whole bunch of us in this room that will read it. We are asking for comments to come in by August 9th, next week Wednesday, because, frankly, we're going to need some time to take these comments and read through them and make sure we understand them, and then have an opportunity to refine our grid modernization strategy with those comments and file that at the end of August, August 29th, and then we will make that public.

Now, to be very transparent with all of you, we're going to get a lot of comments. We have received quite a bit thus far, but we welcome more. Unfortunately, we will not be able to incorporate everyone's comments. We're going to have to make some tough decisions around what aspects we incorporate and what we don't.

But what we will be doing is, for all of the comments that are submitted, whether it's in written form tonight or e-mailed to that address, we will assemble them, we'll incorporate in our refinement of the strategies some of those comments, but we will make sure that all of the comments and feedback that we receive from all of you as an appendix into the final strategy when we submit it to the Public Utilities

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Commission.

So with that, I'm going to hand the mic back over to Rhea.

MS. LEE-MOKU: Thank you, Colton. Thank you, Jay. But don't go too far, Colton, because here's the first question, and it's for you: You spoke of getting input and ideas from customers and residences and businesses plus state agencies. What look was done at options/best practices in use elsewhere in the country?

MR. CHING: Okay, that's a good question. So we actually -- so I made at the very end reference to getting input from folks outside of the state of Hawaii. Specifically what we did was we brought in solution providers, we brought in folks from the Department of Energy, and we brought in folks from other utilities all to Hawaii in May, May 10th of this year, and we had sort of our own little industry day. And we had 28, 29 panelists, we had over 100 people assembled in the largest conference room that we have, and we had another 100 or so people that were actually calling in through a Webex or calling in by conference call and watching a computer screen.

And we got a lot of very, very insightful ideas around what's being done in other areas, what has worked in other areas, what has not worked, what has

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proven to be successful. And it's coming from not just other electric utilities, but it's coming from folks who provide some of those solutions for folks in government who are closely tracking what's happening across the country. And that was very, very useful input to us.

Having said that, one of the challenges that we have in developing this grid modernization strategy is, to a large extent, Hawaii is leading the electric utility industry. And that's why we got a lot of participation. This is why 29 people from across the country, you know, flew into Hawaii on their own nickel, right, stayed in very expensive hotels in Honolulu on their own nickel, to participate, because not only did they want that opportunity to share some of their ideas, but they actually wanted to learn from us and from others that were participating as well.

So, you know, we really tried to get the best ideas and consider all of them as we develop our strategy, but what we're trying to do here in Hawaii -- I'm not talking about the utility; I'm talking about all of us in the state of Hawaii -- what we're trying to do here, we're leading -- many of these ideas are leading the nation in terms of grid modernization work and the incorporation of storage, distributed storage

and distributed PV systems onto the grid.

MS. LEE-MOKU: Thank you, Colton.

This next question is sort of related to our grid. I'm going to allow it. And I think this is for Jay: When or how can HELCO change the pricing of their public (unintelligible) Fast Chargers from flat use fee, for instance, 7.50 a charge, to a realistic cost per or for kilowatt hour fee or a time-of-use charge, for instance, 9 cents a kilowatt hour during daytime?

MR. IGNACIO: You sound like a judge, you're going to allow it. I'm going to allow Colton to answer that.

MR. CHING: I think you see Jay has a gavel; I don't.

So I'm not sure if everyone is familiar with, but the Fast Chargers that Hawaii Electric Light has deployed thus far on the Big Island has been implemented with a flat rate, so you pay a flat fee and get to charge for a period of time. And it's not --

UNIDENTIFIED WOMAN: Charge what?

MR. CHING: I'm sorry, to charge an electric vehicle, yeah. Too much of an insider. I'm sorry.

And, you know, so the question, I think, is founded in this idea: Well, what if I want a specific amount of charge, right? My car is at 80 percent; I

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just want to top it off, right? Or it's really drained, it's at very low charge; I want actually a deeper charge. That, I think, is the origins of the question.

We chose to implement -- and when I say "we," we're actually doing this on all of our islands. We chose to implement a flat rate really for brevity and convenience, speed and efficacy, because this is part of a pilot effort that we're doing. And by charging a flat rate, it allowed us to implement these Fast Chargers for electric vehicles more quickly, offer participation hopefully with a more simple interface for customers; but the fact -- so there's two things that I smiled at with the question, right? Personal (unintelligible) versus SAE, and a person understands the potential benefits of charging either on per-kilowatt hour or on a demand or charging at different times of the day.

And this is exactly where we want electric vehicle charging to go to, because we see electric vehicles having multiple opportunities. One is it actually helps us decarbonize the transportation sector, right? At the same time, if we can create incentives and programs where charging is occurring at the right times of the day or where chargers are

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participants in a demand response program, that actually helps us run the electric grid, right? So you get almost a two-fer by having the charging.

So for long term, I think that's where we want to move to is to variable rates in a per-demand or per-kilowatt-hour charging, but for the pilot, we wanted something that was something we could implement fast and simple.

MR. IGNACIO: Can I add to that? Whoever asked the question, maybe we can have a conversation after, because it was a very good one. On Hawaii Island, we deployed three Fast Chargers across the island as pilots to learn, you know, ourselves, learn about the charger, the installation, but also have customers and see the behavior; but I'd like more information as to how it's working and where can you guide us to improve with respect to more chargers, what locations would work for you, because that's where we need to take it. So we've got only three, but we want to see what needs to be done to take it to the future; so I'd be looking forward to a conversation after this. Thank you.

MS. LEE-MOKU: Thank you, Jay. Thank you, Colton.

So this next question is also related to

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electric vehicles. It's about the electrification of transportation sector. And Jay started to answer it, Colton started to answer it, but I'm going to ask it so maybe we might have something else to add: When will HELCO develop a plan to accommodate the increased power to electrify the transportation sector?

MR. IGNACIO: I'm not sure where that question is going. Right now, in terms of adequate supply, Hawaii Electric Light Company does have an adequate supply. So if customers are concerned that as we have more and more vehicle charging, would we have enough generation? At this point, we have adequate supply.

Another concern might be do we have adequate facilities? Because as you have more and more electric vehicle charging, you are going to actually have higher use on the distribution and transmission system. That might be a bigger challenge, or that might come up probably faster than the first issue; but still, you know, we have good engineers. We have many of them here tonight. We can find the solutions for that. We can make customized system improvements if that is needed.

We see, you know, and we want to have more electrification of transportation, so we are actually

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putting more human resources in that area. We actually hired a manager for the three companies to actually manage that program.

And also, it's not just vehicle transportation, but we're also looking at work that we might be able to do at our shipping ports, actually electrify some of the ports, maybe even the airports, and not just stop at electric vehicles.

MS. LEE-MOKU: Thank you, Jay.

This next question, I believe, is for Colton: What will 100 percent renewable look like, especially regarding home solar installations?

MR. CHING: What will 100 percent renewables look like? You know, I think ideally, 100 percent renewables from an electric customer will actually be not all that different from today, right? And I say it from the perspective of we all -- you know, and we do this without thinking, right? When we come home or we enter a room, we flip on a light switch or we, you know, turn on a computer or a TV, right, and we all just expect it to be there, right? We expect that power to be there.

Our goal is that in that 100 percent renewable energy future, that that expectation, that way we live, this modern society that we live in, in

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which the economy is so dependent on, that part doesn't change.

What does change is where that energy comes from, right? And I think a 100 percent renewable energy system in Hawaii like we described earlier is going to have, as the question implies, not just these larger grid-scale wind or solar systems and grid-scale battery systems and biomass plant and geothermal plant; it's going to also have a lot of distributed systems. And for those of us who call Hawaii home, right, we've, you know, slowly become accustomed to seeing PV panels on many, many homes, right? It's very, very common. If you go anywhere in the mainland, any residential area in the mainland, maybe with the exception of a few neighborhoods in California and New Jersey, oddly enough, it's not common, right?

And so our reality today is actually the future of most places in the mainland. And this sort of very common sight of distributed solar systems and distributed battery systems and electric vehicle in your garage is I think going to be a fundamental part of that 100 percent renewable energy future.

MR. IGNACIO: Can I add to that?

You know, Colton's group -- and some of them are here tonight -- Hawaiian Electric, they do the

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planning for all of the three companies, Hawaiian Electric, Hawaii Electric Light, and Maui Electric; so they completed a power supply improvement plan, and we recently got approval from the Public Utilities Commission that actually kind of paints that strategy going forward. That's basically a plan. What happens going forward depends on, you know, development of technologies, how successful we are in acquiring new resources.

We could put out RFPs, but until, you know, we can get viable bids, we're not exactly sure what the mixture of resources is going to be. Some possible visions would be a mixture of, you know, more wind on our system, actually maybe possibly expansion of some geothermal. We're going to expand biomass. We just recently got an approval to expand a biomass facility.

And then customers, like Colton said, they're going to have choice, and we're going to enable that choice. We're going to work our best to enable that choice. So customers can go from what they do today, you know, "I don't want any of this fancy stuff. I just want to turn on my lights and have my electricity." So they -- they may have zero participation. They don't want photovoltaic; they don't want any demand response; they don't want any

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storage. And that's fine too, right? And then you're going to have a more progressive customer that they want their own photovoltaic; they even maybe want to dabble into residential wind; they want their own storage; they want their electric vehicle; they want to be participants in demand response/time-of-use, and we can enable that as well.

So I see, going forward, a whole mixture and gamut of different type of customers and the utility actually acknowledging that and working with these customers to let them participate in this whole, you know, variety of programs. It's much more complex, it's much more difficult to implement, but I see that's what customers want. You know, we did those surveys. That's what customers want, and we're going to work hard to provide what they want.

MS. LEE-MOKU: Thank you. Thank you, Jay.

Okay, next question. How will HELCO's grid modernization plan accommodate and enable community microgrids?

MR. CHING: I'll take a swing.

MR. IGNACIO: You going to take a swing? Go ahead.

MR. CHING: Yeah.

So what a microgrid is is something as small

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as a single home, but more likely, you know, several homes or businesses or as large as a portion of an island that, on a normal day-to-day basis, is connected; their electric system is connected to the rest of the island. But under certain conditions -- if there's a storm or if there's a problem with another part of the electric grid -- this section or this component can electrically become separate from the rest of the island and continue to operate as a smaller electric system. And that's sort of the standard or common definition of what a microgrid is.

And so I think the question is asking, you know, where do opportunities for microgrids fit in within a grid modernization strategy? The opportunities to create a microgrid is, I think, very much lined up with a grid modernization strategy. A strategy doesn't call out for specific microgrids here or there because, inherently, a microgrid is going to be -- or the need or desire for them will be coming from customers who want enhanced reliability in an area or the ability to separate out for security reasons, right?

But the ability to do that electric separation and maintain operations separately and ability to then come back together later on when it's

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okay requires the same functionality and capabilities that is inherent within the grid modernization strategy. It's having the communications platform so that these intelligent devices can speak to each other; it's having the visibility to know what's going on in different parts of your electric system so that you know when it is a time to separate out if you need to to avoid a blackout in a microgridded area. And the microgrid itself needs a lot of communications and intelligence to operate independently as a microgrid.

So from a functional standpoint, the formation of a microgrid, it's going to require the same kinds of technologies that are part of our grid modernization strategy. Whether one is done is really going to be driven by the desire to obtain some of those operational reliability benefits of a microgrid in a certain part of the island, or if the use of a microgrid may be an alternative to a more traditional approach to achieve or maintain a certain level of reliability.

MR. IGNACIO: So let me take a shot for an on-island example.

So we have the North Kohala part of the island, and North Kohala has about four megawatts of load.

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Dave, how many customers?

DAVE: 2,000.

MR. IGNACIO: 2,000 customers. And we have one transmission line that serves that area. So that transmission line is old and needs to be rebuilt; so we're going through the process of evaluating do we rebuild that line, or does creating a microgrid make more sense, or maybe a combination? I think -- in my mind, without all of the detailed evaluation, I think a combination might make more sense, where we don't do an extensive upgrade; we upgrade the line, but we also invest in creating a microgrid up in North Kohala.

How does that grid modernization tie in? Well, as engineers, we get very nervous if a part of the system actually separates and is operating autonomously, right? There's security in being tied to the grid. When everyone is tied in and locked into the grid, you have much more stability; you have much more control of the voltage of the entire grid. When you have smaller parts of the grid break off in the island, you have less -- you know, you're going to have more power swings happening.

So what grid modernization does, it gives me a little bit more assurance, if you're going to create a microgrid, is that we are going to have much more

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monitoring points up in Hawi -- in a place like Hawi, where we create a microgrid, where today, the way we operate, we only have, you know, maybe monitoring voltages right at the substations. But with a grid modernization system, you are going to have voltage monitoring throughout the distribution system at much more residences so that when we operate the microgrid, we can monitor much more closely the voltages, and it's going to give us much more assurances and much more control in providing the quality services to customers when we operate the microgrids.

MS. LEE-MOKU: Thank you, Jay. Thank you, Colton.

I'm going to do a quick time check, because we really are running over our question-and-answer period, but we still have several more great questions.

Jen, how are we doing on time? What time do we need to --

MR. IGNACIO: The judge says allow it.

JEN: (Inaudible) 7:30.

MS. LEE-MOKU: Okay. Already, great.

Okay, next question: Will the plan incorporate vehicle-to-grid opportunities?

Colton?

MR. CHING: So vehicle-to-grid opportunities

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is the idea of an electric vehicle that's connected to a charger and has the ability to not just receive power from the grid to charge a battery on the car but to actually use the stored energy in that battery of a car and push energy back into the grid; so if the grid needs more power, rather than simply just interrupting the charging, the battery now operates as a source of energy and pushes battery out. So that's what vehicle-to-grid means. That is one of the potential kinds of uses for customer investments and one of the use cases for the demand response program.

The ability to have a vehicle to export back into the grid was something that we actually tested out on the Island of Maui as part of our Jump Smart program with Hitachi and the Japanese government, and we had, I think, about 80 or so electric vehicle owners on Maui that participated in this; so we proved that it can work. We actually demonstrated that using cars connected to their chargers in a VTG mode is actually able to help regulate the frequency on a grid. So we proved out that the technology can work.

The grid modernization strategy I think helps facilitate those things in the future. I think it can be a good potential resource for the system. What really remains to be seen is whether a owner of a car,

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who is going to depend on the car to get their kids to school and themselves to work the next day, how willing are they going to be to allow the utility or the grid to use some of that energy at night, overnight, or during the daytime? Those are the kinds of programmatic things that need to be squared out; but from a technology side, the grid modernization work is very much aligned with facilitating those kinds of technologies from being used.

MS. LEE-MOKU: Thank you, Colton.

Next question: How will the grid modernization plan provide realtime performance analytics to power-producing customers connected to the grid?

MR. CHING: Analytics. Good question.

So one of the natural outcomes of putting in more sensing and more intelligence on a grid like we're proposing in our grid modernization strategy is you're generating just orders of magnitude more information -- well, actually, more data than we are today, right? And the data can be turned into useful information if that data is analyzed in an appropriate fashion. So part of what we're actually talking about now incorporating into our strategy is identifying opportunities to take all this data that's being

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created and using it for the purposes of -- exactly like the question asked -- how do we use the data to create information that can provide more informed decisions, smarter decisions, by folks, by the utility, by each of our customers?

So to give you an example, one of the customer options that we're looking at is the idea of giving customers more data. So one of the things that -- and we have an example up there -- of a current Smart Meter is the ability for the meter to actually almost continuously monitor what's happening in power flow and in voltage, power being used and energy being used, through that meter point. And that's very useful information that can be provided to a customer in a portal, both in terms of how they're using energy, but that same kind of technology can also be connected to a generator, a PV system or battery system, to get better understanding of what that product is actually producing or consuming at any given point in time. And that portal, that interface, can give customers more information to make better decisions.

MS. LEE-MOKU: Okay. Thank you, Colton.

This next question is for Jay: Will grid modernization address dirty power and variations in power spikes which fried customer old electronics?

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MR. IGNACIO: Dirty power. I guess the person asking the question is related to power quality. So certainly with more monitoring devices, we can closely monitor the voltages and the currents so we can better manage.

In terms of can we prevent certain transients, I'm not sure if we actually have devices that could prevent that. We certainly can monitor the state of the power system and maybe proactively monitor maybe some of the phase angles and, you know, change the power flow before, should a fault occur. There could be strategies to prevent faults occurring. Because what happens if you have -- say like a tree branch falls across a line? You can have disruptions in the voltage levels. You can have these large power swings. So part of the strategy is putting devices out there that manage the power system and actually prevent the faults. So in that strategy, you can actually reduce the amount of disturbances to customers.

We have a device there. It's called a fault current indicator. What that is is if you have, say, a tree branch or you have a problem, essentially have a shortcircuit on your power system, so you have a large amount of current flowing, and it will flow through that fault indicator, and that will detect where on the

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system this fault is occurring.

Well, not all faults actually are bolted and stay for a long time; sometimes they're temporary and they'll just -- maybe a tree branch is touching the line. So you might have devices out there that detects these temporary problems; and before they become a permanent problem, you actually detect where it is, you go out, investigate, you clear the tree, you clear the problem, and now you prevent a bigger problem, a bigger shortcircuit on your system, that could cause problem quality problem problems.

Colton, you got any other?

MR. CHING: Yeah, maybe just one more thing to add to what Jay said. I think you covered it really well.

This is getting into the geeky engineering things, but some of the technologies that we're looking at including in our strategy are these intelligent switches; and, you know, the question is about power quality, but a lot of times appliances and equipment gets damaged when they see -- like Jay describes, when a tree falls into a line and there's a fault. Damage of equipment can occur when the fault is seen by appliances for a period of time. So when they see that fault for ten seconds or fifteen seconds before

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protected devices come into play, then the more likely it is that an appliance may get damaged by observing that event.

Some of the intelligent switches that we're looking to include are able to detect these kinds of events much more quickly than conventional technologies. So it doesn't prevent that fault, that tree from falling into a line, but it's able to detect it sooner and be able to react to it faster, which means that our washing machines and televisions and computers will not see that event. In some cases, they may not even notice it; but even if they do notice it, they'll see it for a much, much shorter period of time, in the matter of sometimes fractions of a second rather than multiple seconds. And so that can actually help with the quality of power that we all see in our service.

MS. LEE-MOKU: Thank you.

This next question makes the assumption that the HELCO grid is maxed out for accepting more residential solar, so that's the context of this question. And it's a two-part question. So the first question is: Will this impact solar installations? And, if so, how long 'til grid modernization cures this potential program? Is it 2018? 2019? 2020? So

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forth.

MR. CHING: I'll take this one.

So the incorporation and integration of more distributed solar. And for the answer to this question, I'm going to presume it's a very traditional solar system; there's no battery attached to it, right? It just simply generates during the daytime when the sunshine is present.

On the Big Island or, actually, any of our islands, there are sort of two parameters that we always have to check to answer the question of whether more solar -- more conventional distributed solar systems can be incorporated. The first is (unintelligible), right? In that neighborhood, in that circuit that that system is connected to, does that circuit have the ability to accept and operate with more solar, right? And those checks are done when we receive an application.

And in the case for the Big Island, there are some circuits on the Big Island where the amount of solar on a circuit is close to or at that level; and in those cases, some of the grid modernization efforts that we have in our strategy can aid that circuit to incorporate more solar.

But there's a second check that always needs

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to be done, and it's inherent in the fact that we have island grids where we're not connected to other electric systems. So during the daytime, we have to make sure that -- all of the conventional distributed solar systems, right, they produce what they produce. We don't have the ability to control those systems, so we have to make sure that during the daytime, that the amount of power being generated at noon is no greater than the amount of electricity that's being consumed on the island. And so we have to look at it from an island's perspective to make sure those things are in balance.

And for the Island of Hawaii, it's the second check, the second perspective, that, from a timing perspective, is more of a determinate. And it's the ability of the island, during the daytime, to ensure that the amount of solar that's being generated during the day, plus the other renewables that are operating in the system, right, and that we have enough generation able to control the grid, and that total amount of generation not being greater and always being matched to the amount of the load that we have during the daytime. And that's a very unique challenge that islands have. And that's a challenge that the Island of Hawaii is facing in the near term.

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And so those issues, specifically those system-level issues, will not be addressed by the grid modernization strategy. Those issues are actually being addressed by the Power Supply Improvement Plan -- that's what Jay talked about earlier -- where, on the Island of Hawaii, we're looking to add new generation that's controllable. That's one. Two, we're looking at new technologies, like battery systems, that allows the grid to maintain that balance with lower total generation, which makes more space available for things like rooftop solar to be generated during the daytime and, at the same time, makes sure that system stays stable and keeps everything in check. And so it's the second system-level issues that are being addressed by the research portfolio in the Power Supply Improvement Plan.

I know it's kind of complicated. There are many variables in here. If there's time after at the end, I would be happy to talk more with the person that asked the question.

MR. IGNACIO: So the question was kind of hypothetical if we were there today. We're not there today, but we are approaching that point, so what we need to do as the utility is stay ahead of the game and put in technologies so that we don't have to tell our

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customers, "Sorry, you cannot connect."

Colton talked about some of the system challenges that we have. What happens is we continually need to balance the amount that is being generated versus the amount that is being used. Rooftop solar, during the day periods, they generate a lot of energy, so as they generate a lot of energy, to keep the balance, we're turning down the output of our units. And we're getting to the point where we can turn down our units only so far. And in order to manage the entire grid and keep the stability, there are certain type of units that we need to keep on the system. And you'll hear terms like, you know, "inertia," but there are certain units that we need to keep on the system. So one of the strategies is find ways to take some of these units off so that now you can increase solar and now you have less of these so-called must-run units that you need to keep on the system.

Other strategies is to store it so that as you have more generation, you store it, so you keep that balance. The other strategies that we're using is you actually make people use more during that period. Maybe we can get them through time-of-use programs or through demand response, or through electric vehicle

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charging. Those are the strategies.

So we're pursuing all of those and trying to stay ahead of the game.

MR. NOYES: I just wanted to -- what you are speaking about is what I wanted to comment. Thank you for allowing me.

I'm with P.A. Harris Electric. We've done about 1100 PV systems, about 10 percent of the 11,000 on the Big Island. And I've been studying Germany's and Australia's and China's grids and their utilities, and they have been able to, within ten years -- now Germany within the last couple weeks -- have got to 100 percent of their electricity from wind and solar. Within ten years, they've updated their grid with all the things that I read in the grid modernization strategy last night. All the things that you're saying, they're doing that. Australia -- I don't know if you know that -- now Germany, and China.

My question is why, in this same amount of question -- why is it going to take us 30 years, almost 30 years, to 2045, to get to that point when these other -- I know that we're the leader in the state and the nations, but in the world, these other utilities or countries are way beyond (inaudible).

MS. LEE-MOKU: So can we hold on that

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question? I'm sorry. Because I had some others in the queue, and I would actually like to move into a lightning round, because we have six minutes left.

MR. IGNACIO: I think we should answer that really quickly.

MS. LEE-MOKU: Okay.

MR. IGNACIO: I mean, I think a big difference is, although you may look at Germany, you know, getting to 100 percent, they're interconnected to other grids; so that's a big difference. So although you may say "Oh, they're 100 percent," they're still interconnected to other grids. We don't have that option here.

We do look at other technologies. And grid modernization, you know, one of the less-popular solutions is to control the output of the photovoltaic, so if you cannot turn down your unit, then now you control the photovoltaic and you turn down the photovoltaic. That is not a popular option, but that's an option that all generators actually should contribute to. They all should have controls.

You know, in the long term -- like you talked about 10 percent of the 11,000. Going forward, to get to 100 percent, we're looking at doubling that, right, doubling the amount that we have, so that problem is

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going to be twice as challenging in the future than it
is today. So at some point, the distributor generation
has got to have to play like the generators, and they
are going to have to be controllable, just like the
central station generators. And then we can have more
discussion later.
MR. NOYES: In the meantime, we have gone
from 12 million two years ago to 1 million last year;
and I know all of Hawaii has lost 50 percent of their
jobs in solar because of the slowdown of the utility
being able to modernize the grid. And I'm just wishing
that there was something we can do --
MR. IGNACIO: Like I said, I mean, we're very
progressive. Look at what we're talking about. We got
85,000 customers. We connected 11,000 of them, right?
MR. NOYES: It's amazing.
MR. IGNACIO: It's amazing.
We connected 77 to -- 77 is approved on a
system during the day that has 100 megawatts of use.
That is amazing.
So, you know, I give credit to the engineers
in this room that have been progressive, have been very
aggressive in finding solutions so we can get to this
point. We still cannot stop at this point. We got to
take it more; but I want to give credit to the

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engineers in this room that has really found the solutions to get us to this point already.

MS. LEE-MOKU: Okay, thank you.

Okay. We have lightning round now. Four minutes. Real quickly.

Back to assuming that the grid is maxed out for accepting more residential solar. Jay: Does this situation prohibit the company, HELCO, adopting utility-scale solar and wind?

MR. IGNACIO: We actually made the conscious decision to not put in central station solar early on, because that would have precluded some of the distributor solar to go on. But still what we need to do is look at ways of getting them both, so continue with distributor generation but also find ways to add central station photovoltaic as well.

MS. LEE-MOKU: Thank you, Jay.

Next question is for you again: When does HELCO anticipate incorporating utility-scale battery storage as has been done on Kauai and other jurisdictions?

MR. IGNACIO: So our next battery storage is not actually what you hear or read about in Kauai. They have what is called a nighttime solar. The whole issue that we talked about where you have excess

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photovoltaic generation, you store it. Our next battery system is actually for system stability. It's actually called contingency storage. So we've done technical studies. We need to revise those technical studies, then go out for an RFP and actually build it. I think the time frame is 20- -- '19, '20.

MS. LEE-MOKU: Thank you, Jay.

Next question: It sounds like Hawaiian Electric, Hawaii Electric Light has an expectation that all customers will put in rooftop solar. What about those customers that do not?

And I think you touched on it a little earlier. Maybe you could just add to that.

MR. IGNACIO: Yeah, I don't see 100 percent of, you know, customers actually installing rooftop solar, but we want to allow the choice if they choose to do it, and then we need to find the technologies. So it's all along the same conversation we were having is, you know, allowing the customers that choose to do it and finding the technologies that allow them to do it, so -- but I don't see 100 percent. I don't see customers' behavior being that.

MS. LEE-MOKU: Thank you, Jay.

I was tired, so -- I was standing up, so I came to sit next to this gentleman. He is actually our

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last question for the evening. Go ahead.

MR. MURATA: I have a statement and a question. First, I feel enlightened by your presentation of the grid modernization strategy, and also, to your professional staff before the meeting with a talk story type conversation, thank you for that opportunity.

My question is, in 30 years or less, renewable energy is going to change, increase from 45 percent to 100 percent, in 20 years, correct, or 30 years, somewhere in there. My question is during this process, will the consumer or general public be participating in the streamlining the process of grid modernization and, if so, how can a consumer participate?

MR. IGNACIO: So I think the first opportunity for consumers to participate is to make good, informed decisions about what kinds of programs they want to participate in and what kind of technologies will they choose to adopt over time. Because we really believe, and our strategy is built around, customers making these choices. Our customers across all the islands have really demonstrated the willingness and the capacity to make these kinds of choices. We get a lot of interest in some of the

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pilots that we're doing around time-of-use rates and electric vehicles. We really think that is going to be a big part of us getting to 100 percent.

So from a consumer standpoint, my recommendation is be as informed as you can be about the grid modernization strategy, and at the same time, be as informed as you can be about the various programs that we're currently piloting today. So we're doing time-of-use pilots; we have electric vehicle tariff pilots; we have electric vehicle charging stations; we are going to be launching some demand response pilots. So be informed about those kinds of programs and put you in the best position to make good decisions about participation in the future, because those good choices by customers will actually drive the peace and the manner in which we implement our good modernization strategy.

MS. LEE-MOKU: Thank you.

MR. IGNACIO: Do you want to add to the answer, Darcy?

MR. CHING: Oh, yeah. So Darcy Endo-Omoto, our vice president of Government and Community Affairs, mentioned something that is very important that I should have at the very beginning. So all of you as customers of Hawaii Electric Light and Hawaiian

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Electric and Maui Electric, through these various regulatory proceedings, you are actually represented by the Department of Commerce and Consumer Affairs. The Consumer Advocate's Office was established to represent all of you through these regulatory proceedings. So if you have an interest and desire to express a certain voice/perspective on some of these, another option, in addition to interacting with all of us, is to actually reach out to the Consumer Advocate, or CA's, Office. I know some of you in this room are familiar with them, but for those of you that aren't, that's another opportunity for you to participate.

Thanks, Darcy.

MR. IGNACIO: And thank you for coming tonight. We really appreciate it and enjoyed talking to you.

MS. LEE-MOKU: Thank you very much. We did pretty well on our lightning round, just two minutes over.

I do want to thank our panel, Colton Ching from Hawaiian Electric, and Jay Ignacio, the president of Hawaii Electric Light. Thank you very much.

And I also want to thank all of you for being here tonight. Your questions were very thoughtful, and we appreciate that. Please don't forget to fill out

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your comment form and submit that at the front desk, or you can submit your comments by e-mail.

We'll be here for a little bit longer if you have any questions that haven't been answered.

Thank you, and please drive safely.

(The meeting concluded.)

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STATE OF HAWAII )
) Ss.
COUNTY OF HAWAII )

I, TERI HOSKINS, a certified court reporter in the State of Hawaii, do hereby certify that the foregoing pages are a true and correct transcription of the proceedings in the above matter.

Dated this 11th day of August, 2017.

__________________________________

Teri Hoskins, CSR No. 452

### 2. Kona Comments

No written comments received

## C. MAUI – AUGUST 2, 2017

### 1. Maui Transcript

0001

DRAFT MODERNIZATION STRATEGY - PUBLIC HEARING
MAUI ELECTRIC COMPANY

Held at the J. Walter Cameron Center, 95 Mahalani Street, Wailuku, Maui, Hawaii, commencing at 6:00 p.m., on Wednesday, August 2, 2017.

Reported by: Tonya McDade, CSR, RPR, CRR, CBC
CSR Maui, Inc.
2145 Wells Street, Suite 302
Wailuku, Hawaii 96793
808-244-3376
tonya@csrmaui.com

0002

(Wednesday, August 2, 2017, 6:00 p.m.)

* * *

MS. MARTIN: Aloha, everybody.

AUDIENCE MEMBERS: Aloha.

MS. MARTIN: Thanks for coming tonight. We're really happy to have you here.

And we said we would start at 6:00. That clock says 6:00, this clocks says not. We'll go with that one, right? I'm pretty sure that one is the right one.

I'm Mahina Martin. I am with Maui Electric. I help with their government and community relations. I know many of you in different capacities, so I'm very glad to see you here.

We have a very simple agenda tonight, but I do want to go over some housekeeping items first. If you have cell phones, if you could just silence them or put them on vibrate, just out of respect for folks. If you need to take a call, we ask that you just leave outside and come back in when you've completed your call. There are restrooms around the corner, if you just go out that way. And please, please don't be shy. Help yourself to water and refreshments or dessert any time you need.

Tonight, our agenda is going to be as open as possible. We are here in a very excited way to give this opportunity to hear from you. The purpose of tonight's

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meeting is that we want to be able to share information with you about a strategy to modernize our grid that's headed to our Public Utilities Commission.

And in order to make sure it has its fullest information available that reflects our community's wishes and input, questions, concerns, we've been holding meetings on different islands. And so this is one of them. We just had one in Kona and Hilo. And tonight, of course, is Maui.

We want to be able to collect the public's input in a way that will be included in our filing at the end of August to the commission. And we have here our stenographer who will take a record of tonight's meeting verbatim. And that way, we will not be interpreting what you say, we won't be misunderstanding what you say, and, hopefully, not even involved in the spelling of what's being said.

As you walked in the door, you noticed that we had a table of information. Two things I really want to point out to you. Well, actually, three things. This is a take-home handout. It gives you the exact executive summary contained in the draft. And you will -- where's my -- and I want to point out that there are two forms that you noticed when you came in. And I want to explain to you why there are two different ones. This one is so

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that you can offer your comments that will go with the filing to the Commission. You could also email it to us, so you'll see information on where you can email it. So we're just trying to be helpful. But, also, this one. So just to be clear, this is for you to ask a question that we can answer tonight. We're going to -- you saw a collection box, but our staff is around, also. You know, at the very end of our information presentation, we'll ask for these. You can still offer them throughout the evening, but this is so that we'll be able to pinpoint what the questions are immediately and answer them. If you have a question in combination with a comment, feel free, absolutely, to include it in the white form. It's just that if someone wrote at length tonight, for tonight's purposes, or any of our public meetings, we may not do a good job of picking out a one-sentence question buried into a lot of comments. Yeah.

Is there a question about this?

UNIDENTIFIED SPEAKER: So that means only the white form gets recorded by the Public Utilities Commission on record and the green does not?

MS. MARTIN: The green is for tonight, correct. Yes. Thank you. Yeah, the green is for tonight so that we can facilitate and answer those questions. The white is for us to offer as part of the filing. And, again, you

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can, also, email. All right. I believe the email is on this handout. Yeah, there's a big blue box that tells you where to email your comments. It can be as short or as long and detailed as you would like that to be.

Tonight we have with us, very happy to have them here to help with the presentation and offer information and answer questions, we have our Senior Vice President of Planning and Technology from our Hawaiian Electric Company, this is Colton Ching. Who, by the way, likes to remind us that he is from Maui. He's a Baldwin High graduate. Yay for Baldwin High people.

MR. DE REGO: Exactly. Thank you.

MS. MARTIN: Some people will say "we forgive you," but we're very happy to have Colton with us.

MR. DE REGO: He's from Maui.

MS. MARTIN: Also, with us tonight, that will offer information, is Chris Reynolds who is the manager of our system operations.

We're going to begin tonight by sharing with you two very short clips. They're videos that give a little bit information. The first one is going to talk about the system operations, for those who would like a little bit more information. It's very concise and short, just a couple minutes. And the second one will give us a highlight of reliability. Two very -- a very important

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aspect that we've heard from our customers and all of our users.

So we'll start with the video first and then I'm going to turn it over to Chris who is going to talk about how our system operations is today and --

(Video: Hawaii is first in the --)

MS. MARTIN: -- then we're going to go to Colton --

(Video: -- nation for rooftop solar systems per customer. To integrate all this clean renewable energy, our electric grid now has to operate as a two-way system instead of a one-way system. In the past, energy would be generated at power plants and flow in one direction to homes and businesses. Today, homes with rooftop solar are not only getting energy from the grid, they're sending energy back into the grid. This two-way flow has its advantages and challenges. When they're generating energy, homes with rooftop solar can provide clean power for neighboring homes and communities across the islands. As rooftop solar energy flows into the grid, other forms of energy need to be continuously adjusted. These adjustments are necessary to safely and reliably meet the demand of everyone connected to

the grid. Ongoing grid improvements will help us manage the two-way flow of energy. And that will allow us to integrate even more renewable energy.)

MS. MARTIN: Our second video is going to tell you a little bit about an important part that we've heard from all of our customers. We've been part of Maui for almost 100 years now. And so, obviously, we have come a long way, but we need to move forward on that. Reliability, whether it was then, now or in the future, continues to be a very critical part. So this video would share a little bit about that.

(Video: To deliver safe and reliable electric service to every home and business, the power grid must maintain a stable level of energy at all times. Today, with many different sources sending energy into the grid, maintaining the stable level is more challenging than ever. To help us understand, let's look at the two basic forms of energy feeding into the grid. Rooftop solar and energy from wind and solar farms are called intermittent energy because they generate energy only when the sun is shining or the wind is blowing. Firm energy, on the other hand, from power plants, waste to energy and biomass plants and geothermal facilities is available day and

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night. To maintain a stable level of energy, grid operators must constantly adjust between intermittent and firm energy. For example, when the sun goes behind the clouds or when the wind stops blowing, intermittent energy suddenly drops. So firm energy needs to quickly ramp up to balance the grid. If grid energy drops too low, power outages can result. And when the clouds pass and the wind picks up, intermittent energy increases. So firm energy needs to quickly ramp down. If not, too much energy can damage your electrical equipment or even pose a safety hazard. It's like revving up your car engine and then suddenly slamming on the brakes. Constantly adjusting between intermittent and firm energy isn't good for generators or easy to do. And our small island grid make it even more challenging. That's why we're looking at new solutions like energy storage. With new grid improvements and ongoing research, we're working to maintain a stable level of safe, reliable energy. That will allow us to use even more renewable energy as we move toward a clean energy future for Hawaii.)

MS. MARTIN: So although tonight's purpose is primarily to collect comments and answer questions about

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our proposed strategy for modernizing our grid, we thought a good place to start is how exactly is our system operating today. So just for a few minutes, I'm going to turn over to our systems manager, Systems Operations Manager Chris Reynolds, and then we'll hear about the grid modernization strategy that we're proposing before the Commission from Colton.

Chris.

MR. REYNOLDS: All right. Thank you, everyone, for spending your evening with us.

This is our existing grid. Traditionally, we've always had a central power plant. We have power flowing out through transmission lines. On Maui, that's high-voltage, 69,000, 23,000 volts, stepping down into distribution substations. You have seen our substations around, across the street from Kmart, the new one being built across from the Maui Lani. From there, it steps down typically to 12,000 volts where it's kind of distributed out into neighborhoods. From there, you'll see our pole top transformers, kind of stepping it down to the voltage you need for your home, which is the 240 and 120 volts. Right now, we're changing that. We're kind of moving towards the renewable energy.

Three company wide, Hawaiian Electric, Hawaiian Electric Light, Maui Electric, we're at 26 percent

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renewable energy. Maui County, which covers the island of Maui, Molokai, Lanai, we're at 37 percent. You know, it's -- it's quite a challenge to get even to where we are now. We've deployed certain technologies, we have battery systems on Maui, we have digital relays to kind of help with protection system, but we're going to have to do a lot more.

Right now, our goal is, year 2020, we're supposed to get to 40 percent renewable energy. Of course, it's state law, by year 2045, we're supposed to be 100 percent. But in order to get there, we're going to need to make our grid stronger, more modernized and a lot smarter.

And that's going to take modernizing a lot of the way we -- our equipment and the way we do things. And with that, I would like to introduce Colton.

MR. CHING: So if I stand here and speak, can everyone in the back hear me? Okay.

So I am -- we have some slides here, but I am also going to be referring to this handout here. So, hopefully, everyone had a chance to get a copy. If not, I guess, Shayna has just self-volunteered to get everyone one. So if you raise your hand, we'll make sure we get you a copy.

Let's see. So -- I'm sorry.

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MR. DE REGO: I'm not asking a question.

MR. CHING: Sorry, Frank. I know Frank.

MR. DE REGO: Like asking for directions.

MR. CHING: Yeah, exactly.

So before I actually get into the elements of the strategy, I wanted to talk a little bit about how we came about developing our strategy. And we didn't start developing our strategy by bringing a lot of our smart utility folks together to figure out what it should be. Instead, what we did was we started off by talking with our customers.

So we conducted a range -- a series of focus group meetings and one-on-one meetings with our residential customers and commercial customers here on Maui, on the Big Island and on Oahu. We, also, conducted one-on-one interviews and discussions with folks that we call energy stakeholders, folks who have a lot of interest and are very active in the energy stakes. And we asked them, what -- from your perspective as a customer or as a energy stakeholder, you know, what are the objectives that you think the utilities grid should achieve, you know, what should it do, what kind of things do you want to see with it. And we collected that information as a starting point before we began to develop our strategy.

And across our residential, our commercial

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customers, across the stakeholders that we've met with, and in total was over 200 different discussions from different people that we spoke with, what we took away from those discussions is that our customers are looking for a grid that results in them being able to achieve affordable electric supply and use, having that electric service be reliable. They want to have choices, right? They want to have options and choices in how they interacted with the grid and how they took or provided service to the electric utilities. And they clearly saw a connection and a long-term objective to reach our 100 percent renewable energy goal. Right?

And so these are sort of the four sort of major themes and categories of requirements or objectives that our customers said that they wanted to see from the grid. So if you look at this handout, that's sort of shown here in the middle.

The one additional thing that they talked about that's in the handout was this topic of includability. And we asked our customers some questions around if -- for example, if there is a function of the grid that benefits all customers, our customers told us in these interviews, then, well, all customers should be sharing in paying for that investment. If we're all benefiting for it, we should all pay our part in paying for it.

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The other bit of feedback, though, that we got was if an investment or if a function provides benefits to a single customer or some subcomponent of our customer base, then those customers that see and obtain those benefits are those that should be paying for that investment. That's where the equitability component comes in. And that was another thing that -- that came through.

And so we used this information, right, this feedback that we got from our customers, as really the foundation and the starting point for us to design and develop a strategy of modernizing the grid. Therefore, our strategy is built, really, to provide these objectives and achieve them.

This next slide here just is to give some perspective and some examples.

And, sorry, I didn't realize I'm kind of blocking you folks.

What was very clear, right, even though there were those four categories discussed, there was a lot of emphasis from our customers that they wanted to have choices. Right? Some customers wanted to be a traditional full-service customer, right?

And so my father-in-law -- I keep using my father-in-law as an example. Right. He's going to kill me when he finds out. But, you know, my father-in-law,

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you know, he likes the paper statement every month, he likes writing a check every month, he doesn't have rooftop solar, he doesn't own a battery system. And that's what he wants, right? And so that's the choice that he's making.

But looking around the room, as you folks know, there are many, many customers who want a completely different experience and a completely different option in interacting with the utility. Right? They want to have their own solar generator, right, their own rooftop solar system. They want to have a solar system along with a battery, right. They want to participate in the time of use rate program, be a demand response program participant. And so examples like that, shown here on the right, really are the things that really drove us to ensure that the elements of our strategy provided customers choices to elect to be a participant in any one of these programs here.

And I know many of you in this room -- I know many of you are very knowledgeable in this, but, for the sake of everyone, just run -- spend some time, give you some examples here. Right? Customer solar, the most popular form of distributed energy. Many customers here on Maui and throughout the state have their own rooftop solar systems. That's one form of customer choice and a

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form of a distributed energy resource. But it includes other things, right, includes solar and storage.

And I heard someone during the open house section talking about Tesla Powerwalls. And that's a really good example of a distributed battery system that can allow that owner of the home or the business to take advantage of the ability for a battery to shift the energy that's generated by their own solar system.

A lot of customers are now starting to make should of those choices. We want to make sure that the modern grid that we move to in our strategy facilitates the integration, the operation and the increased utilization of these resources. So these are kind of the more top of mind types of resources, but it doesn't end there.

So lower in the list here we have the category called demand response. And what demand response is, is this notion that customers, either through changes in behavior or through the investment in technologies, like batteries or control systems, can allow some of their electric load, water heaters, for example, air conditioning, for our larger commercial customers, it could be large motors and pumps, right, to make some -- at least some of the load available for control by the electric utility. And demand response participants will

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get compensated for making their load or portion of the load available for that kind of control.

The benefit -- watch out. The sign is starting to fall. The benefit of demand response is that allows the electric utility to have another lever or another gas pedal to balance the system. Right. And at any given moment, Maui Electric's operators, Chris in particular, right, needs to ensure that, at every given moment, as all of us make individual choices in how we use electricity from second to second, that we always have that in balance with the exact equal amount of generation. And that's been the traditional way to operate an electric grid.

What demand response does, though, it gives the system operator, Chris' folks, the ability to not just only resort to adjusting the output of a generator or starting up a next generator as load increases, it allows Chris, Chris' team, to have the ability to actually control a portion of the load. Right? And so if we see a sudden and rapid increase in load, we can actually turn off some of these -- or lower load from these demand response programs to help keep things in balance. Or if we get a sudden dropoff in wind and the wind gust dies or a cloud cover forms over solar panels, then that sudden reduction in generation can be matched with a planned reduction in load through the demand response program.

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And if we can operate the grid in that fashion, using demand response, more efficiently and at a lower cost than starting up another generator, right, or building a new power plant to -- to be able to serve a higher load, then everyone benefits. Right? Those customers that participate in the demand response program will have a revenue stream to help offset their investment in a battery system or electric vehicle. Right? Hopefully, it's done in a way where it's not impactful to their lives or to their business, but then all customers on Maui will benefit from it as well because now Maui Electric is able to operate the grid more efficiently and at lower cost.

So if these kinds of technologies, right, customer solar, customer storage, customer technology that allows more customer load to be eligible and participants of a demand response program, then we want to make sure that our grid modernization strategy transform the electric grid to be able to -- to interconnect and work with these kinds of technologies and programs. It's a very significant shift from what -- what we have traditionally done and seen.

And this change, this shift, is really highlighted here at the top of this sheet. Right? And Chris kind of talked -- or touched upon this at the

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beginning in his part, but the electric grid that we have today, if you go back to Chris' diagram, was really designed for this one-way power flow, right, where power is generated at a few large utility scale or central station generators like HC&S or Kahului or Maalaea. And power that's generating these PUE points from large power plants than are transmitted in bulk in one direction. Right? So from Maalaea, it goes out to Lahaina, goes down to Kihei, right? From here, Central Maui, goes to Wailuku and Kahului, to Waihee, right, and all parts of the island. And from there, the power voltage, the voltage of electricity is lower and then distributed around each of our neighborhoods where the electricity is consumed.

In contrast, the grid that we -- based upon what our customers are telling us what they want in terms of customer choice and the use of distributed resources, is to have a grid to not just do that, but have a grid that can functionally operate in the opposite direction, where customers are generating the bulk of the electricity, right, sending that power, not just within the home to be consumed there, but to create energy and send it back into the grid, flowing power in -- in the opposite direction from where it has traditionally flowed. Right?

And if you think about things like a rooftop solar system and a distributed battery system or an

electric vehicle, these things are intelligent, right? All of these devices have very, very high capabilities, but, in order for these devices to work, not only do we have to accommodate and reverse the power flow, but these devices need to be able to talk with each other and need to provide information to our system operators.

So bottom line, the grid that we have today, the folks at Maui Electric, the engineers, the operators, have actually found very creative ways to take the grid that we have to accommodate the level of distributed solar that we have today on Maui.

And just to put that into perspective, the level of solar that we have here in the islands that we serve, including Maui, runs about 20 times the national average on a per capita basis. 20 times, right? But we know, right, based upon what customers are telling us now and through our interviews and focus group meetings, that our customers want to do even more of that. So the grid needs to do even more.

And we've taken the grid that we have today, we've done some creative things with it to accommodate the amount of distributed solar that we have, right, but we're beginning to see the limitations of what our grid is able to do, right, we need to make modifications and upgrades on that grid to modernize it to allow the grid to do this

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two-way power flow at levels beyond what is capable of doing today.

And when -- you know, Maui, I think, one of the best examples of this. Right? And Chris talked about the requirement, the goal of us to achieve 100 percent renewable energy by 2045, if not sooner. Right? We all require, all of us, to -- well, we require the use of a whole range of different renewable resources. We're not going to get to 100 percent renewables on Maui relying on just one single technology. Right? We're not going to get there cost effectively by just doing large wind farms. We're not going to get there by doing just large solar farms. Right? And we really need more, what we call, grid-scale larger renewable systems and more distributed systems, like distributed solar and distributed storage.

So in order for us to actually achieve 100 percent goal, for those of you who are familiar with the Power Supply Improvement Plan, we're going to need to actually increase the amount of distributed systems in order to get there, which works great because we're hearing from our customers that they have a strong interest and the desire to do more distributed systems. It works very well with the portfolios of renewables that we've developed in our Power Supply Improvement Plan.

Again, customer choice on this list. As I

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mentioned, you know, the grid was built for one-way power flow. It was really built to serve my father-in-law, right, the traditional customer who doesn't have their own generation, doesn't have their own storage, takes all of their electricity, all of the backup power, right, all the power quality from the utility. And that's fine for today, but what customers are telling us is they want more choices, choices like those distributed systems that are covered in this -- in the slide before.

And last point on this -- and I thought for sure, knowing that Chris is going to be giving the introduction, that he would talk about this -- I don't think everyone knows that the distributed solar systems that we have here on Maui -- and I think today we have about, what, 70 --

MR. REYNOLDS: 93.

MR. CHING: 93 megawatts, right. And by comparison, the largest single generator here on Maui is about 28 megawatts or so. Right? So in totality, in aggregate, distributed solar is by far the single largest generating resource on this island. It's a good clean renewable resource, but one of the things that folks may not know is that 93 megawatts of distributed solar is completely invisible to Chris, right, and his system operators. They don't have a way to know what these

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distributed solar systems are producing. Right?

And so if your largest generator who will adjust their output based on solar over the course of day in cloud cover is also producing it without Chris actually knowing exactly what it's doing. Right? So having the ability to sense better what's going on, on the grid, down in local communities where you have rooftop solar is a very important additional sort of grid functionality that we're going to need in order for us to make the greatest use of these distributed renewable systems.

So in a nutshell, that's sort of the guts or the objectives of the grid modernization strategy.

I just want to end by talking a little bit about how we plan to implement these technologies in our strategy. I talked about some of the functions. And the how part is, actually, probably just as important as some of the functions. And this is what makes this draft strategy that we develop probably the most unique and different from grid strategies that have been developed by other utilities.

And in our grid modernization strategy, because our customers told us right here that affordability was a key element, a key objective, our strategy does not call for the deployment of these technologies throughout the entire grid. Right? By doing that, you may be efficient

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in a per unit basis in doing that deployment, you take advantage of economies of scale and whatnot, stuff that the engineers really like, right, but what we are concerned about and why we're not doing this as part of our strategy is because that doesn't give us certainty of whether or not a device that deployed will actually be used or be utilized. Right? And that could result in an investment that's made and a cost that is incurred that doesn't have a corresponding benefit of value because there's no utilization. Right?

So, instead, our strategy and the how we do this and how we execute is built around this notion called proportionality. So some of the technologies I talked about really is -- are examples, but, at the end of the day, our plan to deploy is going to be based by customer choice, back to that main point. So if a customer, one of you as a customer of Maui Electric, decides that you want to get a new solar system or a battery system or participate in the demand response program, right, we will use that decision, that election, and we'll do our best to look at what customers plan to do in the future as well, but to use that choice by customers to participate in a program to be the trigger and to be the guide by which we then deploy these various technologies to provide the functions that are needed to support that customer choice.

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And so we wouldn't be deploying a technology just because there is -- we're doing it next door and we are just going to deploy another one here because it's convenient and here, but, instead, we'll deploy the technologies only when we're sure and certain that the value from that deployment will occur through things like customer choice.

And so the phrase that I think a lot of folks may use or be familiar with is opted in. Right? So if I opt in or Mahina opts in to participate in a demand response program, in order to measure and verify the change in utilization on the demand response signal, we're going to have to put a measurement and verification device through the meter. We're going to have to put, potentially, sensors that will be sort of the triggering or the input information of when the demand response is needed.

Same thing for voltage controls. If a customer elects to do a solar system, right, and we get a concentration of solar systems in one particular area, then, as a result of that, we would be deploying some technologies that actually help to mitigate and manage the voltage in that local area. But that voltage management system would only be deployed when customers choose to adopt PV systems at that point.

Okay. So that's sort of a summary of the how.

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So just as a wrap-up, I want to make sure we have time for questions and answers, a copy of the full draft of the grid modernization strategy is available at this website here, www.mauielectric.com/gridmod. You can find a copy of the draft. We also have in there copies of the Hawaii Public Utilities Commission's decision and order that started this grid modernization effort as well as some other related orders that came out on the same topic. We also have an email address. So in addition to providing the option to provide option -- comments through written form, the white page that we all have, we are accepting comments to this email address. And we'll be taking a look at that as well.

We ask that comments be provided to us by next week Wednesday, August 9th, because we need to take all of the comments that we received thus far, and will be receiving through the night, and refining, using it to refine our grid modernization strategy so that we can file that final version of our strategy with the Hawaii PUC on August 29. And so we're in that stage now where we're taking the draft and developing a final.

So with that, I'll hand the controller and mic back to Mahina.

MS. MARTIN: Thanks, Colton. What I would like to ask is -- when you entered the door, you also got

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these. And the reason we asked for these is so we can make sure we answered all the questions. And not everyone wants to verbalize them. So our staff is available to pick up your questions. I'm going to read them. I hope you can read your writing, but, if I can't, then I'm sure you'll remind me. As we're collecting what you have, you can keep writing, wave your hand if you want a blank one, we'll do our best to answer them tonight.

I also want to recognize and thank them for coming, because it's been such a busy time at Council. And I don't know if she needs introduction, but, of course, our Council Member Kelly King, home of the sunflowers. We've been partners with Pacific Biodiesel far beyond her engagement in politics and really appreciate her interest in energy issues. We also want to thank, because we have a good relationship with the County, through their Energy Commissioner, this is Fred Redell. If you didn't ever meet him, he's the fellow that represents all of us as citizens here in the interest of energy on behalf of the administration from the County. He's a great fellow, so, you know, please -- I went to Molokai and they said we didn't know we had a energy commissioner. So they were asking for his phone number. I gave him his email. But he is a public County employee, so there is an office number available. But both great

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people in government that can help us guide our way through modernizing our grid.

I'm going to ask if there's anything that's been written, Kuhea? No? It can't be like that. No questions? Okay. We're looking for questions that Colton can answer because he is here tonight. So we would like to take first grid modernization related questions.

This one says -- and I'll hand this to you because it's kind of lengthy -- Section 8.1.1 of the draft report states, among other things, that smart meters will be available for replacing old meters as part of a transition to the new business as usual. What is the timeframe for replacing old meters? Colton.

MR. CHING: Sure. So, you know, like anything, the electric industry is changing. There's a lot of new technologies coming in that's fundamentally changing not just electric utilities, but all of the solution providers that provide products to electric utilities. So, you know, I think we're all familiar with the electromechanical meter, the one that has the dial, the black and white dial that turns. You can't get them off of the primary market. Right? The manufacturers of meters have found it much more cheaper and more accurate to manufacture digital meters. Right?

And don't confuse a digital meter with a smart

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meter. I think the -- and there's no sort of real official definition, but a digital meter is a meter where the register that gives you the reading is -- is digital or electronic versus that manual turn tach. That's become the new industry standard, right?

There will be a time in the future, right, that the standard meter that L&G or iTron, the manufacturers of meters, will have may very well be a smart meter, which means a meter that has the ability to not just read, take a reading, but, also, be able to communicate. So if a customer makes a personal choice and elects to not participate in the program, not have a smart meter that has the radio communication, it's fine. You can use a digital meter or you can retain the analog meter as long as the one that you have is working. The digital meter could be in there, right? And if it comes -- the day comes where only smart meters are being manufactured -- because you can deploy a smart meter without the radio. And that's standard design today, right? It has the ability to communicate if you install the radio in it, but if a customer has no desire or has no need for that communication capability, then we won't -- we won't install the meter as part of that meter.

UNIDENTIFIED SPEAKER: Why would you do that, though? PG&E installed all the smart meters and just

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said, no, you have no choice, and we all got smart meters. Why would you like leave half your customers in the 20th Century and put the -- and -- I mean --

MR. CHING: Absolutely. So if a customer -- so the question is, why would we -- why would we not install a smart meter?

UNIDENTIFIED SPEAKER: Yeah, why wouldn't you change, put everybody over on smart meter?

MR. CHING: So we're giving -- we're giving customers that choice. So if a customer wants a smart meter and wants to get interval data, have a customer portal or participate in a program that will use the measurement of that smart meter, that's fine and they can make that election. If a customer chooses not to, because they don't want to take advantage, they don't want a meter or they have no interest in using a program that takes advantage of that function, then we don't want to make that investment and make that -- incur that cost without having some benefits derive from it.

UNIDENTIFIED SPEAKER: The question was about the timeframe.

MS. MARTIN: So we'll -- out of courtesy for those who have questions, we'll go through the written ones first. And, again, you know, I just want to make sure that all the questions are answered.

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UNIDENTIFIED SPEAKER: Can he answer that one, that question that just got asked?

UNIDENTIFIED SPEAKER: Timeframe.

MR. CHING: So this is going to be the timeframe of when analog meters are no longer going to be available, or digital meters. It's really going to be driven by the industry. We won't put in a smart meter if digital meters, regular conventional digital meters are still available. Right? But we cannot create -- we don't have the capacity to create and manufacturer meters. We're going to be dependent upon the meter industry and what they actually produce and sell. And I can't tell you about the timeframe.

UNIDENTIFIED SPEAKER: And you know why, you know what's happening here is the green question thing leads to other --

MS. MARTIN: Other questions.

UNIDENTIFIED SPEAKER: -- comments.

MS. MARTIN: Sure.

UNIDENTIFIED SPEAKER: And people are raising their hands. And you're saying, hey, write it down on a green piece of paper because we're screening everything here, and by the time we get to your -- your follow-up, everybody else will have forgotten the train of thought and everything, especially the person who -- why don't we

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just -- why aren't we allowed to just make comments on the questions that are submitted?

MS. MARTIN: Only because we have other questions and each of those could generate further, more, and we'll never get to the --

UNIDENTIFIED SPEAKER: Absolutely. Absolutely. And I see you're taking great pains to avoid using the word smart meter instead of opt in. And so why is that? I mean, you know, there's all kinds of questions that pop up from that original question that got put on that chair.

MS. MARTIN: So I am going to be very considerate of others who have other questions as well. I understand about moving from one, that might generate a second question. I will ask you to -- I really want to be considerate.

UNIDENTIFIED SPEAKER: You're going to ask us to submit a green piece of paper.

MS. MARTIN: Well, no. I think it's just a matter --

UNIDENTIFIED SPEAKER: So you're going to let us raise our hands and then you're going to ignore us.

MS. MARTIN: No.

UNIDENTIFIED SPEAKER: Okay.

MS. MARTIN: No. We're in the same room. So I'm going to move on only because I said, from the

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beginning, that we'll work it through this way. And then if there's a continuing question, say about that --

UNIDENTIFIED SPEAKER: You said, from the very beginning, you're going to keep it simple. Now you are putting a level of confusion into it. Why is that?

MS. MARTIN: Out of respect for this, if one question generates 10 more, we'll never get to the other folks' questions.

UNIDENTIFIED SPEAKER: Then the first question was a great question, wasn't it?

MS. MARTIN: Actually, yeah, it was. And there are others that will also be great questions. So if you will allow me -- I don't have that many, I'm telling you, I just -- unless everyone, all of a sudden --

UNIDENTIFIED SPEAKER: We'll see what happens.

MS. MARTIN: Okay. Thank you.

Who will pay for the upgrades and will customers' bills increase and by how much?

MR. CHING: Okay. So the modernization of our -- the question about who pays really depends on what particular upgrade that we're talking about. But before, sort of -- I think maybe the broader question that I want -- I want to discuss is that the grid modernization work is not being done just to modernize the grid. All right. Fundamentally, what we're trying to do here is to

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modernize the grid and make investments needed to do that modernization, facilitate other things. Right? And those other things are the more newer distributed renewable systems, the storage systems, the demand response programs. And the reason for doing those things is to achieve lower costs, to be more efficient in getting to our renewable energy goals, running -- having an electric system that continues to be reliable, but to avoid expensive fossil fuels, right, and have a generation system that's more efficient and cheaper. So -- so that will be an investment by customers for the grid modernization to work, but we have to look at it in totality of the benefits, not just of the grid modernization itself, but the economic benefits of those distributed systems and programs that modernization is designed to actually facilitate and advance.

MS. MARTIN: Next question, Colton, is when the future of energy is at every home becomes its own power generation station, with solar on the roof, a small wind field in the yard and a small battery storage unit, the old model of the utility producing and selling power is obsolete. Why are you, our company, investing more in the old outdated models?

MR. CHING: I presume that the question about investing in the old updated model is referring to larger

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generation.

MS. MARTIN: Yes.

MR. CHING: So, you know, like I mentioned in my presentation -- and I hope I wasn't unclear about it -- that in order for us to achieve our renewable energy goals, to get to 100 percent, we're going to need to use many different types of resources. So we're going to still continue to have a need for larger grid-scale in the old systems, right, in combination with distributed systems.

The author of the question is absolutely right. We're going to have significantly more distributed in the old systems, batteries, distributed batteries in our future. That's what we analyze in our plans, this is what our customers are telling us. That will happen. But it won't -- you know, why don't we just keep it down -- but we're going to be -- in order to get to our goals, we're going to need a combination of both distributed systems and grid systems. So it's not -- it's not being blind or not paying attention to the needs to facilitate more distributed systems. It's absolutely one of the key objectives of our grid modernization strategy. But that needs to be done and facilitated in complement to new grid-scale renewables, whether it's wind or solar. You know, 10, 15 years from now, it may be a new renewable

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technology that -- that we don't really know of today.

MS. MARTIN: The next question is, the Federal Tax Credit for grid-scale solar projects start to shrink in two years and vanishes in four, four years. What is Maui Electric doing to solicit new grid-scale PV projects in the rest of this year? Has the PUC replied to Maui Electric's January letter asking that an RFP, request for proposal, docket be opened?

MR. CHING: Okay. So this is a very specific knowledgeable question.

MS. MARTIN: To understand it.

MR. CHING: But for the entire audience, the question is framed around the fact that the federal tax credits for things like large grid-scale solar systems. And it's, actually, a little bit different for -- for wind. Those tax credits begin to -- they're in place today, but they begin to decline in a couple of years and they start to sunset. Not just overnight, black and white, but they start to decline over a few years. And so the question is framed around if that is going to happen, what is Maui Electric doing to try and get grid-scale renewable and take advantage of these tax incentives that, in turn, can result in a lower cost renewable resource for the customers of Maui, because they're benefiting from these tax credits.

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The question, also, makes reference to a request that we made at the beginning of this year. Soon after we filed our power supply improvement plans with the Public Utilities Commission in December, we then made a subsequent request to begin the process of conducting competitive procurement for us to purchase renewable energy from these larger systems that the developer has an interest in constructing and selling energy to us. So time is a critical factor. Right? There are many complicated provisions on what qualifies and safe harboring and all of the like, but we feel it's a very sort of time limited opportunity to extract the value of remaining investment tax credits into renewable resources that can provide lower cost to our customers.

So we've been trying to find ways to -- one, we wanted to make sure we could start as soon as we can, start the process as soon as we can. And then we will be looking for ways to conduct that procurement process faster, right, and be more nimble about it so we can make awards, hopefully get Public Utilities Commission's approvals of the competitive procurement process and, therefore, allow developers to begin making the investments and start building their projects so they can take advantage and be eligible for those tax credits.

We're looking at ways -- the Public Utilities

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Commission has what's called a competitive bidding framework, an established process of how we go about going through competitive process to procure projects, including large renewable projects. And so we're looking at ways to still achieve the intent and spirit of those procurement rules, but to do it in a faster process. Right?

So far to date, we have not received the go ahead from the Public Utilities Commission to proceed with that work, but it doesn't mean we haven't been doing anything. So we've been trying to find options to do the procurement work faster even though we haven't got to start yet.

And another thing that we've done, that you may have heard about, is we issued what's called a request for information. We did this across all five of the islands that we serve, including the island of Maui, Molokai and Lanai. And we -- we asked landowners, larger landowners if they have an interest in -- well, we said we have -- we have a desire, made a request -- will be making a request to conduct an RFP for grid-scale renewables. And so as a large landowner, if you have an interest in making some of your land available as a site to host a renewable energy project, let us know, respond to this RFI. And that allows us to collect information up front, right, of the potential sites, combine that with information about our

grid, where eligible lands or landowners with lands of interest, and where we have existing transmission and distribution infrastructure and capacity within our infrastructure to interconnect these grid-scale systems, and begin collecting that information now so that when we begin the procurement process. Right? We can provide this information to interested developers rather than, at the start, have interested developers only at that point begin the process of looking for potential sites to host a project.

So those are the kinds of things we're looking to do to help expedite the process.

MS. MARTIN: I have a pumped storage hydro question for Chris, some smart meter questions and a customer choice questions. I'm going to move to those. It says here, Chris, will Maui Electric consider pumped hydro solar as a viable energy storage strategy? El Hierro island in the Canary Islands did an $82 million hydro generation plant, and wind power accomplished 100 percent renewable with major savings over the formal diesel generation system. So the question is will Maui Electric consider pumped hydro solar as a viable energy source strategy?

MR. REYNOLDS: Short answer: Yes.

MS. MARTIN: Okay.

MR. REYNOLDS: Long answer: You know, if a developer comes to us with the funding and the capital to make this investment, willing to sell us power that would benefit our customers, we would move forward with that.

MS. MARTIN: All right. This one goes to Colton. And if you need a blank one, just raise your hand. It says, why hide behind customer choice? Customer choice equals do nothing. Most customers do not want to spend money upgrading their system. So why hide behind customer choice?

MR. CHING: You know, with all due respect, I don't think allowing customers a choice and using that use to make smart investments only where it's needed. I don't -- I don't see it as hiding. I respect the person's opinion. And I think maybe that's something we want to turn from a question into a comment. But I really feel, based upon the customer interactions that we've had, discussions we've had with stakeholders, right, that what rings very, very loudly, one is that a lot of customers do have an interest in making an investment in -- in the technology, like solar and storage and others. Right? Customers have already demonstrated that. And more and more customers are inquiring and asking about doing that every single day. So I think there's that -- there's that desire. And my sense is that's been our experience, where

these newer technologies, when they're brand new, they're expensive, right, but the world has an incredible capacity and ability to take these new technologies and make them better and cheaper over time. So these technologies, I firmly believe, is going to be a significant part of our future. And so, yes, we'll make the necessary upgrades and modernization efforts and new capabilities in our grid where it makes sense to do it. And by making sense -- when I say making sense, where doing that actually provides a capability and a function that will provide value to our customers, but not make that investment in places where, if we were to do it, that technology doesn't get utilized. I don't think that that makes sense.

And so I believe it's a good approach and a strategy. And this is the basis for which we have our draft. But, again, I respect the person who authored that question, their perspective.

MS. MARTIN: Colton, are smart meters to include digital readouts that customers can view in order to validate consumption?

MR. CHING: That's a simple one. Yes. And it can be viewed in two ways, right? You can view it by going out to your meter panel and reading it this way, but metering has ability to be accessed through what's called a customer portal which could be, you know, a screen on

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your phone or a page on a website where you can see what your meter is doing in terms of consumption, not just at one point in time, but over time as well. And that's another way to look at your meter.

MS. MARTIN: When I called Maui Electric to say I don't want a new smart meter, I was told I could opt out at a cost of $15 a month. So charging to not get a service sounds like extortion, right? There's a question mark.

MR. CHING: So I don't know the specific basis for that. For Maui, the only advanced meters that I know were deployed here was part of the pilot. There was no opt-out cost. It was a truly voluntary opt-in program. And I'm not aware. Other folks --

UNIDENTIFIED SPEAKER: When you guys did a presentation at the KCA, that question was specifically asked and the response from the MECO rep was that you were going to offer an opt out and it was going to cost money. So that's where that information came from.

MR. CHING: So that was -- thank you for that clarification. So that was --

UNIDENTIFIED SPEAKER: Came from your people.

MR. CHING: That was part of --

MS. MARTIN: I remember.

MR. CHING: -- the earlier smart grid program

that we applied for that we're not going to do. Right? And that is the big -- one of the big differences between the modernization strategy that we have now and the earlier program that we had applied for.

UNIDENTIFIED SPEAKER: That's what they're doing in California.

MR. CHING: That's what's been done in many states, but that is not what is part of our strategy. Our strategy is not an opt-out strategy. It's --

UNIDENTIFIED SPEAKER: That was my question. I wrote that.

MS. MARTIN: Oh, that was your question.

UNIDENTIFIED SPEAKER: I called up when I saw an announcement that you were moving towards smart meters, the insert with the bill, we get them through snail mail. And it announced that you're going to do smart meters, so I called. And I then -- then I called another time as well and got the same answer from different people at Maui Electric.

MS. MARTIN: Okay.

MR. CHING: So that probably was related to that earlier program.

UNIDENTIFIED SPEAKER: So you announced that you were going to do it and then that's not true anymore?

MR. CHING: So we had filed an application with

the Public Utilities Commission to do it. And in January of this year, the Commission dismissed that. So we're not going to do that. Instead, we're developing a strategy that is framed around, basically, the opposite, right, rather than opting out, you opt in to participate in a program.

MS. MARTIN: If you want.

MR. CHING: So if you want a meter, you can -- we'll be glad to provide one for you, but if you don't want one, we're just as glad to --

UNIDENTIFIED SPEAKER: So you won't be charging if we don't want it, is that --

MR. CHING: Correct.

UNIDENTIFIED SPEAKER: What you are saying?

MR. CHING: Correct.

UNIDENTIFIED SPEAKER: You know, because when I'm looking at this thing here, it says we're building a grid for the future, that's what people want, was affordability, like deployment of smart meters. I can't imagine that people were saying we want smart meters, because everybody I have ever brought this up to on Maui, said we're getting smart meters, they don't know what it is, they've never heard of it, even though it was in your electric bill.

MR. CHING: So --

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UNIDENTIFIED SPEAKER: So I would like to see how you, you know, phrased this, that you people came up with your own idea of the smart meters.

MR. CHING: So, you know, in the interest of time, I couldn't cover all elements of the modernization strategy, but, when you have the time, take a look at the document and the link. You'll see, in that, the strategy. I know there's a lot of interest around, questions around metering, but the metering component -- unlike what we applied for in the earlier application, the metering component is a very, very small element. The focus of our grid modernization strategy is to enable distributed energy resources. It's putting technologies on the grid, sensors, devices, remote intelligent switches on the distribution system to enhance reliability, provide greater control of voltages on their system and to take advantage of what's called advanced inverter functions. And that -- that function, combined capabilities and functions of these new intelligent devices is a big -- that is the big part of the grid modernization strategy because it is focused on enabling those distributed resources that I talked about earlier.

UNIDENTIFIED SPEAKER: Quicker response.

MR. CHING: Yeah. Fast and quicker response. Right, quick response of the system.

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UNIDENTIFIED SPEAKER: Quicker response for sending crews out to put -- to shorten an outage.

MR. CHING: Absolutely.

MS. MARTIN: So Bash is offering, because he's from the industry, that it allows for a faster response time when there's an incident causing an outage.

I have a couple more here. So if you still need another one, we're in no hurry. I'm just telling you what I have.

In Section 7.3.2 of our June 2017 draft report, you state that transmissions from smart meters, quote, occur at average power levels far below safety standards specified by the FCC. Those standards were set in the 1980s based on old science and did not take into account the explosion of EMFs emitted by cell phones, wi-fi and cordless phones. Research shows effects on human health, including three types of cancer. How can you justify using meters that have known health hazards?

MR. CHING: I think we're going to maybe have to disagree on the perspectives of health effects, but, again, I'll go back to the point that if a customer does not want a smart meter -- and I'm assuming it's related to the radio communications function -- if the customer doesn't want to have a smart meter, then you don't have to have one. Right? I respect that.

Mahina, I suggest, although it is in the form of a question, we should include that as a comment.

MS. MARTIN: Comment. So whoever authored that on Section 7.3.2, the last question, we'll take it as a comment and insert it, you know, as part of the document that gets filed for public comments.

Colton, in addition to smart meters, what other grid improvements are in the plan? Please be specific.

MR. CHING: Okay.

MS. MARTIN: Oh, it says what other grid improvements are in the coop? Please be specific.

MR. CHING: Okay. So I'll be very specific, but I'll try to avoid too much engineering and utility jargon.

UNIDENTIFIED SPEAKER: Quicker response.

MR. CHING: Yes, quicker response. Right. So that's a good start. Bash, thank you for making that. So one part of grid modernization work is around automating our system, our distribution system. So if you can -- I'll go back to it. That's yours.

Mahina, can I get the remote? Yeah.

So Chris' slide is a good one, too. I'll talk about this. So here at Maui Electric, and the same thing applies to Hawaiian Electric and Hawaii Electric Light, Chris talked about a distribution substation where we take high-voltage, 69,000-volt electricity, and we step down or

reduce that voltage typically to around 12,000 volts. Still really high, but much lower than transmission voltage. We have visibility and we have what's called state of ability to control equipment in the substation here. But once you get past the distribution substation, whether it's overhead lines or underground ducts in your neighborhood, and as the power goes through your neighborhood and gets to each of our homes, there's -- there's almost no visibility and no automation. So when -- and I'll use overhead as an example. When a tree falls on the line, say here, that causes a short circuit. Right? First of all, we may not know that that's occurring other than the substation knowing that there is a problem somewhere along that line. Right? And so at the point, as a protection, to ensure the safety of everyone, that substation will de-energize that line. And then we'll have to send a Maui Electric trouble man or crew member to drive out to that substation and they'll run the line, literally drive the line, until they can identify where the source of the problem is. And then when they find it, they see the tree across the line or branch across the line, they'll manually open up switches around that problem area that will allow the system operator then to reenergize the slide on the circuit so that at least of the customers that are not directly in

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that affected area can get their power restored. And depending upon, you know, traffic and -- and, yes, there is traffic on Maui, right -- depending upon what the weather is like and what our crews are doing at that time, that process can take minutes, sometimes it can take hours. Right?

One element of a good modernization strategy is called automation. So there's devices called intelligent switches that we place along the circuit. When they see a tree hitting the line, these switches have intelligence built into them and they, in combination with something called fault current indicators -- and we have a couple examples behind there -- can actually identify where on the circuit the problem is occurring. And because it knows where the problem is occurring, the switches have the ability on their own to say the problem is between me, switch here, and you, switch there, so you and I, let's open up and let's tell the substation that you can go and reenergize the circuit.

UNIDENTIFIED SPEAKER: Do these indicate wirelessly?

MR. CHING: That can happen in seconds rather than minutes and hours.

UNIDENTIFIED SPEAKER: Do these communicate wirelessly, those devices?

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MR. CHING: So fault circuit indicators, some of them, like the smaller one, just has a visual indicator. Some of the newer ones would have a cellular card on them and they can communicate back. The switches can have communications, but the switches have the ability to sense and then control. One option is by communicating with each other, but the other option is through how they're programmed and the coordination of how they're programmed. So even if we don't have communication capability on this meter, those intelligent switches are able to, through programming logic, determine where the problem is and do the isolation that I just described. So that's one element.

And we all think about that improved reliability, that quicker response, as electric customers that get service from Maui Electric. And so when a problem occurs, it's a windy day, that outage that would have otherwise been two hours becomes a 15 or 20-second outage, right, much shorter in duration and less impactful. But the other benefit of having that quicker response is the fact that we're going to be relying on distributed solar and distributed storage systems that are installed all along businesses and homes on the circuit. And so the faster that we can get at least the majority of the circuit back into service means the faster we can get

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those generators back online, which allows the rest of the island to take better advantage of that generation. Because if we're going to depend on distributed systems to serve our customers reliably, we want to make sure that they can come back into service or stay in service when problems on a distribution circuit will occur.

So that's sort of the doubling effect of it. And that's just one -- one element.

The other element that, perhaps, I'll talk about is -- and this is not a good diagram for that -- is the use of what's called Volt-VAR devices, engineering term, right, but when customers -- or when anyone installs a solar system, right, it's a generator like any other kind of generator. And one of the conditions or one of the natural functions of a generator is that, naturally, it will tend to increase the voltage at the point that the generator is producing electricity. Okay. When that solar system is on or the wind farm is on the transmission system, that's okay because most folks don't take power from the transmission system. They have it come to them through a distribution system where the voltage change at the transmission level does not result in the same or similar voltage change at the distribution level. But when you have that generator now located on the roof of your home, what that means is that natural tendency for

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the voltage to increase right where the generator is located can, in some instances, especially when you have a lot of distributed generators all in the same street or in the same neighborhood all connected to the same 120 or 240-volt secondary distribution systems, can cause the voltage on that distribution secondary system to rise above the upper limit by which Maui Electric needs to provide and is required to provide electricity to all our customers. Because our devices in our computers, our TVs, they're expecting 120 volts, right, by tariff, we have to keep within a certain amount percent above and below. All right. So we want to make sure that the volt -- the natural voltage rise that the concentration of rooftop solar systems would otherwise try to create on the grid in that local area, we want to make sure that rise is not to the point where it exceeds that upper limit. So the traditional way to ensure that doesn't happen is to make our conductors, the wires, or to make the transformer that serves the portion of a neighborhood, make those things bigger. It does what's called reducing impedence in that section. And that helps to reduce the rise, if that makes sense, reduce the rise of voltage that would otherwise occur. That can be expensive and that can take time.

And so what we've come up with as one new technology to help that circuit accommodate more

distributed renewables, without resorting to things like replacing conductors and transformers, is to use these Volt-VAR devices or voltage regulation devices. And we've been piloting a couple of different systems, different technologies. And we've found some that work very well.

And so one example of where these technologies have been put in place on actual circuits and have actually been very successful in reducing the voltage rise in circuits with large amounts of distributed solar systems was tested out on Oahu. We picked a couple of circuits on the windward side using brand new technology, actually not even designed for this purpose. Really designed for another purpose. We used those technologies to actually demonstrate that with the same amount of solar operating on that circuit that the voltage rise was significantly less than what it was or would be when those systems were not there or when they're turned on.

So use of technologies like this -- and we're not binding to one specific vendor, we want to be able to have many options -- is to use technologies like this as a new technology in lieu of a traditional transformer or conductor replacement to allow our systems or circuits to accommodate more distributed solar and, then later, more distributed storage systems. That can actually help us with electric vehicles as well. So one of the things

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we're concerned about is when you have a large increase in electric load, the opposite effect happens, right, voltage tends to drop when the load increases. And the traditional solution there is to put in larger wires or larger transformers to deal with the voltage.

These voltage devices can also work in the opposite direction, by helping elevate or maintain voltages above the minimum range without having to resort to more costly time-consuming upgrades alternatives.

So those are two examples. I've gone on for a while, so I'll stop there. I can -- I can discuss it more, more of the technologies, if you folks have questions.

MS. MARTIN: There will be a quiz after. I just have a couple more. One, I think, Chris can help answer. When will you, the company, lower the base power level at the Maalaea power station, power plant, and will you be adding battery peaker plants?

MR. REYNOLDS: Maalaea Power Plant, I don't want to brag, but our power supply department has been very diligent about working on lowering their minimum output. They have gone through some generation control changes and they've gone through a program like a -- so, basically, they have low load modifications on these plants. So, actually, you can run these generators that will normally

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block that higher rate and actually run 'em lower now, and still maintain their emission compliance. It's kind of important for this -- earlier this year, we saw an incredibly low daytime load on Maui, 72 megawatts. So on that day, we have 21 generators available at Maalaea, that day, we were only running three. And one of them was a heat recovery unit. So, actually, there's only two units that are burning diesel. So, yeah, they've done a great job in lowering the minimum amount of power that can come out of Maalaea at a very safe level.

UNIDENTIFIED SPEAKER: Impressive.

MS. MARTIN: And the last green sheet I have is for Colton.

MR. REYNOLDS: Was there something about the batteries?

MS. MARTIN: Oh, yeah. Sorry.

MR. REYNOLDS: We are -- we are looking at battery technology and how to actually -- especially in the South Maui area because there's a -- there is some issues as far as voltage protection. So we are kind of continuing looking at that. Right now, it's not quite at the right price point we like because any time we put something like that, everybody, even me as a ratepayer, will have to pay for that. So right now, we're still kind of looking at this. It's not critical, but we are -- we

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do like seeing the advantages the batteries offer and it's a nice alternative to the traditional way.

MR. CHING: Mahina, can I just add to that? So earlier in the evening, one of the first questions we got was about this RFP process, right, the competitive procurement for new grid-scale renewables. We fully expect, as part of that competitive solicitation, that solution providers will be proposing things like a combination of solar and storage that produces renewable energy, but will use the batteries and will generate that energy to charge that battery that would then allow Chris and the operators at Maui as well as folks on other islands to use that energy on demand, right, to help -- for example, help to serve the load during the evening and not necessarily only produce and inject that energy into the grid during the daytime. And it's very, very likely that we will be getting proposals like that. And I'm hopeful that those proposals, actually, will be competitive.

The other question that we got was around these investment packs, right, related to that. And so one of the quirks or -- quirks is probably not the right term, but one of the functions or features of these tax credits is that tax credit can apply to the battery as well as long as the battery system is designed in a certain way

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and has a certain -- at least a certain portion of the energy that's used to charge that battery comes from that renewable resource that's built as part of it. And so that battery cost now can be brought down to those tax credits. And that's another opportunity. And if we can find ways to -- to procure these resources timely, where those systems can be brought in at a lower cost. And it's big, it's 30 percent. It's 30 percent, so big, big help in reducing.

MS. MARTIN: Colton, this question says, with regards to the technology being used, explain how smart meters and demand response, how -- namely, how can the utility turn off and on my appliances related to smart meters and demand response?

MR. CHING: Okay. What's a good example? I'll give two examples. Let's say a customer has made an investment in solar system and a battery. And so that customer may say, hey, I want to participate in Maui Electric's demand response program, right, which that means that, you know, potentially up to the entire load of my home can be made available to Maui Electric to control, right, to either reduce the amount of energy that's being provided to that home or maybe down to nothing, right, for that customer. Their daily lives, their life at home, would still be unaffected because they will just shift

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their usage of electricity from the grid onto the battery. And we may not be able to stay on that battery for a really long period of time, right, because it may not be fully charged, but the needs of the utility may be -- Chris is dealing with the ramping event, and so he needs that capability only for a few minutes. Right? And so that customer with the battery says, yeah, if you're going to pay me to give you that flexibility, I'll just shift my load over to the battery, as that homeowner, right, it doesn't affect me at all, I still use my appliances and equipment in the same way. In that example, the demand response program is done by controlling -- by having a way to communicate with that controller of that battery system or separate controller that oversees how the home's load is served by both the utility and that battery system. A meter in that case would be used to -- what's called M&V, or measure and verify, how that home's use of power from the utility changed or went down as a result of that signal that Chris' folks had when they needed that reduction. So we want to make sure that if we're going to compensate customers to provide that response, that when we call on them, we actually get the response that we were expecting. And that's where the function of the meter comes into play.

MS. MARTIN: We promised that we would go to

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7:30. I think, in recognition of your time, I just want to let you know that we do value your comment. And we encourage you to email in as well in the next week. We absolutely want that input to be included into the document that's going to be filed with the PUC. We are doing everything we can to make sure that opportunity is there, completing as much of these meetings that we can.

Having said that, everything you said tonight, again, as I said earlier, went to our stenographer here who has been with us. And we appreciate her time as well.

And if there are comments that you want to write down later, submit to us, please do. Email is fine. If you have a question, we're going to be here for a little bit, but, on behalf of Hawaiian Electric and Maui Electric, we certainly want to thank you for coming tonight and spending your time. And we are still going to be here to answer further questions that you might have.

So thank you, everybody. Appreciate it.

(Meeting concluded, 7:25 p.m.)

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CERTIFICATE

I, TONYA MCDADE, Certified Court Reporter of the State of Hawaii, do hereby certify that the proceedings contained herein were taken by me in machine shorthand and thereafter was reduced to print by means of computer-aided transcription; and that the foregoing represents, to the best of my ability, a true and accurate transcript of the proceedings had in the foregoing matter.

I further certify that I am not an attorney nor an employee of any of the parties hereto, nor in any way concerned with the cause.

DATED this 14th day of July, 2017.

_____________________________

Tonya McDade
Certified Shorthand Reporter #447
Registered Professional Reporter
Certified Realtime Reporter
Certified Broadcast Reporter

## 2. Maui Comments

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

AUGUST 2, 2017 - 6:00 PM – CAMERON CENTER AUDITORIUM

Thank you for attending this evening's Grid Modernization Strategy (GMS) Public Meeting. Please provide your name and organization you represent (if any), along with your comment(s) on the Draft GMS. This information will be included as part of the final submission of the GMS to the Public Utilities Commission at the end of August 2017. Comments are also being accepted via email at gridmod@hawaiianelectric.com.

FIRST NAME:* Debra LAST NAME:* Greene

ORGANIZATION (IF ANY): KeepYourPower.org

(*required)

COMMENT(S):

Wireless smart meters make our electrical grid vulnerable to hacking by petty thieves and rogue nations. When even governments and global corporations are regularly hacked, what are you going to do to insure the security of smart meter data and of our "modernized" power grid?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* Debra LAST NAME:* Greene

ORGANIZATION (IF ANY): KeepYourPower.org

(*required)

COMMENT(S):

Smart meters will not make for faster grid restoration. BRIDGE recently released their 2015 Outage & Restoration Management Survey Results Summary. Over 20,000 utility employees – executives, managers and engineers – from 90 utilities across North America were surveyed. 81% of the surveyed utilities had installed "smart" meters, but only 16% use "smart" meters as their primary source of power failure alerts. Customer calls come first. Well before "smart" meters – utilities rely on SCADA systems for outage alerts. SCADA stands for Supervisory Control And Data Acquisition. It is technology employed by utilities for decades and does not involve metering but operates at the transformer and substation level. Why are you installing expensive smart meters when they are not going to improve outage response?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* Debra LAST NAME:* Greene

ORGANIZATION (IF ANY): KeepYourPower.org

(*required)

COMMENT(S):

Smart meters have been shown to cost customers more by forcing people to reduce consumption and pay higher prices. What will you do to keep needy families from being penalized by these meters?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* Debra LAST NAME:* Greene

ORGANIZATION (IF ANY): Keep Your Power.org

(*required)

COMMENT(S):

Smart meters are a public health hazard, according to Dr. Samuel Milham (physician, epidemiologist), author of Dirty Electricity as well as over 100 peer-reviewed scientific publications. The World Health organization has declared EMFs, such as those emitted by smart meters, as a Class 2-B carcinogen (in the same category as DDT, lead and chloroform). What are you going to do to ensure the health and safety of those with smart meters?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* Debra LAST NAME:* Greene

ORGANIZATION (IF ANY): KeepYourPower.org

(*required)

COMMENT(S): ↓

Swiss RE, the second largest insurance provider in the world, lists "unforeseen consequences of electromagnetic fields" as the highest risk category and EMF devices are now excluded (i.e., not insured) across markets. Why do you want to take on this liability and what are you going to do to ensure the health and safety of those with smart meters?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* Debra LAST NAME:* Greene

ORGANIZATION (IF ANY): Keep Your Power.org

(*required)

COMMENT(S): ↓

Data collection by smart meters violates privacy and constitutes in-home surveillance. The Hawaii Civil Liberties Union has cautioned against use of smart meters due to the potential violation of our Fourth Amendment Right to Privacy. What are you going to do to protect the privacy of those with smart meters?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* Debra ~~[illegible]~~ LAST NAME:* Greene

ORGANIZATION (IF ANY): Keep Your Power. org

(*required)

COMMENT(S):

Hundreds of fires, several explosions and two deaths have been linked to smart meters. What are you going to do to ensure the health and safety of those with smart meters?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* KATHLEEN LAST NAME:* GILLARD

ORGANIZATION (IF ANY):

(*required)

COMMENT(S):

I have an extensive background in Environment and Development. Smart meters are not necessary for grid modernization. They are expensive and unnecessary for the integration of renewables. In an official report, one of New England's largest utilities, Northeast Utilities, criticized smart meters in detail, saying there was "no rational basis" for their implementation, and that smart meters did not reduce outages or "modernize" the electricity grid. Why are you installing expensive smart meters, that we will have to pay for, when they are unnecessary for grid modernization?

Sent from my iPhone

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME*: Jon LAST NAME*: Woodhouse

ORGANIZATION (IF ANY): The Maui Independent

(*required)

COMMENT(S): I am very concerned about the implementation of smart meter technology on Maui. I have yet to come across a study which shows the new meters actually provide consumers with significant savings – which supposedly is a primary reason for their introduction.

I trust that with the proposed "Opt in" policy on Maui I will be able to keep my analog meter, which works just fine.

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

AUGUST 2, 2017 - 6:00 PM – CAMERON CENTER AUDITORIUM

Thank you for attending this evening's Grid Modernization Strategy (GMS) Public Meeting. Please provide your name and organization you represent (if any), along with your comment(s) on the Draft GMS. This information will be included as part of the final submission of the GMS to the Public Utilities Commission at the end of August 2017. Comments are also being accepted via email at gridmod@hawaiianelectric.com.

FIRST NAME:* Erin LAST NAME:* Fowler

ORGANIZATION (IF ANY):

(*required)

COMMENT(S): After this presentation I still do not understand WHY a new grid is needed to use solar energy. I also do not understand why smart meters & smart cities are needed. They seem invasive and of no benefit for me. I heard the presentation, it was repeated multiple times that this grid is needed but the connection between the solar systems needing a new grid was not clear, nor were any other potential options offered & then a potential rebuttal as to why this option would be better. This presentation seemed very flat & one sided.

COMMENT/QUESTION

COMMENT/QUESTION: In Section 7.3.2 of your June 2017 Draft Report you state that transmissions from smart meters "occur at average power levels far below safety standards specified by the FCC." Those standards were set in the 1980s based on old science and do not take into account the explosion of

NAME AND EMAIL ADDRESS/PHONE NUMBER EMFs emitted by cell phones, wifi, and cordless phones. Recent research shows effects on human health, including 3 types of cancer. How can you justify using meters that have health hazards?

Maui Electric

GRID MOD COMMUNITY MEETING – 8/02/2017

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

AUGUST 2, 2017 - 6:00 PM – CAMERON CENTER AUDITORIUM

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FIRST NAME:* Lili Townsend LAST NAME:* Townsend

ORGANIZATION (IF ANY): ♡

(*required)

COMMENT(S):

My Name is
Lili Townsend from
Kehei
I stand here today to
Thank you for hearing
us and to oppose
smart meters catagorically
I feel like
a combination of
a canary in the coal
mine +
crusader rabbit!

for fear of EMF's
in the airport.
I never gave this
issue much thought
until last year when
a cascade of events
caused a blow
to my nervous system.
I became electro-
sensitive.
My left hand, the one
that held my iphone 6

Why?
Because of extreme
anxiety, pain +
sleeplessness
plus a heightened
sense of fear..
I suffer from
Electro magnetic frequency
sensitivity
and it makes my life
a living Hell.
I can no longer travel

became an antenna
for EMF + WiFi.
It feels like its
asleep with icy/hot
sensations.
Heat + pain go
up my arm as
well as bruising
I wear a glove +
vest with metal thread
to help keep me
safe.
I began to get

Headaches like
a pressure band
around my head.
I experienced brain
spikes which feels
like an icepick
slammed into my head.
I replaced remote
phones with corded
ones + use ethernet
instead of WiFi..

There's an informative TED talk by Jeremy Johnson which explains alot about this and the connection to smart meters.

The Research is all out there. Thousands of people around the globe are experiencing the same thing. Cancers & Brain tumors are on the rise

The City of Portland has banned smart meters and with good reason. And they are not even the best technology of now!

I wanted you to know what this is like & warn you that this could happen to anybody.

One researcher calls this the man-made epidemic of the future.

If my Neighbor installs one near me it will effect me & I am afraid.

To import this dangerous technology to our island seems like an ongoing crime of ignorance.

Thank you [redacted]

## D. OAHU – AUGUST 7, 2017

### 1. Oahu Transcript

001

HAWAIIAN ELECTRIC COMPANIES
PUBLIC MEETING
RE:
DRAFT GRID MODERNIZATION STRATEGY

TRANSCRIPT OF PROCEEDINGS

Monday, August 7, 2017

Taken at President William McKinley High School,
Hirata Hall,
1039 South King Street,
Honolulu, Hawaii 96814,
commencing at 6:58 p.m.

Reported by: LAURA SAVO, CSR No. 347

A P P E A R A N C E S

Colton Ching, Sr. Vice President, Planning & Technology
Scott Seu, Sr. Vice President, Public Affairs
Kurt Tsue, Director, Community Relations
Annelle Amaral, Facilitator

| PUBLIC TESTIMONY BY: | PAGE |
|---|---|
| Tom Harris | 38, 45, 51 |
| Brigitte Otto | 49 |

HONOLULU, HAWAII AUGUST 7, 2017, 6:58 P.M

-- o0o --

MR. SEU: All right. Good evening, everybody. Thank you for coming. My name is Scott Seu. I'm senior VP of public affairs for Hawaiian Electric Company. So joining me up here at front -- in the front, who will be giving some of the information to you to kick off, will be Colton Ching, senior vice president of planning and technology. We are also going to be assisted by Annelle Amaral, who will help facilitate -- facilitate tonight's discussion.

I want to make sure I cover all of the information correctly. So that's why I'm going to look at this.

Okay. So, generally, tonight we're going to structure it so that, first off, Colton and I are going to be giving you a little bit of background information about our current electric system and then what we have in our Draft Grid Modernization Strategy. So that will be the first part of the evening.

From that point, we'll have some time for some questions and answers. So if there's any questions that were spurred on in your minds from the presentation, we'll have a chance to clarify some of that information.

Okay. And then the third part of the evening

will be we are providing an opportunity for folks to actually provide some verbal testimony or comments tonight. And in addition, by the way, we also have sheets where you can submit written comments to us.

As you are listening to the presentations, we would ask that if you have questions that come to your mind, again, for any clarification, write it down on one of these purple half sheets. Okay? And then when you have it completed, just hold it up, and somebody from Hawaiian Electric will collect it from you and that will make the Q and A session go a little bit faster. And if you have written comments, then use the full-page written comment sheet.

Okay. So the purpose of tonight really is to collect input from you folks, from our customers, from the community about this Draft Grid Modernization Strategy. We will be collecting comments through August 9th, I believe, because what we then have to do is incorporate the inputs in turning around our next revised filing of the grid-mod strategy, and all of that will be filed to our Public Utilities Commission by August 29th. So all the comments you submit to us or state verbally will be documented and included in what we file to the Public Utilities Commission.

We do have a court reporter who is collecting --

documenting everything that is being shared tonight. So we want to make sure that we have a complete record.

Let's see. So we publicly announced the draft grid-mod strategy on June 30th when we filed that to the Public Utilities Commission, and that draft grid-mod strategy has been available online.

We will provide this opportunity for customers on the record, again, so that we can capture as many different inputs and opinions about this grid-mod strategy as possible.

So let's see. What else do I have here?

We ask that anyone speaking tonight, please state your name before providing your testimony or your comment. I think we also want to make sure that people have a fair chance to comment. So if you have submitted a question, and we have an answer and that leads, in your mind, to a follow-on question, again, we ask that you, please, fill out another question form, and that way we can provide a fair opportunity for us to get through everybody's questions. Okay?

Okay. I think I went through -- I think I went through -- you know what, I forgot, very importantly, emergency exit here, emergency exit there. Of course, you can also try to use those entry doors that you came in on. And I think as you walked in, you should have

seen the women's and men's restrooms.

Okay. With that, I will start the background overview of our electric system.

Okay. Well, so first off, I'm going to start by laying out why are we here talking about a modernization strategy for our electric system or what we call "electric grid."

The existing grid that we have --

You know, I'm going to do my best to avoid the jargon that we all talk about within the electricity -- electric company, but, please, if I do -- if I do say an acronym or use jargon, at that point, please don't hesitate to interrupt me. Our general rule is don't interrupt each other, but if I say something that is utility speak, please do go ahead and raise your hand and say, "What is that?"

So our existing energy system is -- basically, it was designed to produce electricity and provide it to our customers through a distribution -- what we call a transmission and distribution system, but, basically, the energy is going one way. It's going from where it's being produced out to the customers. So that has been our traditional energy system.

So with that, I want to -- I'm going to show you a very short video clip here.

(Video playing for audience.)

MR. SEU: Okay. So, you know, for those of you who have been with us in this journey of working with our renewable energy development, all of this will be very old hat to you. But what we often find is that we, in the energy sector, we tend to just jump right into the discussion of debating various technologies and systems that are needed to get to our 100 percent renewable future. So what I want to do is just, in a few minutes, just explain what our traditional grid -- some of the major components are.

As I mentioned, it starts with producing electricity somewhere. So in this depiction, we have what is a conventional power generation plant. You could replace that with a wind farm, with a solar farm, some other alternate source of producing electricity. Once the electricity is actually produced, then in order to get it to our customers, we actually increase the voltage of that electricity to a pretty high number. On Oahu, we boost up the voltage to 138,000 volts, and we then send that high-voltage electricity over our transmission line system. So these are the big wires, the big poles that you see going over the Ko'olaus or going -- basically taking this high-voltage energy and getting it into the general vicinity of the

neighborhoods.

What we do then is we flow that high-voltage electricity into our distribution system. Okay. So the distribution system is now taking that electricity, and we're lowering the voltage to, in most cases, about 12,000 volts. Okay. Still too high for any of us to use in our homes. We then provide that 12,000-volt electricity out into the neighborhoods, and that's where you will see, if you -- for example, if you have a utility pole right in front of your house or down the street, you will see a pole-mounted transformer. Okay. So within that pole-mounted transformer, we're taking that 12,000-voltage electricity and bringing the voltage down even lower, 120 volts, getting it into your house. So, now, that's the usable electricity typically for all of us as customers.

So what we're doing in this traditional grid is producing electricity. We want to up the voltage as high as we -- as high as feasible here so that it can be more efficiently sent across the island; right? It's almost like that's the freeway of electricity. And then as we're getting closer to where the customers are actually going to use it, we will be lowering the voltage down in a few different steps. Okay. So that's the traditional electric system that we currently have.

Like I said, the power generation plant, it includes -- like, on this island, it includes the conventional power plants that we have out in Campbell Industrial Park, whether it's our Kahe Power Plant, our biofuel plant in Campbell, the city's H-POWER plant. So those are some of the conventional plants that we have.

Also, though, it will include the wind farms up in Kahuku and the North Shore. It would include the large solar farms. So that is our traditional -- that's what our traditional grid was designed for.

You'll notice, though, that, as was shown in that earlier video, now we have distributed energy systems across the island, primarily in the form of rooftop solar systems on our customers' homes and businesses. So that is the difference of what we're transitioning to is taking this traditional electricity grid and moving it forward and modernizing it so that we can actually accommodate a much more diverse set of resources on our system.

You can send the next video.

(Video playing for audience.)

MR. SEU: So as the system operators -- the system operators sit in a building across from the Blaisdell on Ward Avenue, and their job 24 hours a day is to try and maintain that perfect balance between how

much electricity is being produced and how much is being used. So you can imagine if you're there at the desk and you're monitoring what's happening on the island, if there is a sudden reduction in energy that's being produced, say, from a wind farm, then they immediately have to see that one of our power plants is going to be jumping in to service and fill that gap. And then all of a sudden, if the wind then kicks back in, well, very quickly, that power plant unit has to ramp down or reduce its output. So it's always a constant balancing act that we're performing here.

Okay. So this is my last slide. 100 percent renewable energy by 2045. Okay. That's -- that is the mandate for us. We measure -- right now we measure our performance using what's called a renewable portfolio standard calculation or an RPS. There are some nuances to how you calculate that right now. We're actually customer-owned renewables. There's sort of a double counting, but right now the impact of that double counting is fairly, fairly small. But our goal is truly 100 percent renewable energy. We don't -- we don't get wrapped around that equation, but using that RPS calculation, at the end of 2016, we're at 26 percent RPS.

We recently received commission PUC approval for

what we call our Power Supply Improvement Plan, which sort of mapped out a number of different scenarios for adding additional renewable resources in the future. And under our Power Supply Improvement Plan, we expect to be at about 48 percent by the year 2020. And, again, 100 percent by the year 2045.

What we show in this slide here, though, is that it's going to take a combination of grid resources as well as customer resources in order to achieve that 100 percent future. So the grid resources on the left will be the large-scale -- sometimes people call it utility-scale renewable resources.

On the customer resource side of the equation, though, will be not only customer renewable energy generation, but also how our customers make use of energy at any given time. So as an example, I referred earlier to maintaining that perfect balance at all times. Well, you can also balance things by being able to manipulate the actual amount of energy you use. So it's a combination of firm generation ramping up and down to beat the variations in the intermittent renewables, but also the other tool that we have at our disposal is can we actually control the load of a customer? So for me, that might actually be not only reducing my energy usage, but let's say that I have an

electric vehicle and now I can actually increase how much energy I'm drawing from the grid; right? So that's an example of how much customer resources can also provide an active balancing value.

So with that, I think that is my portion, and I'm going to hand it off to Colton to talk about the grid-mod strategy.

MR. CHING: Thank you, Scott.

Okay. I'm going to get my notes here. So good evening. Thank you, again, for coming and spending your Monday evening here with us. Before I get into the grid modernization strategy, if I can ask, just by show of hands, folks who have either read the grid modernization strategy cover to cover with gleeful energy or at least read the executive summary. That's awesome. Thank you for investing the time.

So in the interest of time and so that we can allow ourselves adequate time for questions as well as public testimony, I'm going to kind of run through my slides rather promptly and not cover every single detail of the strategy itself, but I do want to spend some time talking about -- before I actually talk about the strategy, spend some time talking about how we developed the strategy in draft form.

The process for us developing the strategy

really started off with us sitting down with our customers, sitting down with energy stakeholders in the past months to get their input, their comments, their thoughts on what are the objectives, what are the functions, what are the needs that our customers have, and what do they want a modern grid to do for them.

So in the first couple of quarters of this year, we sat down with over 200 customers on Maui, on Hawaii island as well as here on Oahu, as well as conducted one-on-one interviews with many, many stakeholders. And what was interesting was whether they were a residential customer or whether they were a commercial customer with a business or they were someone who has a keen interest in energy and is actively involved in the energy space here in Hawaii, there was a lot of common themes in what our customers told us.

What they said that they wanted from the grid is for the grid to provide affordability. They want the electricity that they buy from Hawaiian Electric or the electricity that they produce and consume themselves to be affordable. That's a no-brainer. It's to be expected. But customers also said they wanted that electric supply to be reliable. We even asked questions like, "If you were able to get our electricity at a slightly lower price, would you be willing to accept

slightly lower reliability in electricity?" And the overwhelming response was, "Absolutely no." Customers want and expect and need high levels of reliability in the electric supply.

The third theme that we heard from customers is they want to have choices in how they consumed electricity, choices in how they interacted with their utility and the grid, and how they provided services into the grid.

So Scott talked a little bit about things like distributed energy resources and demand response; right? Customers have told us through these interviews and focus group meetings that being able to make those kinds of choices by making the decision to invest in some of these technologies themselves or make the decision to participate in something like a time-of-use rate and change indicators, those kinds of choices -- those different kinds of choices were things that were very important to them, and they wanted their grid to be able to afford them the ability to make these kinds of choices as they look to use energy more efficiently and hit their affordability targets.

And then, lastly -- this is no surprise to us from Hawaii -- that our customers also had a strong alignment and recognition of the state's desire and goal

to go to 100 percent renewable energy. And so they felt that the grid that we need in the future must be a grid that can support this 100 percent renewable energy goal. And what was really encouraging was that many of our customers that provided us the feedback understood that they also played a role in getting our state to this 100 percent goal. So that was pretty awesome.

So we used these four -- these comments and feedback that we got from our customers around these four sort of themes or four ideas as the foundation for us to begin the development of our grid modernization strategy. So if you look at the strategy draft that we filed, the strategy is being designed around creating a grid that allows these functions, allows our customers to make these choices, allows for affordable, reliable energy, and allows for an energy system in total to achieve this 100 percent renewable energy goal.

Now, before I move on to the next slide, I hope everyone had a chance to pick up one of these when they came in.

Scott talked about the '70s grid, the grid that we have today, the grid design for one-way power here at the top. What we're going to be talking about are the functions that a modern grid needs to provide the new capabilities, the different capabilities on the

right-hand column. So if you look at your handout, you'll see that Scott mentioned the grid that we have today was built for a one-way power feed to send power from a few large generators out in Nanakuli, out in Pearl City, out in Campbell Industrial Park, and send it one way along our transmission system to each and every one of our homes and businesses where the utility provided everything, provided the power, provided all the energy, provided all the voltage stability, frequency regulation, all of the traditional service that we all kind of took for granted that utility was going to be provided to them; right? But what we've heard from our customers through these discussions is that the grid that we need on the right needs to be able to allow for more two-way power flow.

We have some of it today. We've been able to modify our grid to a limited extent to real eke out the capabilities of what we have today, but we really need to do more. And the Power Supply Improvement Plan that Scott talked about, we talk about a 2045 future having two to three times as much distributed energy resources, rooftop solar systems and battery systems than we have today.

So even though we're maybe leading the nation at 20 times the national average, what our customers are

telling us is that even with the levels we have today, we want to do a lot more. And the resource plan is telling us that if we want to get to 100 percent, by all means, we need to do more. So the grid needs to facilitate this two-way power flow.

Earlier here, I talked about energy choices; right? The grid was designed for what's called a traditional full-service customer. I actually quoted to the Maui News talking about my father-in-law. So I think I'm going to get into trouble with my wife this weekend when she reads the article. But, you know, my father-in-law is probably a really good example. He has no interest in a rooftop solar system or battery system. He's a very traditional kind of guy, and he wants traditional service from the electric utility.

On the other hand, my father, right, has a rooftop solar system. After my wife got a Leaf, now he's been shopping around to get an electric vehicle. He's interested in participating in demand response with his water heater and other loads; right? And they both are making individual choices; right? And the grid needs to be able to accommodate both. We still need to accommodate my father-in-law who wants that traditional supply, and we do need to accommodate my father who wants some of these new interactions with the utility.

We talked about enabling 100 percent renewable energy, but we need to achieve a 100 percent renewable energy goal to that upper right-hand block up there in a way that allows us to continue to provide along with distributed systems that our customers make an investment in, and this combined system needs to still provide reliable electric service to all customers. And we think if we do it in a right, deliberate way, not only can we maintain the reliability that everyone wants, but we can actually enhance the resiliency of the electric system. So when bad things happen, like major storms and things of the like, that the electric system is more able to respond to that event and bring electric service back quickly. We'll talk a little bit more about that later.

You can see on the right-hand side the other sort of new functions and new capabilities that we need for our electric system.

So what's in our strategy? This slide covers, by example, some of the new technologies that we're looking to deploy. It's part of our grid modernization strategy. And I will talk about some of the -- highlight some of them, but this slide here is an illustration to show the range of technologies that we are proposing to deploy as part of our strategy and

include within it, but this is not to mean that we will have these technologies or all of these technologies deployed everywhere. In fact, foundational to our grid modernization strategy is this concept of opting in. And this is an element of our strategy that's very, very different from almost every other grid modernization strategy amongst the U.S. electric utilities; right? So rather than deploying these technologies everywhere across the island and try to do so in an efficient, low-cost manner, what we're going to do in our strategy instead is to deploy these technologies and these systems selectively when a customer makes a decision to participate in a program or if the circuit in the neighborhood operationally demands a certain capability that's not provided today. We will not deploy these technologies until those kinds of elections are made where we can ensure that that investment will result in an immediate and equal or greater value to that individual customer or to a group of customers in the neighborhood or potentially to all customers here on each of our islands.

So that opt in or what we call a proportional strategy -- proportional deployment in our strategy is one very, very unique and different element in the strategy that we are proposing now versus the smart grid

foundational program that some of you may be familiar with, which we filed an application with the Public Utilities Commission in 2016 and had that request denied.

So in contrast to that earlier proposal, we're not going to do that program. What we're saying is this strategy is very, very different. Sort of opt in and proportional deployment. That's a very, very different strategy.

So our strategy from a technology standpoint uses some advanced systems for the first topic of allowing or enabling a grid to accommodate, integrate and greater utilize distributed energy systems like rooftop solar and battery systems. Some of the technologies we identified to aid in that is on the --

On the far right, you see advanced inverters. That's actually customer equipment. We identified some specific new functions that a device called an inverter can produce if you select the right run with the right program. These are devices that customers will purchase or have installed as part of their rooftop solar system or their battery system. We identified certain capabilities that many of these converters can provide that can actually help mitigate some of the voltage issues that might otherwise occur and actually help run

that electric system in their particular neighborhood. So part of the strategy is actually defining the right equipment on the customer side. The cost to deploy one of these advanced inverters versus a traditional one is very small. Just a matter of several dollars. But that really helps in the grid's operation in conjunction with some other devices.

Like, for example, on the left-hand side, the bottom, you'll see a secondary -- it's called a secondary bar controller or an SBC. This is a device that is mounted on the electric system in neighborhoods. It's a very, very new technology that we actually piloted here on Oahu. I think we were the first utility to use this technology for PV additions. And this technology actually helps -- it looks at and identifies what the voltage is that the grid is seeing in different localities, and it's actually able to adjust the voltage upwards or downwards based upon what it's seeing and help keep the voltages to each of our homes at the right voltage; right? Because when we plug in our television or we plug in our laptop or refrigerator into an outlet, it's expecting 120 volts. And by tariff, we need to make sure that when we provide electricity to you, we provide it at 120 volts, the voltage we expect, and within a 5 percent band around it and no more.

So these devices actually help manage those voltages, which it then, in turn, allows for more distributed battery systems and distributed photovoltaic systems to be installed on our homes and businesses while still maintaining voltages at their acceptable limits. So this is some examples.

Another set of examples I want to point out sort of is in the top. It's called remote intelligent switches. This combined with the device to its right called a remote current indicator -- we had an SCI current indicator on the table outside. Take a look at it. A couple of examples. But those devices are part of what's typically called distribution automation. These technologies can sense what's happening on the conductor. They actually can sense the conductor itself and determine when there's a problem on a circuit that may be assigned that there's a fault or an outage. And rather than the traditional manual approach of when there is a problem, we de-energize an entire circuit, and resort to our workers driving out to the location of where that circuit is and driving or running a line to figure out where the problem is before we manually switch customers back on. That can be 30 minutes. It can be one hour. It can be a four-hour event, depending on the weather and traffic and other circumstances. But

these devices are able to basically perform that same function to sense what's happening on a line, make decisions through a coordinated control with each other, other switches, to automatically isolate where a problem is. So if a tree fell on a line on the corner at the end of the street, it will isolate that portion of the circuit where the tree is resting -- where the branches are resting on a line; right? And open up that section, reconnect all the other parts and re-energize the rest of the circuit. So that helps to bring power back on more quickly. So what may be a half-hour or two-hour outage becomes a five-second or eight-second outage. Very short.

That helps to provide greater reliability to customers, which we heard very strongly from customers that they want. But the other purpose for doing this is so that the distributed systems that are now prevalent in all of our circuits, these rooftop solar systems, these distributed storage systems, if we want to count on them and rely on them to serve the entire electric grid, then we can count on them more if that distribution circuit that they're connected to is more reliable and is able to come back into service more quickly if there's a problem. So it provides not just more reliable service to our customers, but allows us to

greater utilize some of these distributed resources that our customers are connected to.

And there are many other examples here. I won't go into all of them in the interest of time, but if you haven't done so already, I encourage you, on your way out, to go in the back and take a look at some of the devices. Sheri and others can talk to you a lot about what some of these technologies can do.

This is just another depiction of some of those same technologies. The reason for showing this is to show that all of these devices, if and when they're deployed, will be deployed on a distribution circuit. And one of the things about the electric system today that most folks may not realize is that the electric utilities, Hawaiian Electric included, have the ability to communicate with monitoring and control devices in a substation. You see where it has a substation on the left-hand side? But along the distribution feeder where either an overhead or underground line runs through all of our neighborhoods and ultimately serves our homes, that portion of the electric grid, the utility has almost no visibility at all. We don't know what's going on. We don't know when there's a problem other than when a customer picks up the phone and calls and says, "Hey, I've got a power outage. You need to send someone

to take a look at it."

So a portion of our grid modernization strategy is really now, through these technologies that we described, provide the ability for the electric utility -- for Hawaiian Electric to actually see what's happening along the circuit. And when we're able to see what's happening along the circuit, when we're able to have these intelligent devices installed that can provide us information of what's going on, we can work with each other in an autonomous or coordinated fashion, then we can operate the utility system much more efficiently and with greater utilization of some of these resources that we have.

So we're at a step now where, again, as Scott mentioned, we published the draft strategy. The purpose of our meeting tonight is one of the many opportunities to have our customers, our stakeholders, people who work in the industry, and I see several of you out here tonight, to provide us feedback and comments on the draft strategy because we're in this step now where we're taking the draft, taking public comments, taking stakeholders' comments and then refining our strategy based upon what we're hearing, and then using that to develop our final strategy that we'll be filing with the Public Utilities Commission on August 29th.

So if you haven't, if you weren't one of the folks who raised your hand earlier, don't worry. If you want to take a look at the grid-mod strategy, you can go to that website, www.HawaiianElectric.com/gridmod. From that site, you can download a copy of the strategy. It's fun reading, I think. It can be long.

You also can find on the same page some relevant orders from the Public Utilities Commission on this topic. So that kind of helps provide context to the grid-mod strategy that we developed.

On that site, as well as this here, is the email address, gridmod@HawaiianElectric.com. If you have provided a written comment sheet tonight, that's great. That's awesome. You can provide a verbal comment tonight after the Q and A. But if you'd rather provide comments via email, that's the email address to use to send it to us. Several of us working on the grid-mod strategy read that -- read the email that we get in from that every single day. So we definitely use that as we develop our final.

Now, we won't be able to incorporate every single comment/point of feedback that we get throughout this journey in the last month or so that we've been doing these meetings, but what we've committed to our customers and the stakeholders that we've met with is

for all of the material that we get in writing, whether it's here tonight on paper or it's with the email address, we'll provide a copy of that and assemble it and include it as an appendix in the grid modernization strategy final version that we file with the PUC on August 29th and make sure all that gets in there.

So with that, I will turn it back.

So we're going to do the Q and A?

THE FACILITATOR: No. I'm going to read, actually, some questions, and then you get to answer spontaneously.

MR. CHING: Great.

THE FACILITATOR: This is the fun part for us.

So there are a number of ways to give input. The first one we're going to walk through is the -- if you wrote down a question, we've collected it and now we're going to ask the questions and see who jumps up with an answer. Okay?

So this is from Mr. Richard Conrad.

"If you will require advanced meters on homes with solar, will the meters be used only to monitor or eventually also to control the solar inverter feed onto the grid? And if not, why are not monitoring and control of voltage at substations adequate to integrate solar?"

MR. CHING: Okay. That's a good question, and I'll actually use this slide to help answer it. So the first part of the question was about how we will be using --

Is it a smart meter as part of a PV installation?

THE FACILITATOR: Yes.

MR. CHING: So if a customer decides to participate in a DER program and install a rooftop solar system, in our strategy, we identify the installation of a smart meter not for the revenue and billing function of the meter, but smart meters and advanced meters have the ability to really be a very high-performing sensor. So they can actually measure the voltage, the power flow and the frequency at that point where the utilities' grid interfaces with an individual's home or business. And that's a very important point because that's the point with tariff where the utility has to provide power at a certain power quality and certain voltage.

So the meter really is going to be used, first and foremost, as a sensor and is able to provide a point of visibility and monitoring. It's not intended -- that meter is not intended to be a control point because the only thing it can really control at that meter panel is to turn off or on all of the power of the home. What

we're looking to use that meter for is that visibility. When it comes to the control of the operation of a PV system, that's, in part, where advanced inverters come in.

So one of the operational characteristics and operational values of an advanced inverter is that with the right advanced inverter, with the right program, we're working on those details right now. An inverter is able to sense what's happening on the customer's PV system, what's happening with voltage there locally on that rooftop behind the meter, and based on that programming, it changes the reactive power it provides, potentially changes the amount of vars -- technical term, engineering term -- vars it produces or be able to actually adjust the power output. But that would be an autonomous function based upon the programming of these advanced inverters.

The meter in this example would not be used for turning on and off the inverter system. However, we also have been looking at other technologies: collar connector, potential use of a second meter, or there's a company called Eaton that's testing out some smart breakers, like the breakers you have on your breaker cabinet in your kitchen or in your hallway that's able to selectively control certain devices, including a PV

system.

Our intent of that controllability is not to control a PV system on a day-to-day basis in its regular operation. It's really to have that backup capability to provide control during abnormal situations. So if we have a very abnormal day where we have an extremely low electric load, but it's a sunny day and PV systems are producing a lot, our operators may not be able to balance out the grid. We have too much generation and not enough load to serve -- to be served by that electricity, and that imbalance can create instability of the grid. So if we find ourselves in an abnormal situation, we may resort, for example, by controlling/turning off for a moment some of these PV systems so that we can regain the balance. But in our strategy, that functionality is not intended to be a normal control functionality, but more for abnormal situations that we don't expect to happen on a regular basis.

I think the other part of that question was around if you're going to do voltage control there locally at the home, why can't you just do it at the substation? And it's a good question. And one of the unique things about the electricity is that the voltage on our grid varies from location to location. And so we

may be able to sit and manage the voltage at a perfect level at a substation up on the left-hand side where the distribution circuit begins, but if we have a lot of distributed PV or distributed storage systems that are not working in unison, they may be raising the voltage down at the end of the meter where these individual devices are located and raise the voltage at the end point beyond and above what we need to provide under our tariff. But, yet, in time, the voltage will be --

THE FACILITATOR: Colton, I have five more questions.

MR. CHING: Okay.

THE FACILITATOR: Brigitte Otto: "Will renters and residents of apartment buildings be able to decide for themselves whether or not to have the wireless advanced meters, or will only the owners of those apartments or single-family dwellings be the ones that make that decision?"

MR. CHING: So, you know, every circumstance may be different, but we look at our customers as customers. It doesn't matter if you are a renter of a home or owner of a home. If your account is with Hawaiian Electric as a renter, then you are the customer of ours. So if you choose to participate in a time-of-use program as a renter of a home, it doesn't require an investment of

some technology, right, that you don't want to make an investment if you're just renting that home. You can elect to participate in a time-of-use rate program and elect to have a smart meter as part of that. But if you are renting a home that has a PV system on there, you know, you'll need to work it out with your landlord as to how that system will be used. But if you're not going to use that system, then you would be a traditional full-service customer of the utility. Unfortunately, you wouldn't have the benefit of the utilization of that PV panel.

THE FACILITATOR: Okay. Good.

From Ellyse, E-l-l-y-s-e, Mazzi, M-a-z-z-i: "What are the inverter capabilities that you're looking for in advanced meters' inverters? Are these capabilities over and above the inverter capability currently required?"

MR. CHING: Wow. That's a very insider, baseball question.

THE FACILITATOR: Very technical.

MR. CHING: This is -- the specification and identification of these new advanced inverter functions, this is for the benefit of everyone in the room. This is someplace where Hawaii is really leading the nation. We're actually -- and you can argue against this, but

we're getting ahead of places like California. And so we've been working with the folks who actually manufacture these inverters, who are looking to provide new functionality in it, and we are looking to work with them not just to provide the capability, but to make sure that these inverter manufacturers are able to enable these functions and actually operate on a day-to-day basis with these functions enabled. And because of insurance requirements and other reasons, the manufacturers of this equipment needs to ensure that they're certified for this specific use in electric systems. So when we buy electronics from a store, we look for something that's UL certified; right? So you go --

Each of these manufacturers will go to a certification agency like Underwriters Laboratories to make sure these devices pass -- passes UL's test in this operation. So many of the manufacturers in our inverter systems are actually in the process right now, but the functionality that they're looking to get certified to are the functions that we've been working with inverter manufacturers on for, gosh, the past year-plus.

THE FACILITATOR: John Russell asks, "With local mountain areas, why is HECO not discussing pumped energy storage? Pumps can respond very quickly to energy sags

and surplus of power in the system. Additionally, hydro technology is very reliable and proven."

MR. CHING: Yeah. So the question is about two things, the use of pump-storage hydro, which is a form of storage, not a generator, and you use water -- moving water between a lower and upper elevation to provide both the load and source of energy, sort of like a battery.

We actually looked at the use of that technology in our Power Supply Improvement Plan. We actually made it an option to be selected by this very complex optimization tool that we used. The author of the question is right. Pump-storage hydro is a proven technology. It can, if designed in the right way and right location, provide a very responsive function, but it does come with challenges. It's a very, very high-cost system. It requires -- typically requires the use of damming at least one or two reservoirs to make the system work. It's physically very large, and one of the challenges that we have here in Hawaii, particularly on Oahu, is trying to find an appropriate location of these large pieces of infrastructure, but we did look at it.

Hydroelectric is the other question, which is the use of -- typically in Hawaii, the use of a running

river or stream to provide electricity by running through a hydro generator. We do have those systems actually on the Big Island. We do have it on Maui.

Again, when we did our Power Supply Improvement Plan, the cost of those resource options versus some of these newer technologies, whether it be solar, storage, those technologies have been dropping so quickly in price and becoming so much better operationally that when we look at the economics, those other resources are selected.

Having said that, you know, if someone has a very good hydroelectric project or pump-storage hydro project, when we go through our procurement efforts, we're going to be open to those options. But we're going to let the market really determine what's the most cost-effective solution for all of our customers.

THE FACILITATOR: Okay. Grant Nakaya, N-a-k-a-y-a. It says, "In a worst-case scenario, if this application is denied by the PUC or no individuals or community opt in, how would that affect the 100 percent renewable goal? Is it possible to attain 100 percent renewable without upgrading the grid? What is the proposed deployment timetable?"

MR. CHING: So it's another good question. I'll actually go back to the Power Supply Improvement Plan

that we filed at the end of December and, as Scott mentioned, we recently got accepted by the PUC.

What we found, in order to take all of Hawaiian Electric Company -- so this is the island of Oahu, Maui Molokai, Lanai and the Big Island of Hawaii -- to 100 percent renewable energy, we cannot rely just on the larger grid-scale resources like wind farms and large solar farms. We cannot rely just on distributed rooftop solar systems and distributed storage systems. We actually need both. And on top of that, we need something else; right? Especially here on Oahu where over 70 percent of the energy use in the state occurs right here on Oahu. Majority of Hawaii residents are here, and that's why we have a much higher utilization of energy. But Oahu isn't blessed as bountifully as our neighbor islands with renewable energy options as well as the land to make those renewable energy choices on a large-scale work.

So we need all of the above, and I strongly believe that in order to make that future happen, to make all of these resources work that will get us to that 100 percent, then we're going to need a grid that operates in a different way, and I really don't think that the grid that we have today is going to provide those functions and capabilities that we need in the

future.

THE FACILITATOR: Okay. Tom Harris says, "All 150 meters in my condo tower are within 4 feet of a communication closet offering direct-bound, not wireless communication channels via test," (sic) "pair coax, c-o-a-x, fiber optic to a local router which talks to HECO by conventional telco circuits. However, they are not only far from the power poles, but may which directly expose certain residents to high levels of EMF. Why not use wired methods of connecting the meter to the substation?"

That sounds very technical.

MR. CHING: Yeah, it actually may be above my expertise, but let me take a swing at it.

THE FACILITATOR: Okay.

MR. CHING: So when people think of smart or advanced meters that communicate, people automatically think about some wireless option. That's one of the things we are definitely looking at in our strategy, but one of the foundational components of our strategy is to use open standards, sort of like Wi-Fi or our computers and laptops, right, and phones, and open standards for these devices to speak with each other. And one of the -- one of the elements of some of these new open standards is to allow not just for wireless

communication through the radio or something like that, but also allow for PLC, power line carrier. Basically, for those of you who have that Ethernet over your power line's plug in your home that allows for your internet to run through a power line, it's a similar concept to that; right?

So we want to be open to these different technologies as long as they adhere to the open standards that are being developed right now that gives us flexibility and optionality to use the latest technology as things evolve, and they can all communicate with each other. But this is some of the exciting stages, right, where some of these newer technologies are starting to use wired, wireless and other things.

I've got to apologize. That probably is the limit of my expertise. I'd be happy to take that question afterwards a little bit deeper --

MR. HARRIS: That's my question. Can I clarify it?

THE FACILITATOR: If you need to clarify, sir, come here.

MR. HARRIS: If I may.

MR. CHING: Yeah, sure.

THE FACILITATOR: If you come here to the

microphone --

MR. HARRIS: I can project enough from here.

THE FACILITATOR: Well, the difficulty, sir, is the stenographer.

MR. HARRIS: Very good. The stenographer would have trouble. Thank you.

THE FACILITATOR: Thank you. If you could identify yourself.

MR. HARRIS: My name is Tom Harris, and I'm an officer with the condominium I referred to in my question. My training is as a biologist, but I've worked most of my life as a systems engineer. So I work in computer network technology and information security but was brought up primarily as a zoologist and biologist. So it's from those perspectives that I ask these questions.

The primary problem with the open standards that are currently being developed is that there's very strong scientific evidence that these are biohazards that are being ignored. And if they're working at 2.1 gigahertz frequencies with pulsed electromagnetic fields that are trying to communicate with a distant power pole that is hundreds of feet below the comm closets or the meters, which happen to be on every floor in our particular condos' instance, is that on every floor,

there are six meters that are within 20 feet of my head when I'm sleeping, and they're trying to communicate with pulsed ultra high frequency to a power pole that's 300 to 400 feet away when they're, in fact, 4 feet away from a comm closet where there's lots of opportunity for channels, for fiber coax and twisted pair to talk to a router downstairs that could then talk to that power pole.

So there are technologies that are already preexisting, aged, tested open standards that already exist that have been around for decades, which are highly reliable and have no radiation hazards whatsoever, and, yet, we're looking at smart meters that have proven to be highly biohazardous, carcinogenic and directly cause harm to biological systems.

Try looking at -- why cannot you have a look at using older, proven technologies with sufficient bandwidth already existing to achieve the communication standards that this wonderful plan does offer?  It's a wonderful thing.  The only thing that we're objecting to is this high-frequency wireless link.  Thank you.

MR. CHING:  So just to clarify, the open standards that we're looking at is in the 900 megahertz range --

MR. HARRIS:  Okay.

MR. CHING: -- and not the 2-plus gigahertz.

MR. HARRIS: That's really close to 1 gig, though, and that's still pretty high.

Thank you.

THE FACILITATOR: Robert Harris says, "In the appendix slash exhibit, there was a lengthy discussion of the cost of DERs. Is there a reason this was included in the smart grid proposal? Have you reached out to the major DER providers for input?"

MR. CHING: So we did input some folks that are in the DER space as part of our stakeholder outreach. We have not spoken to everyone to be fair. I'm not exactly sure what specific section is being referenced, but we welcome additional discussion around that. Maybe we'll provide some peaceful input into our final version.

THE FACILITATOR: Okay.

MR. CHING: Can you convert that question into a comment?

THE FACILITATOR: Yes. And, actually, we'll enter all of these as part of the record.

As we have indicated, there are a number of ways to participate in assisting Hawaiian Electric in the development of their revised strategy for the -- the document that's due to the PUC. So what was also handed

out --

MR. SEU: Sorry to interrupt. I do also want to explain that we actually did receive a fair number of other comments, and what Kurt has been trying to do is group them into -- into --

I mean, basically, a lot of them were very similar in terms of what they're commenting on or asking about. Are there any of you folks who submitted a question that you feel we did not at least address or touch on? We can certainly pull that out and address it.

THE FACILITATOR: So what we'd also like to do or what has been offered is on that first table when you came in, there were comment sheets, and so you can also make your own comments in writing or online before August 9th. The comment period is going to close, and then they will draft the document for the PUC by August 29th. We also have some people signed up to give oral comments into the record.

All right. Let me yield once more, however, to the last question, and that is Todd French says, "How does Hawaiian Electric plan to implement a costly new grid system that increases customers using home solar in order to meet their 100 percent renewable mandate and maximize shareholder value?"

That's an interesting quandary.

MR. CHING: Yeah. I think the question is asking about the cost of investment for grid modernization. That's the first part. That cost or the intent -- original intent -- the core intent of the grid modernization strategy isn't to modernize the grid for the sake of modernizing. The strategy is built around doing the necessary modernization efforts to facilitate or to enable different customer programs and technologies. And it's those programs and technologies that are actually designed to make the cost of generation lower, make the cost of generation more renewable, make the cost of generation more predictable and allow for all of these systems to operate in a more efficient manner.

So from an electric utility standpoint, providing that total value, right, the grid modernization in combination with the programs and the technologies it enables, is really the goal here. It's not just the grid modernization. And so if, as a state, we made this commitment to get to 100 percent renewable energy, as an employee of Hawaiian Electric, I see my role is finding the most cost-effective, most efficient, most reliable way to get there; right? And the more that we can make that work for all of our customers, not

just for customers who may elect to participate in one program or another, but also for my father-in-law who may choose to not participate in any program, but make the electric system more valuable to them, make it more efficient. That, to me, is our job.

And from a utility employee that works for an investor-owned utility, creating greater value from the electric system that allows our customers to make more choices in how they interact with us, how they consume their energy, how they provide their energy back to us, to me, is how we ensure the health of our electric utility going into the future.

THE FACILITATOR: Okay. Good.

MR. CHING: It's not just about selling kilowatt hours.

THE FACILITATOR: Yes.

There are five people who have signed up to give testimony here at the microphone and onto the record. So I will call your name, and if you can make your way down here, I'm going to ask that you try to limit yourself to three minutes, if possible. We're supposed to be pau by 8:30.

So the first person, it looks like from what I'm reading -- is Allen --

Is it Leonard?

MR. LEONARD: Yeah, but I'm going to defer to writing. I'm going to submit testimony.

THE FACILITATOR: Thank you very much, Mr. Leonard.

Tom Harris, did you also want to --

MR. HARRIS: If I may now.

THE FACILITATOR: Yes. So as I call you -- your name, you have to make your way to this microphone so you can be heard, and it will be entered into the record.

If you keep it down to three minutes, I'd appreciate it.

MR. HARRIS: I will try.

THE FACILITATOR: It's a challenge.

MR. HARRIS: Yes, it is. I'll try and summarize, then.

THE FACILITATOR: Thank you.

MR. HARRIS: There have been a number of quite expensive U.S. government toxicology studies that have found that wireless radiation and cell phone and smart meter frequencies and intensities does cause cancer in rats and other biological systems. They've been carefully vetted by the National Institutes of Health. And the conclusion is that nonthermal levels of RF radiation can and do cause cancer. The exposure to

smart meter radiation is a primary concern here.

There have been a number of other -- hundreds of other peer-reviewed publications that have reported biological effects of significant harm in cells in animals, including DNA breakage and interference with healing and other behavioral effects as well.

Two-thirds of independent-funded research have demonstrated health hazards. Any assurances of safety by the FCC, where utilities rely on FCC statements, pertain only to safe insofar as not causing shocks or burns, and they do not address lower, nonthermal levels of RF radiation.

There have been three independently conducted surveys of hundreds of persons in different parts of the world, and they have found, on installation of wireless smart meters, previously healthy residents have developed significant electrical sensitivities for the first time and are no longer able to be near wireless smart meters, Wi-Fi or cell phones without debilitation and physical symptoms.

I'm going to skip over a lot of that.

Major insurance companies, including Lloyd's of London, have announced that they will not give liability coverage to manufacturers or installers of wireless devices for health damage claims.

Close-proximity wireless-exposure problems for electrically sensitive people who wish to exercise caution is not solved by having an opt-in-only program because wireless exposure will be present from those neighbors nearby who did opt in. Wireless exposure would still be present from them.

Regarding persons who are concerned about RF exposure --

I'm skipping over a lot here.

-- for even nonwireless, digital meters to be safe for people with such sensitivities, their internal power supplies would have to be changed from their presently used electrical noisy switch-mode types to linear power supplies, and they would have need to have added filtration.

So I'm skipping over a lot.

Essentially, we have an opportunity to get rid of a major part of the biological hazards that are offered by this technology that was developed over the last 20 years without these biohazards having been previously tested. There are a host of preexisting technologies for communication that do not depend upon wireless technologies that already have the bandwidth and capability, but they would require a change in the infrastructure and a reduction of the dependence upon

these pre-existing technologies in which there have been huge investments because they've been designed to operate in the wireless mode, but they could easily be converted, with some significant expense, to be using bound technologies, such as fiber-optic or coaxial cable, and completely eliminate the biohazards that the current systems that are being offered to us present. And this is just one link, just the smart meter link, in this really wonderfully advanced system that we should really embrace for complete energy independence for Oahu and Hawaii. Thank you.

THE FACILITATOR: Thank you.

It is not our intention to put pressure on you, to limit you from fully expressing yourself, but if I can just remind you, you can send in your longer testimony, all of that good information that you skipped over, to the different sites that I think you already have.

MR. HARRIS: Is that stuff on the board for us, or is that leftover for somebody else?

THE FACILITATOR: Here. It's up here: "To GMS online, www.HawaiianElectric.com/grid." Those sites.

Okay. The record is open until August 9th. So, again, with the press of time, do it quickly, but you can do it this way. So we're not trying to cut off some

very valuable input.

Eric Olson? You signed up to speak. Eric? He may have left.

Okay. Brigitte Otto.

Aloha.

MS. OTTO: This is actually the first time I'm speaking in front of an audience.

THE FACILITATOR: Is it? This will be fun.

MS. OTTO: Okay. My name is Brigitte Otto, and I'm electrosensitive, and that's why this smart meter plan is a nightmare for me because I -- I cannot use cell phones. It doesn't even have to touch my head. If a cell phone approaches me, it feels as if someone is pinching me. And I had to give up my iPad that caused me tremendous problems. I already feel my neighbor's Wi-Fi. That is already a problem. I don't have Wi-Fi. I have Ethernet. And that's why I understand smart meters and cell phone towers are the worst offenders, and I'm afraid that this will torture me and cause me extremely serious health problems.

I thought about other electrosensitives in other states who ended up in wheelchairs after being exposed to smart meters. And, also, I'm renting, and even if I can opt out, what if the neighbors have smart meters? They will still be too close.

And I heard from others who -- actually, one lady, she said she convinced her whole building to opt out of smart meters, and she could still feel smart meters from the other side of the street. They still caused her problems.

Yeah, I mean, how am I going to protect myself from neighbors' smart meters? And also -- I mean, I'm all for solar energy. That is all good. I'm all for environmentally friendly energy, renewable energy as long as no smart meters are involved. And it would be technologically possible to use solar energy without smart meter technology. Why isn't it done? For instance, there could be a second -- a second analog meter could be installed instead. That could be a possibility.

And I'm also wondering, as I have heard, that HECO wants to get rid of analog meters, and this is also a concern. As soon as I have a digital meter, how can I be sure that down the road, it won't be converted into a smart meter without even me knowing about it? And even if it is not digital meters, they are a fire hazard. And, yeah, I mean, there's a lot to say about smart meters.

THE FACILITATOR: And then this is important information, and I know you have something in writing.

I hope that you'll submit it.

MS. OTTO: I will, if I could.

THE FACILITATOR: Thank you very much. Thank you.

And Meysam Razmara, M-e-y-s-a-m R-a-z-m-a-r-a.

Okay. Those are the names that I have who have signed up to speak. We have 10 minutes more. So if one of you still wanted to rise to speak, we'd like to give you that opportunity as long as you can keep it to about three minutes.

MR. HARRIS: Annelle, could I add about 30 seconds?

THE FACILITATOR: Oh, you want 30 seconds more?

MR. HARRIS: Definitely. It's something I had forgotten that Ms. Otto reminded me of.

Again, for the steno, it's Tom Harris.

THE FACILITATOR: Then say your name again.

MR. HARRIS: Thank you very much.

Ms. Otto's testimony was quite painful --

THE FACILITATOR: Tom Harris?

MR. HARRIS: Tom Harris, yes.

-- painful because she is one of three people I know who are profoundly electrosensitive and have trouble just wandering around the city because of the inundation of Wi-Fi. I have no sensitivity at all. I

don't feel it, but these people are in pain.

I have a firsthand testimony of a close friend who lives on Pueo Street who had a test smart meter installation, and she ultimately had to have it removed because it killed all of the plants within 30- or 40-foot radius of the meter, and it killed all the fish in her fishpond.

So these biological tests that show peer-reviewed research and whatnot, all well and good, but we have -- I have this firsthand testimony of a close friend who has actually gone through the consequences of direct biohazards. So the claims that these technologies are established and safe, well, to be mild, are quite suspect to me. And thank you.

THE FACILITATOR: Thank you. Thank you very much.

MR. HARRIS: Thank you for the opportunity.

THE FACILITATOR: Yes.

What I'd like to do right now is give Colton the opportunity to make some closing remarks, I guess, and then we still have some time to mingle before they shove us out of the building, I think.

MR. CHING: Okay. So I just want to thank everyone again for coming this evening, spending your Monday night here with us. Just to remind everyone, if

you think of additional comments and points of feedback to provide, please do so by emailing that address above. Some of you spoke with notes. Again, I encourage you to actually send that full body of notes in as well. That allows us to get that full set of information to be incorporated and documented.

As we mentioned, we're going to be here until about 8:30 before McKinley kicks us out. So, you know, Scott and I are here. You can ask us questions. We still have some of our boards and equipment located outside. So you can talk to some of our engineers and folks who actually know this stuff better than me and Scott. You can ask them specific questions about some of the technologies and some of the systems.

So, again, thank you very much for being here tonight. Safe travels. Thank you.

(Meeting adjourned at 8:20 p.m.)

C E R T I F I C A T E

STATE OF HAWAII )
) ss.
CITY AND COUNTY OF HONOLULU )

I, LAURA SAVO, a Certified Shorthand Reporter in and for the State of Hawaii, do hereby certify:

That the foregoing proceedings were taken down by me in machine shorthand at the time and place herein stated, and was thereafter reduced to typewriting under my supervision;

That the foregoing is a full, true and correct transcript of said proceedings;

I further certify that I am not of counsel or attorney for any of the parties to this case, nor in any way interested in the outcome hereof, and that I am not related to any of the parties hereto.

Dated this 14th day of August 2017 in Honolulu, Hawaii.

S/S Laura Savo
LAURA SAVO, RPR, CSR NO. 347

## 2. Oahu Comments

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

**August 7, 2017 (6:30 p.m. – 8:30 p.m.) McKinley High School Hirata Hall**

Thank you for attending this evening's Grid Modernization Strategy (GMS) Public Meeting. Please provide your name and organization you represent (if any), along with your comment(s) on the Draft GMS. This information will be included as part of the final submission of the GMS to the Public Utilities Commission at the end of August 2017. Comments are also being accepted via email at gridmod@hawaiianelectric.com.

FIRST NAME:* Meysam LAST NAME:* Razmara

ORGANIZATION (IF ANY): AIPA

(*required)

COMMENT(S): one Problem that future grid encounters is so-called Duck-Curve
1) Problem that CAISO struggles with.
~~[illegible]~~ considering 100% RPS policy, and due to high Penetration of non-dispatchable power sources, it seems that HECO's future Problem would be Duck-curve Problem Due to 35% ITC. There are a lot of advances in DER. The question is that why HECO in the first place does not consider working with State to consider Storage system as part of solar system to eligible ESS for ITC?

2) TOU is definitely a good way to go. However, other newer Pricing policies like dynamic ~~programming~~ Pricing provides more ability for grid for ~~[illegible]~~ real-time demand Flexibility (DF) service. I wonder if HECO considers this option instead of TOU?

3) May be unrelated! when we talk about RPS of 100% or even 60%, is there any study to analyze how much would be LCOE for Customers under 60–100% RPS?

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

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FIRST NAME:* Donald LAST NAME:* Chang

ORGANIZATION (IF ANY): PRIVATE PARTY

(*required)

[redacted]

"I" intermittent renewable PVs wind ...

COMMENT(S):

(1) Distributed energy technology based on consumer or small private owned PV's assumes that they will be continually maintained. What would happen if the cost of recapitalization or maintenance of the distributed systems (generators) "I" become unaffordable. Why can't the centrally purchased and maintain systems "FIRM" supply be upgraded instead of going with a smart distribution system. Why not invest in large Renewable Energy public or corporate owned based on FIXED Invest return approved by PUC to be fair to all.

(2) Distributed energy technology provides minimal benefits to condominium owners who have no ability to obtain their own "I" renewable intermittent PV generation. A ~~robust~~ robust network ("Grid" "DOMB" ~~dumb~~ system would be less expensive and less susceptible to cyber attack, software and micro electronic failure. Smart grids would be just as vulnerable to downing as traditional systems. Why not spend money on going underground or redundant circuits? multiple feeders.

Summary

I am sorry for the writing. In summary ... Assumption that private owned PV systems will be maintained for life of smart grid pay back may not assured. A conventional system that is made more robust, underground, multiple feed grid system would be more survivable. A large public/corporate owned generation system would be fairer to all which is rate controlled

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

**August 7, 2017 (6:30 p.m. – 8:30 p.m.) McKinley High School Hirata Hall**

Thank you for attending this evening's Grid Modernization Strategy (GMS) Public Meeting. Please provide your name and organization you represent (if any), along with your comment(s) on the Draft GMS. This information will be included as part of the final submission of the GMS to the Public Utilities Commission at the end of August 2017. Comments are also being accepted via email at gridmod@hawaiianelectric.com.

FIRST NAME:* Tom LAST NAME:* Harris

ORGANIZATION (IF ANY): Wilder @ Pikoi AOAO

(*required)

COMMENT(S): There is clear + unmistakable science which clearly indicates the current smartmeter technology to be carcinogenic + biohazardous.

It is clearly known that Cancer is Caused in rats by smart meter + cell phones

hundreds of other peer reviewed publications have reported harmful biological effects including DNA rupture > 2/3 of independently funded research projects have demonstrated unhealthy effects

FCC Standards of Safety address only shock + burns, not non-thermal radiation

Insurance Companies will not issue liabilities

Opt-in by my neighbor exposes me.

# II. Comments Received

## A. EMAILED COMMENTS

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| Date: | Fri 6/30/2017 1:02 PM |
| Subject: | Battery storage for non PV owners? |
| Body of the Email | Are there any plans to provide opportunities for customers to purchase battery storage to take advantage of Time of Use pricing and to help smooth out the "Nessie Curve"?<br><br>-Albert Katsuyama |

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| Date: | Tue 7/4/2017 2:17 AM |
| Subject: | Designer Coder |
| Body of the Email | Hi There,<br><br>Would you be interested in hiring a Web designer or coder for 1 week on trial basis?<br><br>We deal in providing virtual team of dedicated Web designer or coder and have been into this business for the past 15 years. Our clientele base is extended to US, UK, Canada, Australia and more.<br><br>Please share your valuable requirement about the skill set you are looking for and I will revert back to you with some **sample resume** for your review.<br><br>Appreciate your time and look forward to hear from you.<br><br>Thanks<br><br>Kerry bell |

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| Date: | Fri 7/28/2017 8:07 AM |
| Subject: | Smart Meters |

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| Body of the Email | I am opposed to the installation of smart meters because of their detrimental effects on health and the specter of such a system being used to control and penalize consumers from the use of electrical power and to raise the rates they will have to pay.<br><br>-Harry Yoshida |

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| Date: | Fri 7/28/2017 9:40 AM |
| Subject: | unsmarts METERS |
| Body of the Email | un SMART METERS are not safe, violate privacy,<br><br>And exude EMFs. We don't want them.<br><br>Pamela Palencia |

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| Date: | Fri 7/28/2017 3:55 PM |
| Subject: | Smart Meters |
| Body of the Email | Aloha<br><br>I understand that the county is once again looking at the installation of smart meters.<br><br>I want you to know that I object, do not want one, and also do not want them in my neighborhood.<br><br>I am one of those select few who are sensitive to EMFs. I know from living in California where they were installed in my neighborhood that they do affect me.<br><br>Please do not adopt a plan for use of these here on Maui.<br><br>Ane Takaha |

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| Date: | Sat 7/29/2017 9:24 AM |
| Subject: | EmF sensitivity |

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| Body of the Email | Good day<br>I am one of the thousands of people who are EMS sensitive.<br>For me it takes the form of pressure headaches and spikes in the brain that are sharp and painful and frightening.<br>When I am in the vicinity of a cell phone mast or a Smart meter I feel an icy hot sensation and throbbing in my left arm where I used to carry my cell phone ..<br>I will never permit a smart meter on my home and am frightened that they will be placed anywhere near me.<br>Thorough research will show how dangerous EMFs Are.<br>Cancers are proven to be associated with smart meters ......please inform yourself of this research.<br>Respectfully submitted,<br>LiLi Townsend |

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| Date: | Sat 7/29/2017 11:56 AM |
| Subject: | "Grid Modernization" plan comment |
| Body of the Email | I do not support the deployment of technologies that place profit over the health of people.<br><br>Smart meters are a public health hazard:<br><br>1. Hundreds of fires, several explosions, and two deaths have been linked to smart meters.<br>2. EMF devices are now excluded by insurance companies.<br>3. Smart meters will not make for faster grid restoration. New England's largest utilities criticized smart meters saying there was "no rational basis" for their implementation.<br>4. Data collection by smart meters violates privacy and constitutes in-home surveillance.<br>5. Wireless smart meters make our electrical grid vulnerable to hacking by petty thieves and rogue nations.<br>6. Smart meters have been shown to cost customers more by forcing people to reduce consumption and pay higher prices.<br><br>Keith Ranney |

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| Date: | Sat 7/29/2017 5:33 PM |
| Subject: | SMART METERS ARE ALREADY OBSOLETE |
| Body of the Email | NO NEED SMART METERS, SO NO NEED SMART GRID.<br><br>SPEND HAWAIIAN ELECTRIC CUSTOMER REVENUE ON ACCELERATING THE HAWAIIAN ELECTRIC UTILITY "DEATH SPIRAL" BY INVESTING CUSTOMER MONIES IN FREEING ALL CUSTOMERS FROM PERPETUAL DEPENDENCY ON |

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| | HAWAIIAN ELECTRIC'S GOVERNMENT-GUARANTEED FOR-PROFIT MONOPOLIES.<br><br>NO NEED FOR CUSTOMERS TO PAY UNEARNED GOVERNMENT GUARANTEED SUBSIDIES--AKA SO-CALLED "PROFITS"--TO ABSENTEE HAWAIIAN ELECTRIC STOCK OWNERS, AND NO NEED TO PAY OBSCENELY EXCESSIVE AND UNDESERVED SALARIES TO FAR TOO MANY HAWAIIAN ELECTRIC EXECUTIVES. |

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| Date: | Sun 7/30/2017 11:10 AM |
| Subject: | smart meters |
| Body of the Email | i'm sorry I cannot attend the wed. meeting but would like to express my concern regarding the installation of smart meters in maui meadows. I am among many who are against the use of smart meters. I sincerely hope an alternative solution will be found. if economy is the issue I can think of one alternate solution to reduce the cost of electricity.<br><br>hi. electric should bill for trimming trees which extend into power lines. planting a tree close to power lines is crazy. expecting the power co. to trim that tree is ridiculous. but the electric co. actually pruning these trees at their cost is just plain stupid and grossly unjust to the rest of us who are responsible for what we plant.<br><br>when I purchased a house with a tree that grew into power lines I took down the tree at my own expense. hi. electric should require all home owners to do the same. if hi. electric needs to trim trees the home owner should foot the bill or take the tree down. how much money would that save?<br><br>Barbara Kaneshige |

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| Date: | Sun 7/30/2017 9:47 PM |
| Subject: | smart meters |
| Body of the Email | *After reading about smart meters I do not want them around me. They are dangerous on many different levels including our health. Also I do not need a smart meter to tell me when I upload electricity .... I am aware of this as well as the amount. Keep them out of Maui....*<br><br>*Dhyan Sandhya*<br><br>*Please keep this as a vote against smart meters as a renter on Maui* |

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| Date: | Tue 8/1/2017 12:39 PM |

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| Subject: | smart meters |
| Body of the Email | As a resident of Maui county, count me as AGAINST the "grid modernization" toward smart meters. I see no upside for we the people, only potential dangers.<br>-Helena Berg |

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| Date: | Thu 8/3/2017 10:07 PM |
| Subject: | No Thank you smart meters |
| Body of the Email | Please do not install more smart meters on Maui. I have several friends and relatives that have experience health problems from living near them even for a few months. These include lack of sleep, headaches, lowered immune system and one friend who died of cancer in her 40's.<br><br>Thank you for doing the smart thing and the right thing and not supporting them.<br>-Heather |

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| Date: | Mon 7/3/2017 8:03 AM |
| Subject: | High rise |
| Body of the Email | How can something like this help at a high rise condominium project or can it?<br><br>*Milton Miyasato* |

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| Date: | Mon 8/7/2017 4:54 PM |
| Subject: | Comments on Grid Modernization |
| Body of the Email | **COMMENTS ON HAWAIIAN ELECTRIC'S POTENTIAL USE OF WIRELESS SMART /**<br>**ADVANCED METERS, FROM A PH.D. BIOCHEMIST**<br>Claims by Hawaiian Electric so far about safety of *wireless* advanced meters and of concern for<br>customer safety is empty propaganda, and shows they have not taken into serious<br>consideration any of the following facts:<br>1. A recent 25 million dollar US government NTP (National Toxicology Program) study has found that wireless radiation at cell phone (and smart meter) frequencies and intensities DOES cause cancer in rats. These results were carefully vetted and accepted by the National Institutes of Health. The conclusion is that low non-thermal levels of RF radiation can and does cause cancer (remember that the FDA uses animal studies as a first assessment of risk to |

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| | humans).<br>2. Hundreds of other peer-reviewed publications have reported harmful biological effects of such radiation in cells and animals, including DNA breakage and interference with healing of DNA breakage. Numerous recent studies on humans have shown behavioral effects and other effects. In general, more than 2/3 of independently funded research projects have demonstrated unhealthy effects.<br>3. Any assurances of "safety" by the FCC or by utilities relying on FCC statements pertain ONLY to "safe" insofar as not causing shocks or burns. The FCC themselves have admitted that their "safe level" limits do not account for other biological effects caused by lower, nonthermal levels of RF radiation. The have deferred to the EPA on this, but political pressure has silenced the EPA concerning these matters.<br>4. Three independently conducted surveys of many hundreds of persons in different parts of the world have found that upon installation of wireless smart meters, previously healthy residents have developed electrical sensitivities for the first time in their lives, and are no longer able to be near wireless smart meters, wi-fi or cell phones without suffering debilitating physical symptoms. In many cases, their new symptoms began soon after smart meter installation and *before* they became aware that a smart meter had been installed. These surveys also found that people who were already electrically sensitive had serious declines in their health soon after smart meters were installed, again, in many cases *before* they knew that a smart meter was present.<br>5. Major insurance companies, including Lloyd's of London, have announced they will not give liability coverage to manufacturers or installers of wireless devices for health damage claims.<br>6. The close-proximity wireless exposure problem for people who are electrically sensitive or who wish to exercise caution is not solved by having an "opt-in only" program for the following reasons:<br>A) Wireless exposure would still be present from close neighbors who opted in, especially in apartments with banks of dozens of smart meters.<br>B) Wireless exposure would still be present from close neighbors who might be required to have wireless smart/advanced meters because of having rooftop solar feeding into the grid.<br>C) There would be increased wireless exposure near collector - repeater sites.<br><br>**SOLUTIONS: ALTERNATIVES TO WIRELESS**<br>Do we even really need real-time monitoring at every home, even at homes with solar? In the case of rooftop solar, would advanced meters be used only to monitor, or eventually also to control the feed of each individual PV system onto the grid? Why are not advanced monitoring and control of voltage at substations: "Expanded use of sensors and automated controls at substations and neighborhood circuits" as stated by Hawaiian Electric, adequate to integrate solar? Furthermore: "Ching explained that advanced inverters are like small computers. They have capabilities to run the local grid; they sense what`s happening locally and make adjustments in how it operates." So why the need for wireless smart/advanced meters? (Most customers will not take kindly to having their appliances controlled by Hawaiian Electric – such external control was implied by Ching when he said: "The new demand response model is to adjust demand to accommodate changing supply.")<br>For many years, Heco has had a very successful postcard program for self-reporting of monthly readings. For a more automated reporting system to further |

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| | reduce the need for meter-readers, there are at least three other practical alternatives:<br>1. Hawaiian Electric could issue a phone number for customers to dial-up a dedicated company computer and simply punch their 5 digit meter reading into their phone keypad. (They could have pre-registered their phone number linked to their account so the computer's caller ID would automatically know which account was reporting.)<br>2. Hawaiian Electric could set up a website for customers to log onto and simply enter their meter reading.<br>3. Hawaiian Electric could supply an email address for customers to email their meter reading. (Where a customer has solar, the customer could report two readings separately, incoming usage, and outgoing feed.)<br>**OTHER ALTERNATIVE REPORTING MEANS:**<br>Viable alternatives include cell-phone technology built into an advanced meter, built in modem reporting via the internet, or fiber optics. (Although automated cell phone reporting is a form of wireless, it need produce only a short communication burst once a day or in case of outages, as contrasted to the constantly pulsing wireless mesh networks usually used in present wireless smart meters.)<br>(BPL - Broadband over Power Lines or PLC -Power Line Communication, would be an extremely unsatisfactory and unhealthy alternative because it inadvertently causes the whole power line transmission grid to become a transmitting antenna, radiating spurious RF (the data communications) into neighborhoods, as well as conducting it into home wiring). Hawaiian Electric has claimed "Enhanced outage management and notification technology" benefits of wireless smart/advanced meters. But they already have a fast and successful<br>automated system of a dedicated outage-reporting phone number for customers to call in event of an outage - additional benefits of smart meters in this regard would be very minor. The "Expanded use of sensors and automated controls at substations and neighborhood circuits" would already enhance automatic knowledge of outage locations. The old electromechanical analog meters have been safe, reliable, accurate, long-lived and inexpensive. So far, digital meters, whether they be smart or advanced or even nontransmitting, have been neither safe (including many reported fires), unreliable, inaccurate (they<br>give inaccurate readings due to spurious/"dirty" RF and noise increasingly present on power lines today), are a short lived technology (will become obsolete quickly), and overall are a very expensive and complex system.<br><br>**REGARDING PERSONS WHO ARE CONCERNED ABOUT RF EXPOSURE:**<br>For even non-wireless digital meters to be safe for persons with electrical sensitivities, their internal power supplies would have to be changed from the presently used electrically noisy switch-mode types to linear-type power supplies, and they would need to have added filtration to keep their power supply noise and their digital processor and digital signal noise from being conducted back into homes. Current models do not have adequate filtration. Even with additional filtering, there are no guarantees that a presently non-wireless digital meter would not be secretly upgraded in the future to either include a transmitter or to activate a transmitter already imbedded. Trust is not there, and ordinary assurances will not suffice.<br>THEREFORE:<br>1. Persons who already have electrical sensitivities, and also any who wish to minimize their exposure to RF, must be allowed to retain their present analog |

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| | electromechanical meters, as long as they self-report by any of the 4 means listed above. They should not be assessed ANY extra fees, costs, or higher rates. To be fair, those who op-in should pay a fee or higher rates to cover the cost of the new technology.<br>2. Hawaiian Electric must further accommodate electrically sensitive people by not allowing any of their close neighbors to opt-into having *wireless* smart/advanced meters. Utilities have been putting a great deal of emphasis and money (ultimately customers' money) into "Customer Acceptance Programs" (propaganda) because smart/advanced meters provide no real benefits to consumers. In fact, they are actually dangerous: in addition to harming health, they are a cybersecurity risk, an invasion of privacy and have caused fires on the sides of homes.<br>DO NO HARM to the health of customers should be the first priority of any Grid Modernization Strategy.<br>Otherwise both suffering and lawsuits will ensue.<br><br>-Richard H. Conrad, Ph.D. biochemist, Oahu |

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| Date: | Mon 8/7/2017 9:51 PM |
| Subject: | grid modification comments |
| Body of the Email | Radio waves are the ultimate pollutant. You can't see, hear, smell them, but contrary to what the "experts" say your body is stressed and injured by them. Unfortunately for me, over exposure has left me with Electromagnetic Hypersensitivity (EHS). If a wireless smart meter is installed on my home or even in my neighborhood, I would not be able to live in my home.<br>I've had EHS since 2004. I lost my dream job in educational television that I worked so hard to get. This job that I loved exposed me to microwave signals daily for six years until my body broke down and I had to quit. The many cell phone antennas and microwave transmission dishes on the roof above my office pushed me beyond my body's limits.<br>This was just the beginning of a very long, living nightmare. The damage had been done. I could not even sleep in my own home because of my neighbors' wi-fi signals coming into my home. After twelve years, I still am injured by Electro Magnetic Radiation (EMR). I lost my job, had to sell my home and I've spent more than $60,000.00 seeking treatment to heal this affliction. I've spent my life savings and have no money for my children's college education.<br>What if this happens to you? To your loved one, spouse or children? What will happen when we have a generation of outcasts that cannot work, go to school or even function in their home because of the e-smog that is prevalent? |

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| | I have been a Hawaii public school teacher since 1989 and a school technologist since 1992.<br>Since 2001 I have been suffering from an illness that the World Health Organization (WHO) calls Electromagnetic Hypersensitivity (EHS). This was caused by over exposure to microwaves (cell phone repeaters on the roof of my working place and wifi). My symptoms include: a burning sensation in my head that continues and increases until I can move away from the source, a terrible sensation of pain through out the body, muscle spasms, irritability, insomnia, confusion, inability to concentrate and others. This all translates to stress on the body which can lead to a whole host of other ailments.<br>I do support having a "Smart Grid" which would have the capability to save energy, I DO NOT support the use of wireless technology in that system or anywhere else.<br>Mahalo,<br>Paul Stanley, M.Ed. (Educational Technology) |

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| Date: | Sun 8/6/2017 5:54 PM |
| Subject: | Must-See Documentary Reveals Dangers of Smart Meters - Take Back Your Power, a Smart Meter Expose |
| Body of the Email | Dear PUC Commissioners, Consumer Advocate, State Legislature, Governor, News Media, HECO, and residents of Hawaii,<br><br>This message goes to 395 recipients, including 236 Bcc recipients. Please forward to as many of your friends and co-workers and neighbors throughout the state ASAP.<br><br>I am submitting the following multi-award winning full-length 1:23:18 documentary, **Take Back Your Power**, a smart meter expose, as my public comment to HECO's plan to upgrade its grid for the sole benefit of its profits and monopoly control, its continued stranglehold on our energy, and continued abuse of power and fleecing of our people.<br><br>The documentary has been updated for 2017. Producer Josh del Sol, in conjunction with Dr. Joseph Mercola, **has made it available for viewing free all this week (through 8/11)** at Mercola's website<br><br>Must-See Documentary Reveals Dangers of Smart Meters<br><br>The opening scene is not a recreation by actors. It is actual footage from the Maine Supreme Court.<br><br>**After Aug 11, the documentary will cost you $19.95.** |

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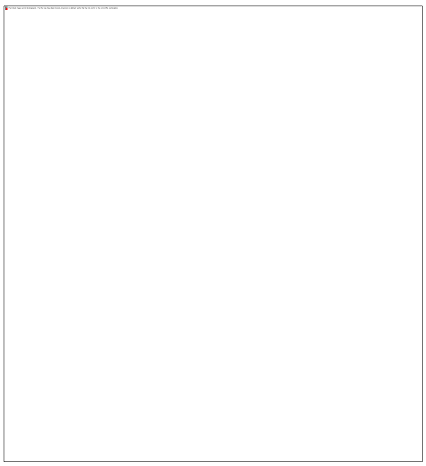
| | Our political leaders continue to abuse their power to support a company that not only was one of the instigators of, but actively participated in the Overthrow on Jan 17, 1893, none other than the HECO monopoly.<br><br>Our politicians are all fighting to stop a tsunami, a **world-wide movement to stop smart meters, and they will be buried by that tsunami.**<br><br>**It is time for our people to wake up, rise up, march, and overthrow the dinosaur HECO monopoly to bring about publicly owned, non-profit power to Hawaii.**<br><br><br><br>**It is time for our people to rise up in 2018 and take back control of an abusive, out of control, Democrat monopoly government that answers to no body and is accountable to no one, except the wealthy, power elite Queen Bees like HEI CEO, Connie Lau.**<br><br>**Encourage Representative Colleen Hanabusa to run for Governor.**<br><br>**Spread the word throughout Hawaii and refuse smart meter installation if you value your privacy and your health, and that of your children.**<br><br>**Big Brother is watching you!**<br><br>Mahalo,<br><br>Ed Wagner<br><br>Mililani |

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| Date: | Sat 8/5/2017 1:28 PM |
| Subject: | Modernization of Power Grid |
| Body of the Email | Question: How will this upgrade help customers without rooftop solar? Also, how will the cost of this upgrade be paid for? Will it come from everyone utilizing Heco's system, including those with rooftop solar? |

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| | This needs to be addressed at your public meeting.<br>Thank you.<br>Barbara Umiamaka |

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| Date: | Mon 8/7/2017 1:26 PM |
| Subject: | Grid Modernization |
| Body of the Email | Aloha,<br><br>I do have concerns about Grid Modernization. I heard that they are the same as Smart Meters and Smart Meters are known to be health hazardous, invade privacy and cause fires. We wish not to have them in our house or in the community.<br><br>Mahalo,<br>Mio |

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| Date: | Mon 8/7/2017 1:26 PM |
| Subject: | Grid Modernization |
| Body of the Email | I do not wish to have a smart meter at either home on my property located at *[omitted from publication]*. I realize there are many meetings being planned around this issue which I will be unable to attend but I do wish to make my position known on this topic - NO SMART METER for me. Mahalo Carole Newell |

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| Date: | Sun 8/6/2017 10:18 PM |
| Subject: | Smart meters |
| Body of the Email | These smart meters are far from smart, I am extremely opposed to these horrible meters, causing more damage than most people know about. I shall testify as well.<br><br>Mahalo, Julie Dahl |

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| Date: | Mon 8/7/2017 8:50 AM |
| Subject: | SSTUSA – Introduction |

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| Body of the Email | We are delighted to hear Hawaii electric and in particular, Maui electric is getting serious about modernizing its energy grid. I personally visit Maui on a regular basis and the essential upgrades are long overdue.<br><br>We offer a vast array of sophisticated energy management tools, such as demand response , geothermal energy storage technologies such as HQA horizontal quad array and HSA horizontal spiral array that is vastly superior to vertical geothermal. Besides geothermal Portions of Maui are suitable for pumped hydro, OTEC and SWAC.<br>http://www.sstusa.net/index.html<br>We welcome the opportunity to discuss, design and install a renewable resiliency system for maui electric and others.<br><br>Sincerely,<br><br>Jeffrey Bisk |

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| Date: | Tue 8/8/2017 2:39 PM |
| Subject: | CCA |
| Body of the Email | Aloha,<br><br>Does HECo/MECo/HELCo allow for Community Choice Aggregation?<br><br>Eric Olson |

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| Date: | Tue 8/8/2017 2:46 PM |
| Subject: | Clean Energy Portfolio |
| Body of the Email | What other Clean Energy solutions are you pursuing to help stabilize the grid to reach 100% renewables? Can you break it out by percentages and MWhrs served (Hydro, Kenetic, Fuel Cell, BESS, PV, Thermal, etc).--<br><br>**Eric Olson** |

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| Date: | Tue 8/8/2017 2:46 PM |
| Subject: | Comment on Grid Modernization |

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| Body of the Email | Comment relating to the use of wireless in Grid Modernization,<br><br>from Richard H. Conrad, Ph.D. biochemist on Oahu, Aug 8, 2017:<br><br>The article below, hereby submitted as a comment to Hawaiian Electric, describes definite harmful effects of wireless on human beings - firefighters - harm documented by scans and other medical testing - harm recognized and accepted by the California legislature. The EMF radiation they were exposed to is not very different from that emitted 24/7 by wireless smart meters.<br><br>'Health Exemption for Firefighters sends a Message to the World'<br><br>https://betweenrockandhardplace.wordpress.com/2017/06/26/guest-blog-health-exemption-for-firefighters-sends-a-message-to-the-world-by-susan-foster/ |

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| Date: | Tue 8/8/2017 2:46 PM |
| Subject: | Comment on Grid Modernization |
| Body of the Email | Comment relating to the use of wireless in Grid Modernization,<br><br>from Richard H. Conrad, Ph.D. biochemist on Oahu, Aug 8, 2017:<br><br>The article below, hereby submitted as a comment to Hawaiian Electric, describes definite harmful effects of wireless on human beings - firefighters - harm documented by scans and other medical testing - harm recognized and accepted by the California legislature. The EMF radiation they were exposed to is not very different from that emitted 24/7 by wireless smart meters.<br><br>'Health Exemption for Firefighters sends a Message to the World'<br><br>https://betweenrockandhardplace.wordpress.com/2017/06/26/guest-blog-health-exemption-for-firefighters-sends-a-message-to-the-world-by-susan-foster/ |

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| Date: | Tue 8/8/2017 2:49 PM |
| Subject: | Community Solar |

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| Body of the Email | What is happening with Community Solar? How does it work? Who is participating? Who manages it? How do the community and solar companies get involved?<br><br>**Eric Olson** |

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| Date: | Tue 8/8/2017 2:48 PM |
| Subject: | Disaster Ready |
| Body of the Email | How much focus is placed on "Disaster Preparedness" as part of the resiliency of the modern grid? Can Energy Partners install micro-grids that isolate and remap around damaged areas (Similar to Mesh Networks in Communications)? Do you have specifications and requirements for such a project?<br><br>**Eric Olson** |

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| Date: | Tue 8/8/2017 1:31 PM |
| Subject: | Doc as Comment on Grid Modernization |
| Body of the Email | MA HEARING TODAY FOR: An Act relative to utilities, smart meters, and ratepayers' rights.<br><br>SENATE DOCKET, NO. 344 FILED ON: 1/16/2017<br><br>SENATE . . . . . . . . . . . . . . No. 1864<br><br>The Commonwealth of Massachusetts<br><br>__________________<br><br>PRESENTED BY:<br><br>Michael O. Moore<br><br>__________________<br><br>To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts in General<br>Court assembled: |

The undersigned legislators and/or citizens respectfully petition for the adoption of the accompanying bill:

An Act relative to utilities, smart meters, and ratepayers' rights.

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PETITION OF:

| Name: | District/Address: | |
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| Michael O. Moore | Second Worcester | |
| Diana DiZoglio | 14th Essex | 1/26/2017 |
| David Paul Linsky | 5th Middlesex | 1/26/2017 |
| Linda Dean Campbell | 15th Essex | 1/31/2017 |
| Kate Hogan | 3rd Middlesex | 2/2/2017 |
| Jack Lewis | 7th Middlesex | 2/2/2017 |
| Marjorie C. Decker | 25th Middlesex | 2/3/2017 |
| Solomon Goldstein-Rose | 3rd Hampshire | 2/3/2017 |
| Jennifer L. Flanagan | Worcester and Middlesex | 2/15/2017 |
| Kathleen O'Connor Ives | First Essex | 3/27/2017 |

SENATE DOCKET, NO. 344 FILED ON: 1/16/2017

SENATE . . . . . . . . . . . . . . No. 1864

By Mr. Moore, a petition (accompanied by bill, Senate, No. 1864) of Michael O. Moo DiZoglio, David Paul Linsky, Linda Dean Campbell and other members of the General Court fo legislation relative to utility meters and the rights of utility ratepayers. Telecommun Utilities and Energy.

[SIMILAR MATTER FILED IN PREVIOUS SESSION
SEE HOUSE, NO. 2868 OF 2015-2016.]

The Commonwealth of Massachusetts

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| | In the One Hundred and Ninetieth General Court<br>(2017-2018)<br><br>________________<br><br>An Act relative to utilities, smart meters, and ratepayers' rights.<br><br>Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:<br>Chapter 164 of the General Laws is hereby amended by inserting after section 116B the following section:-<br><br>SECTION 116C: Smart/wireless utility meter information<br><br>a) As used in this section, the following terms shall have the following meanings:<br><br>(1) "Electromechanical analog meter", means a purely electric and mechanical device, using no electronic components, no switch mode power supply, no transmitter, no antenna, and no radio frequency emissions.<br><br>(2) "Utility company", shall mean an electric, gas, or water company, or town or city-owned utility or other utility provider.<br><br>(3) "Wireless meter" shall mean: Any transmitting metering device with electronic components and/or any electric or battery operated meter that is capable of measuring, recording, and sending data by means of a wireless signal from a utility consumer or member to a utility company, municipality, or cooperative association in a manner utilizing one-way communication, two-way communication, or a combination of one-way and two-way communication either through the meter itself or through a device ancillary to the meter. Common names include, but are not limited to, AMR, ERT, smart, AMI, and Comprehensive Advanced Metering Plan CAMP.<br><br>(4) "Equivalent technology" shall mean utility infrastructure that communicates data using wireless frequencies, but which may be undisclosed due to proprietary rights.<br><br>b) The department of public utilities shall direct utility companies to provide ratepayers the following:<br><br>(1) a choice of the type of utility meters to be installed and operated on their places of residence, property or business; among the choices offered shall be the installation and ongoing operation of an "electromechanical analog meter"; and |

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| | (2) the ability to retain and operate an "electromechanical analog meter" on an ongoing basis at no cost; and<br><br>(3) the right to replacement of a wireless meter with a non-transmitting electromechanical meter at no cost.<br><br>c) The utility companies shall be required to obtain the ratepayer's written consent:<br><br>(1) before installing wireless meters or "equivalent technology" on the ratepayer's property and<br><br>(2) before altering the functionality of said meters.<br><br>d) The utility companies shall provide written notice to ratepayers within 90 days of the effective date of this act for the purpose of informing said ratepayers if wireless meters have been installed on their properties. Ratepayers shall have the right to request that the utility companies remove said wireless meters and install in their place electromechanical analog meters that emit no radiofrequency electromagnetic radiation. There shall be no cost or other periodic usage charges to the ratepayer for such removal, replacement installation, and use of a non-wireless utility meter. The utility company shall promptly comply with such removal and replacement installation request made by the ratepayer to said company.<br><br>e) Utility companies are:<br><br>(1) prohibited from shutting off service to a ratepayer based on the ratepayer's utility usage or on the ratepayer having electromechanical analog meters;<br><br>(2) prohibited from imposing any disincentive on a ratepayer for not consenting to the installation or use of wireless meters;<br><br>(3) required to notify ratepayers in writing that the installation and use of wireless meters are not mandated by state or federal law and are not permitted without the ratepayer's consent;<br><br>(4) prohibited from discriminating against ratepayers who may have medical conditions that are exacerbated by exposures to pulsed microwave radio frequencies; and<br><br>(5) prohibited from installing "equivalent technology", such as direct wireless connection to devices in the home or business, on poles or in any other manner near the home or business of an individual requesting a non-transmitting meter. |

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| | f) The department of public utilities shall establish terms and conditions to comply with the requirements of this section.<br><br>g) This section shall take effect upon its passage. |

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| Date: | Tue 8/8/2017 2:42 PM |
| Subject: | Electric Cars Load Displacement to the Grid |
| Body of the Email | What is the estimated increase in energy needs to support 100% Fossil fuel free transportation in Hawaii? Specifically, the shift of automotive consumption to the electric grid creates a need for more residential solar. How is HECo creating incentives for customers to increase PV to offset EV cost shift from gas pumps to electric bills?<br><br>**Eric Olson** |

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| Date: | Tue 8/8/2017 2:44 PM |
| Subject: | Jurisdiction |
| Body of the Email | More comments from Richard H. Conrad, Ph.D. biochemist, Aug. 8, 2017, results of three surveys, plus one article: https://smartgridawareness.org/2014/01/18/symptoms-from-exposure-to-smart-meters/ https://smartgridawareness.org/2014/12/07/symptom-development-from-smart-meter-rf-exposure/ https://skyvisionsolutions.files.wordpress.com/2014/01/halteman_survey-results-final.pdf http://www.conradbiologic.com/pdfs/9-Reasons-Today's-Smart-Meters-Are-A-Mistake.pdf NINE REASONS WHY TODAY'S SMART METER SYSTEMS ARE A MISTAKE by Richard H. Conrad, Ph.D. biochemist May 9, 2014 INTRODUCTION Smart electric meters and smart grid systems track and record details of customers' energy usage, and transmit the information to utilities wirelessly at microwave frequencies. Authorities are attempting to make smart meters mandatory. They are usually installed without permission and sometimes against the wishes of homeowners. Smart meters fill homes with pulsed microwave radiation 24/7 without consent, and infringe on the privacy, security, safety and health of residents. For the above reasons there is world-wide opposition to smart meters. Fifty-seven jurisdictions in the US are opposed to mandatory smart meters. Fifteen jurisdictions in California have made smart meter installations illegal. More than half of the States in the US have wireless smart meter opposition groups. The opposition is growing and is persistent. The American Academy of Environmental Medicine (AAEM) in a letter to the California Public Utilities Commission (January 2012) called for an immediate |

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| | moratorium on smart meter installation and in October 2013 restated their call for a moratorium based on new scientific evidence that "clearly demonstrates adverse health effects in the human population from smart meter emissions." Many experts concur (see References and Notes section). Safe wired (vs. wireless) alternatives that enhance sustainability and do not infringe on personal rights are technologically feasible right now (see Alternatives at end of References and Notes section) but in most cases are not being offered. There is an enormous amount of propaganda being disseminated by the smart meter manufacturers and others that paints a picture far from the truth. Smart meters cause more problems than they solve. Here is the reality: 1) NO REAL COST JUSTIFICATION In January 2014, Northeast Utilities in Massachusetts filed a statement to the Massachusetts Department of Public Utilities which concluded: "There is no rational basis for AMI (smart meter Advanced Metering Infrastructure)......there is ample evidence that this technology choice will be unduly costly for customers and that the objectives of grid modernization are achievable with technologies and strategies that rank substantially higher in terms of cost effectiveness......the costs associated with AMI are currently astronomical, while the incremental benefits for customers are small in comparison......There is no cost justification that can support the implementation of (smart meters)......consider the results and experiences of recent and ongoing pilots before blindly moving forward with an AMI mandate". !2 The Attorney Generals of Illinois, Connecticut and Michigan have independently stated they oppose smart meters on the basis of high cost and little or no benefit. Smart meters have not been saving consumers money but have caused sky-rocketing utility bills, resulting in class-action lawsuits in California and Texas. 2) INVASION OF PRIVACY RIGHTS Smart meters relay detailed information about times and amounts of electrical power usage. Energy usage data allows the reconstruction of a household's activities, including when residents are home or away. Even in the absence of "smart"/wi-fi transmitting appliances and Zigbee chips, the specific appliances consuming power and their time of consumption can be determined through analysis by special software developed at MIT. (This is for the sole benefit of the utilities; the statement that consumers will make use of an ability to see a running analysis of their consumption is propaganda - most customers are not interested.) One cannot rely on a utility's claim that they will not release or sell information to other parties. Smart meters are an open portal into every home - an unacceptable intrusion into customers' privacy. A very slippery slope. A related invasion of rights is the plan for the utilities to eventually be able to control major household appliances. This will be a serious infringement on freedom within one's own home; the freedom to use such devices whenever they are needed. It will impose forced limitations on when one can wash dishes, wash or dry clothes, take a hot bath, or run the A/C. Another very slippery slope. 3) SUSCEPTIBILITY TO HACKING AND CYBER-TERRORISM Utilities have not established adequate protections from hacking or for preventing sensitive data from being accessed by unauthorized persons or entities. The FBI, a former CIA director and industry |

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| | experts have expressed alarm over the hacking and cyber-terrorism potentials of a smart grid. Smart meter/grid technology greatly increases vulnerability to cyber-terrorism. Utilities are not likely to ever be able to effectively defend against these threats - it will be a never-ending risk - an expensive on-going battle with hackers and terrorists. 4) ADVERSE BIOLOGICAL EFFECTS OF MICROWAVE RADIATION Low level microwave radiation is not innocuous. Thousands of peer-reviewed research publications (Bioinitiative 2012; January 16, 2014) show adverse biological effects from pulsed microwave frequency radiation at exposure levels well below FCC limits; often lower by orders of magnitude and in the range of emissions from smart meters. (For non-thermal biological effects, peak intensity is more important than averaged power. 24/7 exposure to smart meter pulses is actually an exposure of the same order of magnitude as using a cell phone for a much shorter time.) Studies have shown detrimental effects of low-level microwave exposure on animals, birds and bees. In animals: reduced fertility and sperm viability, disturbance of immune function, increased numbers of breaks in DNA, breaching of the blood-brain barrier making it more porous to toxins, increased oxidative stress, increased cancer rates and many other effects. See "Important letters from experts" in References and Notes section. In humans, !3 alterations in brain waves, sleep patterns and heart rates; increased cancer rates. There would be much more known about health effects in humans but funds have been withdrawn for research on non-thermal effects, and non-thermal findings by the EPA have been kept under cover. 5) POSSIBLE HUMAN CARCINOGEN The World Health Organization's International Agency for Research on Cancer (IARC) has classified microwave radiation, specifically including that emitted by smart meters, as a possible human carcinogen. This means that in order to continue to receive electrical power, people are being forced to live with a device on their homes that emits possibly carcinogenic microwaves 24/7. The results of thousands of studies strongly suggest that microwaves are not safe for humans. At least with cell phones a person has a choice whether or not to use them. If the smart meter roll-out plan had been submitted as a proposal for an experiment on human beings, which it undeniably is, any Institutional Review Board, including the division of the NIH that supervises such experiments on humans, would have rejected it outright. Millions of persons world-wide are being used as guinea pigs without their permission. The smart meter roll-out violates Nuremberg principles. 6) FCC AND INDUSTRY SPIN The FCC has never actually said that adherence to their standards is a guarantee of complete safety. It is industry spin that has interpreted and proclaimed it this way. The FCC says that their MPE, or Maximum Permissible Exposure level, was selected to protect from the overheating of tissue (this and electric shock are the only hazards of microwave/radio frequencies that the FCC officially recognizes). Their MPE does not protect from short and long-term health effects from lower, non-thermal levels such as emitted by smart meters, cell phones and Wi-Fi. Therefore any smart meter plans or decisions based on the MPE are completely invalid. The FCC admits that non-thermal effects do exist |

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| | and have been reported to effect human EEG and sleep patterns and then goes on to say that biological effects do not necessarily mean harmful health effects in humans and more research is needed; this is akin to saying that you are using low-level microwave emitting devices at your own risk (see FCC DOUBLE-SPEAK in References and Notes section). The many non-thermal effects that have been found (thousands of peer-reviewed research papers) should raise red flags, but instead are ignored by our regulatory bodies as if they simply do not exist. Yet smart meters are becoming obligatory, and PUCs and utilities are basing claims of safety on the FCC's standards. See REFERENCES AND NOTES section at the end of this document for a description of THE FCC DOGMA). Environmental Protection Agency (EPA), 1993: The FCC's exposure standards are "seriously flawed." (Official comments to the FCC on guidelines for evaluation of electromagnetic effects of radio frequency radiation, FCC Docket ET 93-62, November !4 9, 1993.) Food and Drug Administration (FDA), 1993: "FCC rules do not address the issue of long-term, chronic exposure to RF fields." (Comments of the FDA to the FCC, November 10, 1993.) National Institute for Occupational Safety and Health (NIOSH), 1994: The FCC's standard is inadequate because it "is based on only one dominant mechanism— adverse health effects caused by body heating." (Comments of NIOSH to the FCC, January 11, 1994.) Amateur Radio Relay League Bio-Effects Committee, 1994: "The FCC's standard does not protect against non-thermal effects." (Comments of the ARRL Bio-Effects Committee to the FCC, January 7, 1994.) Environmental Protection Agency (EPA), 2002: Norbert Hankin of the EPA's Office of Air and Radiation, Center for Science and Risk Assessment, Radiation Protection Division, wrote: "The FCC's current (radio frequency/microwave) exposure guidelines, as well as those of the Institute of Electrical and Electronics Engineers (IEEE) and the International Commission on Non-ionizing Radiation Protection, are thermally based, and do not apply to chronic, nonthermal exposure situations.....the generalization by many that the guidelines protect human beings from harm by any or all mechanisms is not justified.....there are reports that suggest that potentially adverse health effects, such as cancer, may occur......Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures." The FCC standards were set before, and do not take into consideration, the WHO's IARC decision to classify microwave radiation, including the radiation from smart meters, as a possible human carcinogen. This is yet another reason why the FCC standards do not protect consumers. Certainly smart meters cannot by any stretch of the imagination be considered safe. Any organization that bases claims of "no long or short-term health effects from smart meters" or "smart meters are safe" or "smart meters have been determined to be safe" on the FCC dogma is hiding behind non-existent liability protection. Contrary to industry propaganda, the only "testing" of the safety of smart meters has been their deployment. The only results of this "testing" that have been reported are survey reports and many personal testimonials of health effects (some of which were accompanied by sworn affidavits) including testimonials |

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| | from the "Smart Meter Health Effects Survey". See the Survey and its results and testimonials at: (testimonials are in Appendix 6, beginning on page 65): http://www.mainecoalitiontostopsmartmeters.org/wp-content/uploads/2013/01/Exhibit-10-Smart-Meter-Health-Effects-Report-Survey2.pdf The report from a previous survey: http://www.conradbiologic.com/pdfs/EMSnetwork- Survey-Results-FinalReduced.pdf !5 Additional testimonials can be read at: http://www.conradbiologic.com/pdfs/Santa-Rosa- Smart-Meter-Hearings.PDF Nine countries (including China, Russia and much of Europe) representing 40% of the world's population, have much lower exposure limits than the US; some countries have established guidelines more than 100 times lower. Certainly China and Russia are not known to be overly protective of their populations. 7) MENTAL AND PHYSICAL DEBILITATION Many people worldwide independently report becoming electrically sensitive for the first time in their lives after a smart meter was installed, and can no longer tolerate using cell phones or Wi-Fi. It is important to note that in many of these cases, brand new and severe symptoms began to appear days or weeks BEFORE they learned that a smart meter was nearby (see Survey report). Therefore effects on human functioning are a reality and not paranoia or hysteria. Because of the severity of these symptoms, in many cases people are forced to abandon their homes if utilities refuse, as they sometimes do, to remove the smart meter. Once a wireless smart meter system is in place, there exists a very real potential for the remote reprogramming of pulse patterns emitted by (either all or selected) smart meters by hackers, terrorists, or by any government in the future. This could be used to purposefully affect a population's (or selected sub-populations') mental and physical functioning. This would be analogous to what the Russians did to the US Embassy in Moscow, and the military knows exactly how to accomplish this. Smart meters are already inadvertently having this effect on susceptible persons at their usual low pulse duty cycle of 1% or less (see Survey report). Imagine how much greater the effect would be, and on how many more people, if the duty cycle was raised for example to 50% at the push of a button. A potential weapon of mass debilitation attached to every home. An extremely slippery slope. Exposure to EMF such as that from smart meters and other sources, rapidly causes painful physical symptoms and disability in a significant percentage of the world's population, whether or not these people can directly "sense" EMF and whether or not they are aware that they are being exposed. This is in spite of junk science sponsored by industry - poorly conducted experiments - that have supposedly "proven" that the symptoms are not caused by EMF exposure. More than any other electronic device, smart meters have been the cause of persons world-wide being converted from normal, to becoming electrically sensitive, to the point of not being able to use their beloved cell phones or wi-fi any longer (see Survey report). Take note: smart meters really are disabling people, and the number so disabled is growing rapidly. This is one of the main reasons that there are over 200 smart meter opposition groups world-wide. Many of these health effects are irreversible. Electrical Sensitivity (ES) is very real, and it is direct evidence that non-thermal |

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| | effects do cause serious health problems in humans. See References and Notes !6 section for a definition and discussion of ES. Even in the general population that has not yet become electrically sensitive, it is very probable that smart meters are causing subliminal effects on sleep patterns, neuropsychological functioning, leakage of the blood-brain barrier, and increased oxidative damage including DNA breakage. No official testing has ever been done with smart meters to look for these effects. 8) OPT-OUTS NOT SUFFICIENT Opt-outs are not a satisfactory solution because of cumulative microwave emissions from neighbor's smart meters and nearby banks of smart meters. Furthermore, utilities have been charging initial and on-going monthly extra fees to opt-out. The true purpose of these fees is to discourage opting out, not to compensate for manually reading an analogue meter as claimed. (Customers can do this themselves and submit the monthly reading to the utility via the post card system such as has been in effect for years on Oahu or via an automated touch-tone phone system.) Any demand of extra payment to avoid having privacy, security or health infringed upon within one's own home is, without exaggeration, extortion, particularly in light of the fact that microwave radiation, including that emitted by smart meters, is classified by the WHO as a possible human carcinogen. 9) SAFETY AND BENEFITS PROPAGANDA Utilities and PUCs have been believing, relying on and disseminating the smart meter "information" supplied to them by the manufacturers of smart meters and others. This propaganda is riddled with misleading and false statements, and uses FCC dogma as its basis for safety (see NOTES AND REFERENCES for reason 7). Unfortunately the truth is that the FCC, FDA, EPA and other government agencies have been passing the buck around in a circle from one to the next for many years, with none of them releasing their own research results. No one can honestly refute the red flags raised by the enormous body of peer-reviewed research, so agencies use deceptive double-talk and say that the research findings are not significant. They really do have serious safety concerns, but are influenced by pressure from the telecom industry. Telecom lobbyists manipulate public opinion by making false proclamations through the press. Their chief lobbyist, "fixer" and generator of spin was Tom Wheeler, who is now the Chairman of the FCC - a classic example of the fox guarding the henhouse - hence the public remains without protection from non-thermal effects. Business as usual in Washington, but in this case causing unnecessary death, disability and suffering, lack of optimum productivity, and increased health care costs. CONCLUSION Don't take the path of intentional ignorance. Take a lesson from history: the "harmless" X-ray machines in every shoe store, DDT that "only affects insects", malathion "drinkable", asbestos "no effect on humans", thalidomide "no significant side effects", tobacco "doesn't cause cancer", estrogenic plasticizers "parts per billion can't hurt anyone" - the list goes on and on. Please remember these huge blunders and make decisions accordingly. !7 Who should one believe, those with vested financial and political interests, or those whose priorities are the prevention of human suffering, maximizing cost benefits to consumers, and consumer security and privacy? Do |

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| | not rush ahead based on propaganda and wishful thinking. For the purpose of protecting the pocketbooks, privacy, security, health and safety of consumers, the deployment of smart meters and their associated systems should be halted until after they are redesigned and the new design is proven secure, safe and financially beneficial for the consumer. (Some possible safe alternatives to wireless smart meter systems are presented in the References and Notes section.) An unbiased study on the safety of smart meter systems as they are currently being deployed: $ • would not hide behind the current FCC "safety" limits and would not be influenced by industry propaganda,$ $ • would treat and evaluate the deployment of smart meters as an experiment on human beings that requires approval by an Institutional Review Board (such as an IRB at a major university) according to the NIH standards for experiments involving human subjects (one of the NIH requirements being prior full disclosure to and the signed consent of each subject),$ $ • would test for subliminal effects in humans, including neuropsychological testing, and monitoring of sleep patterns and EEG (especially QEEG) and EKG before, during and after extensive exposure to actual typical smart meter emissions, first at normal duty cycle, and then at maximum duty cycle.$ $ • would honestly take into account:$ $ i) the thousands of research reports on non-thermal effects, ii) the recent classification of microwave emissions including that from smart meters as a possible human carcinogen, iii) the unusual symptoms and health effects from smart meters independently reported by thousands of persons world-wide, iv) the warnings of the dozens of research scientists who have written about the !8 dangers to human health of smart meters and other microwave emitting devices, v) microwave exposure from neighbors' smart meters and mesh system routers. (Smart meter emissions from the homes of immediate neighbors and also from dozens of surrounding houses all add together to contribute significantly to exposure inside one's home, even when attenuation by walls and building materials is taken into account.)$ $ SUMMARY 1) No real cost justification 2) Invasion of privacy rights 3) Susceptibility to hacking and cyber-terrorism 4) Adverse biological effects 5) Possible human carcinogen 6) FCC and industry spin 7) Mental and physical debilitation 8) Opt-outs not sufficient 9) Safety and benefits propaganda Any of the above nine reasons should alone be cause enough to halt the deployment of smart meter systems of the present design. These systems were designed to satisfy perceived desires and needs of utilities, without anticipating that they would be an all-around bad idea for consumers and will end up being an on-going nightmare for the utilities themselves. With these systems: high costs, privacy invasion, hacking, and harm to humans are not going to go away, but will only get greater and greater. So will the liability consequences. A number of class action lawsuits are already underway. There are ways to accomplish reasonable utility goals while avoiding negative impacts on consumers and the slippery slopes of |

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| | intrusion into privacy and personal rights, and the extremely slippery slope of installing a potential weapon of mass debilitation on homes. The only alternatives that are safe and beneficial are wired alternatives that have no wireless features. Don't follow the mistakes of others down the wrong track, rather, reject the ill-conceived wireless systems currently being deployed elsewhere. Take a stand like Northeast Utilities did recently (see reason 1), and help set a precedent based on common sense. REFERENCES AND NOTES to accompany the above nine reasons are listed by reason number: (additional references and supporting documents for each reason are available upon request) Notes for Introduction: A listing of citizen groups worldwide that have banded together to oppose smart meters: !9 http://www.takebackyourpower.net/directory/ A list of Smart Meter Lawsuits: http://thepeoplesinitiative.org/lawsuits/ http://www.mainecoalitiontostopsmartmeters.org/category/legal/ For legal documents concerning litigation against Kaui's KIUC: http://stopkiuc.com AEEM letter calling for a moratorium on smart meter installation: October 23, 2013: http://skyvisionsolutions.files.wordpress.com/2013/11/aaemwireless- smart-meter-case-studies.pdf Notes for the Nine Reasons: [1] Letter from attorney for Northeast Utilities to the Dept. of Public Utilities in Boston on January 17, 2014: http://haltmasmartmeters.org/wp-content/uploads/2014/01/NSTAR_R12-76-Comments-7986-POSTED01172014_HIGHLIGHTED.pdf A year-long study by Toronto Hydro showed 80% of customer's bills increased after Smart Meters were installed (Smart Meter Program Headed for Disaster, Horgan, 2010, www.bcndpcaucus.ca). "Dozens and dozens of customers...are reporting some billing spikes, in one case more than 1,000 percent," reported Canada TV, www.TakeBackYourPower.net, 2013. A class action lawsuit filed in Bakersfield, CA, (Dec. 2009) states smart meters inflate customers' bills; Smart Meters Draw Complaints, USA Today, July, 2010. [2] Report for Colorado PUC by E.L. Quinn, which includes a detailed description of how much can be learned about private lives from smart meter data: http://www.dora.state.co.us/puc/DocketsDecisions/DocketFilings/09I-593EG/ 09I-593EG_Spring2009Report-SmartGridPrivacy.pdf Former CIA Director Gen. Patraeus stated that government will routinely spy on people through their "smart" appliances (Wired, 2012); also www.StopSmartMeters.org, 2014. http://www.takebackyourpower.net/news/2014/04/16/industrys-own-words-6-admissions-of-in-home-surveillance-using-smart-meters/ [3] http://smartgridawareness.org/2013/09/29/smart-grid-cyber-security-in-state-of-chaos/ The FBI warned that smart meters are being compromised and hacking will spread !10 (www.KrebsOnSecurity.com, April, 2012). Former CIA Director James Woolsey has labeled the smart grid "a really, really stupid grid" based on security concerns (EnergyNow.com, 2011). Kenneth Van Meter, Lockheed Martin's general manager of Energy and Cyber Services said that "by the end of 2015 we will have 440 million new hackable points on the grid... every smart meter is going to be a hackable point" (Computerworld, Oct. 2010). Cyber expert David Chalk stated there is 100% certainty the entire wireless mesh grid will crash |

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| | in the next three years (Business Wire, April, 2012). Research firm Zpryme estimates US utilities will spend a cumulative $7.25 billion in smart grid security from now until 2020. [4] Bioinitiative 2012 is a 1479 page report by 29 doctors and scientists from 10 countries that cites almost 2000 research studies on the biological effects of electromagnetic fields (EMFs) and radio frequency (RF) radiation. The authors state: "Bioeffects can occur from just minutes of exposure to mobile phone cell towers, WiFi, and wireless utility 'smart' meters that produce whole-body exposure." EMF exposure has known cumulative effects. Alarming and sometimes exponentially increased cancer rates have directly paralleled increased use of wireless technologies: www.BioInitiative.org. The US Naval Medical Research Institute (1972) published a report with over 2000 references documenting biological effects of microwave and RF radiation. Important letters from experts: http://sagereports.com/smart-meter-rf/?page_id=282 An additional lists of scientific papers showing health effects of EMF: http://www.powerwatch.org.uk/science/studies.asp http://www.takebackyourpower.net/research/health/ Biological Effects of Electromagnetic Fields, an excellent video by Professor Ted Litovitz: www.youtube.com/watch?v=6lAFbQqyVio Jan. 2013 NIH research "A Review of the Ecological Effects of Radiofrequency Electromagnetic Fields (RF-EMF)" reviewed 113 studies and found 50% of animal studies and 75% of plant studies showed ecological effects of RF-EMF. In Nov. 2012 a Dutch court turned down a cell tower permit referencing research in Germany and Switzerland that showed negative effects of EMFs on bees. US Dept. of the Interior complaint about impacts from non-ionizing radiation on birds: http://www.saferemr.com/2014/03/dept-of-interior-attacks-fcc-regarding.html !11 [5] WHO classification of microwave radiation as a Group 2B human carcinogen: http://smartgridawareness.org/rf-health-effects/iarc-monograph-volume-102-rfelectromagnetic- fields/ Dr. Lennart Hardell (Professor of Oncology and Cancer Epidemiology who specializes in risk factors for cancer) wrote in 2013: "RF-EMF emissions from wireless phones... (should be)...regarded as carcinogenic to humans, classifying it as group 1 according to the IARC classification. Current guidelines for exposure need to be urgently revised."<br><br>http://www.ncbi.nlm.nih.gov/pubmed/24192496 $ [6] FCC guidelines are not based on any studies of long term low-level exposure to pulsed (digital) microwaves. Meeting current FCC guidelines only assures that one will not have heat damage and says nothing about the risks of many chronic diseases including cancer, miscarriage, semen quality, birth defects, autoimmune diseases, autism and ADD/ADHD. THE FCC DOGMA: The DOGMA being adhered to by the FCC, IEEE and the telecom companies, and parroted by numerous government and international agencies and the power companies: "There are no significant effects of non-ionizing radiation (EMF) on living cells other than bulk heating of tissue at high levels of exposure." To biologists and physicians in the know who have read the literature, experienced electrical sensitivity directly themselves or have seen |

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| | hundreds of patients with electrical sensitivity, such a "no effect" statement is not reality or good science but is absurd. Not simply a propaganda statement made out of ignorance and wishful thinking, but an outright lie. These groups defend their dogma by discounting all evidence to the contrary without honest consideration or scientifically valid rebuttal. This may have begun as blind ignorance, but now, now that they have been fully informed of facts, it is a dishonest litany in service of power and profit. They adhere to and vehemently defend their dogma in spite of scientific logic based on peer-reviewed laboratory research and epidemiology studies. They feel it is their duty and obligation to increase profits for their shareholders; they cannot afford to admit to real health effects for fear it would bring their house of cards tumbling down. Do not be misled; their arguments are hollow and devoid of the actual reality of the situation. Most nonthermal studies funded by industry show no effects, and most publicly funded non-thermal studies do show effects; see "Business Bias as Usual" at: http:// www.conradbiologic.com/pdfs/Electromagnetic-Business-Bias.pdf. FCC DOUBLE-SPEAK: An example of the FCC's double-talk is found on page 8 of their OET Bulletin 56, Fourth Edition, August 1999, Questions and Answers about Biological Effects and Potential Hazards of Radiofrequency Electromagnetic Fields, where they say: "scientific laboratories in North America, Europe and elsewhere have reported certain biological effects after exposure of animals and animal tissue to relatively low levels of RF radiation. These reported effects have included certain changes in the immune !12 system, neurological effects, behavioral effects, evidence for a link between microwave exposure and the action of certain drugs and compounds, a "calcium efflux" effect in brain tissue ....... and effects on DNA." But then they go on to say: "In general, while the possibility of "non-thermal" biological effects may exist, whether or not such effects might indicate a human health hazard is not presently known. Further research is needed to determine the generality of such effects and their possible relevance, if any, to human health." This is not logic; to any scientist with biological training it is transparent spin. [7] A definition of ES is: "sensitized to EMF" as in allergic to, developing symptoms in response to EMF but not necessarily being able to sense EMF directly. Usually the EMF is detected only via painful and debilitating symptoms that it produces when or very soon after exposure to it, even when the person is not at first aware of its presence. It is EMF that is triggering the symptoms, because of repeated correlations with EMF exposure but not with anything else, and because of the timing of those correlations, including not finding out about the presence of the EMF until after the symptoms develop - i.e, not knowing at first that the EMF was present. This type of correlation is strong because: 1. it is reproducible with the same results (inadvertent blinded experiments repeated hundreds of time by almost every individual with ES, and in more than hundreds of thousands of people with ES), 2. there is no correlation with any other variable, 3. the timing of symptoms is that they follow after EMF exposure, and 4. people are in many cases unaware of the EMF source until after symptoms develop. Of course, ordinary simple correlation |

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| | by itself does not prove causation, but, the properties 1 throughout 4 above of the correlations in this case, all taken together, legitimately and strongly imply causation - cause and effect: EMF, including from smart meters alone, causes debilitating symptoms. For the "Smart Meter Health Effects Survey" and report of results, see: http://www.mainecoalitiontostopsmartmeters.org/wp-content/uploads/2013/01/ Exhibit-10-Smart-Meter-Health-Effects-Report-Survey2.pdf For personal testimonials of serious health effects, see Appendix 6, page 65 in the above link, and also: http://www.conradbiologic.com/pdfs/Santa-Rosa-Smart-Meter-Hearings.PDF For the results of a 2011 smart meter survey see: http://www.conradbiologic.com/pdfs/ EMSnetwork-Survey-Results-FinalReduced.pdf !13 For expert witness testimony against smart meters in the State of Maine, USA case, see: http://www.mainecoalitiontostopsmartmeters.org/2013/02/introduction-to-our-puc-filingsof- expert-and-lay-witness-testimony/ Also see the other references listed at: http://www.conradbiologic.com/articles/ EMFreferences.html [9] The book "Cell Phones" by Dr. George Carlo and Martin Schram. Notes for Conclusion SUGGESTIONS FOR ALTERNATIVES: Possible safe alternatives to wireless smart meter systems are meters either connected directly to fiber optics or hard wired to phone lines or CATV cable, and modems that transmit the data on the optical fiber, phone lines or CATV cable with filtering on the rest of the phone lines or cable going into the home; these modems designed to have very low RF emissions, to be shielded and use very low power, very low RF emitting types of microprocessors and LCD displays and filtered linear power supplies. To maintain privacy, data collection by smart meters should be stored as a simple running usage summation within the smart meter itself, and only then reported in a single transmission per month to utility. For safety and security reasons, cut-off switches should no longer be incorporated into smart meters. To locate power outages, sensors every few city blocks on phone poles could call in info via phone modem. To report instantaneous power draw it would be adequate to employ sensors at the substations; these would see an instantaneous power usage aggregate of many households, effectively preventing invasion of privacy because they could not be used to ascertain what is going on in any one home. It is important to note while examining alternatives to the mesh system, that PLC/BPL (Power Line Communication/Broadband over Power Lines) is NOT a safe alternative to smart meter mesh networks, for the following reasons: a) PLC/BPL operates by transmitting at either about 35 KHz or 85KHz onto the power lines, and not just out into the street, but also inadvertently backwards onto the house wiring throughout the whole house. b) In contrast with smart meters operating via Mesh networks, which are designed to transmit wirelessly into space and not to couple into power lines (though some inadvertent coupling probably does occur), PLC is designed to couple its frequency directly and efficiently onto the power lines. c) Due to its KHz frequency range, PLC travels much further on power lines than microwaves do because of its long wavelength, not only on power lines but also deeper into the house wiring with much less |

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| | attenuation due to distance. Thus the 60 Hz house power becomes contaminated with these frequencies. d) Outdoor power lines suspended in air from poles act as ideal radiating/transmitting antennas for the PLC frequencies, because the length of these wires is in the same !14 range as the wavelength. This in turn contaminates whole neighborhoods/cities with the KHz radiation by radiation through space, not only by conduction through wiring. e) From reports of persons made newly electrically sensitive by smart meters in areas where PLC is already deployed instead of wireless AMI/Mesh, PLC seems to be at least as sensitizing as AMI/Mesh, and in general causes more painful symptoms. This is understandable from the properties of PLC described in a) through d) above. Richard Conrad's CV: http://www.conradbiologic.com/mycv.html |

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| Date: | Tue 8/8/2017 10:29 PM |
| Subject: | My comments and questions on HECO's plans to upgrade O'ahu's power grid |
| Body of the Email | First of all, mahalo for arranging the meeting on August 7 and giving me the opportunity to speak.<br><br>As I already mentioned during the meeting, I'm very concerned about being exposed to the radiation emitted by smart meters. One of the reasons is my own electro-sensitivity. Another reason is the worry about what this type of radiation might do my parrot, who has been living with me for 21 years now, especially after hearing Tom Harris mention during the meeting that all of his friend's plants died after smart-meter exposure.<br><br>Since I'm renting an apartment, I'm concerned that renters and residents of apartment buildings might not have the same options owners of single-family houses have. I understand that, under normal circumstances, I could choose whether or not I wanted to have a smart meter. **However, if neighbors opted in, there would still be an exposure problem for an electrically sensitive person in an apartment because of banks of many wireless advanced/smart meters nearby.**<br><br>If the advanced meters include chips to communicate with appliances in the home to turn off air conditioners or hot water heaters when deemed necessary by HECO in abnormal situations, such communication, whether it be via ZIGBEE-WI-FI or signals over the house wiring, **would make a home unlivable for persons with electro-sensitivity**. Since I live in a small apartment, neighbors' appliances could cause me serious problems too, making it impossible for me to continue living in this building.<br><br>Would HECO be willing to pay for medical care becoming necessary due to smart-meter exposure? Many major insurance companies, like for instance Lloyd's of London, have stated that they will not provide liability coverage to manufacturers or |

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| | utilities for health effects of wireless devices. I need to be far away from a wireless advanced meter. Neighbors' WiFi signals already cause me problems. The addition of smart meters would be disastrous.<br><br>Unless safer alternatives than smart meters are introduced, apartment buildings should be exempt. Smart meters should not be installed in a building that has more than one unit. While the idea of an opt-in system appears to be fair at first look, it ignores the fact that neighbors can be drastically affected by choices made by residents of apartment buildings. This is comparable to second-hand smoke but considerably worse because radiation penetrates walls.<br><br>I have even heard about other electro-sensitives who were affected by smart meters radiating from other buildings in close proximity.<br><br>I have a public digital meter right in front of my bedroom window and am concerned that, sometime in the future, it might be converted into a smart meter. How would I be able to protect myself? What would HECO do to protect me?<br><br>Further, I'm extremely concerned about a substation that is planned to be built on a nearby lot acquired by HECO. It will result in increased radio-frequency exposure. Living near a substation is always a concern, especially to electro-sensitives. (Substations should not be built in residential areas.) However, I'm afraid this wireless technology would make it even worse.<br><br>Life would become very hard for electro-sensitives after widespread installation of smart meters. Smart meters would be everywhere. Shopping (even for groceries), taking a walk in a city or village, eating out in restaurants, visiting friends or family who have smart meters installed would all become problematic. To a degree, this is already the case due to widespread WiFi. It cannot be completely avoided. However, smart meters would make the situation considerably worse.<br><br>Would hospitals (for humans or animals) be connected to wireless advanced/smart meters? Since radiation emitted by these meters suppresses the immune system (http://www.bioinitiative.org/report/wp-content/uploads/pdfs/sec08_2007_Evidence_%20Effects_%20Immune_System.pdf), recovery would be more difficult, and the risk of not surviving a serious condition would increase. This is especially |

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| | true for electro-sensitives but also for the average person. A stay in a hospital would become riskier than ever.<br><br>Electro-sensitives will be forced to give up their jobs if their workplace has a wireless advanced meter and they develop symptoms. Or will HECO allow for arrangements?<br><br>Will schoolchildren, including those who are electro-sensitive, be forced to be exposed to smart meters?<br><br>If I move into a new home (apartment or house) that has a wireless advanced meter, can I have it removed and replaced by an analog meter? It would be harder for electro-sensitives to find apartments because they would have to make sure neighbors don't have smart meters either.<br><br>I heard HECO would be planning to phase out analog meters. This would be of concern to me for several reasons. Digital meters should have good radio-frequency filters on their internal power supplies, which they don't. Digital meters are a fire hazard. If I want to avoid radiation emitted by a smart meter, how could I be sure my digital meter won't be converted into a smart meter sometime down the road, without me being notified?<br><br>It is not technically necessary for solar panels to be connected to smart meters. There are other, much healthier ways to monitor solar and/or other renewable energy. For instance, a second analog meter could be installed. It would be much safer.<br><br>Why does HECO still want to introduce a smart-meter grid after other communities have had bad experiences with these meters (for instance fires, erroneous billing, and residents developing serious health issues)? Why is HECO willing to spend a fortune on something that is an extremely serious risk to health and safety (not to mention privacy)? Why is HECO willing to jeopardize people's health and safety?<br><br>http://www.naturalhealth365.com/toxic-radiation-brain-cancer-1994.html<br><br>http://www.naturalblaze.com/2016/11/nerve-disrupting-frequencies-radiating-smart-meters-information-perspective.html<br><br>http://www.naturalhealth365.com/smart-meters-emf-2268.html<br><br>http://stopsmartmeters.org.uk/resources/resources-scientific-studies-into-the-health-effects-of-emr/<br><br>http://emfsafetynetwork.org/smart-meters/smart-meter-fires-and-explosions/<br><br>The World Health Organization has declared EMFs, such as those emitted by smart meters, as a Class 2-B carcinogen, which is the same category DDT, lead and |

chloroform are in. Exposure to smart meters can also cause sleep problems, tinnitus, chronic fatigue, headaches, difficulties with memory and concentration, nausea, joint or muscle pain, heart palpitations, rash, eye problems and more.

People who had not been electro-sensitive before can become so due to exposure to high amounts of RF radiation emitted by a smart meter. People who already are electro-sensitive are more than likely to experience a worsening of symptoms.

http://www.es-uk.info/docs/front-03-es-smart-meters.pdf

Wireless advanced meters are not necessary for grid modernization. If HECO doesn't want to send out employees to read analog meters anymore, the postcard system, which has been in place and working very well for a long time, could be used, or consumers could send in readings via email, or via a HECO website that could be set up for that purpose.

Wireless advanced/smart meters are less safe and cause much more harm than what we have now. They are a serious health hazard and have a history of causing fires and artificially elevated billing. They pollute the environment with EMF radiation, which most people do not feel and are not aware of. Otherwise, this technology would not be considered. If those holding influential positions at HECO and other utility companies were electro-sensitive like I am, they would find alternatives that were safer than wireless monitoring. A smart-meter grid is certainly not environmentally friendly, even less so than what we have now. It also is a cybersecuritiy risk.

If the plan to have widespread smart-meter coverage goes forward, I predict that a few decades from now (or sooner), it will become obvious, even to non-sensitives, that the harm done by this technology far outweighs the benefits and cannot be justified. Eventually, this technology will be abandoned and replaced. By that time, better alternatives will become visible, even to those who don't see them now, although safer options are already available (but ignored). The worst part of it will be that many people (not just electro-sensitives) will have become seriously sick or even died. The high amount of money spent on a wireless-advanced-meter grid will have been wasted. In my opinion, it should be used for a safer and healthier alternative now.

It usually takes time for a truth to be widely accepted. Tobacco is a good example. Ionizing radiation is another example. People used to wear watches with radioactive luminous radium paint on dials and hands.

Brigitte Otto,

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| Date: | Tue 8/8/2017 12:04 PM |
| Subject: | Public comments re "plan for upgrading power grids" under the www.hawaiianelectric.com/gridmod proposal |
| Body of the Email | Thank you for considering and responding to the public about the following.<br>*Would NEM users have their cost, usage or solar systems impacted or changed by the "plan for upgrading power grids" under the www.hawaiianelectric.com/gridmod proposal?<br>*What would the impacts or changes be on NEM users be if "smart meters", "voltage management", "demand response", and "distributed resources" are implemented<br>*Some customers do not want smart meters (http://www.pbs.org/newshour/rundown/how-smart-are-smart-meters/): would customers be allowed to opt out (without penalty) of smart metering or other technology considered intrusive by the customer under the "plan for upgrading power grids" under the www.hawaiianelectric.com/gridmod proposal<br>*What are the rate costs under "plan for upgrading power grids" under the www.hawaiianelectric.com/gridmod proposal; what would the cost to the average household be; what will the total monetary outlay be<br>*Will Hawaiian Electric pay for and own all of the land and technology installed under "plan for upgrading power grids" under the www.hawaiianelectric.com/gridmod proposal (versus leasing, ownership/operation by a 3d party, a partnership etc.)<br>*Will the "plan for upgrading power grids" under the www.hawaiianelectric.com/gridmod proposal be reviewed and evaluated by an independent expert picked by the PUC and be available to the public; and will all financial details regarding costs including the how the costs are calculated (without withholding any information) be available to the public |

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| Date: | Tue 8/8/2017 11:53 AM |
| Subject: | Public Meeting - 7 Aug @ McKinley High School |
| Body of the Email | Comment Concerning Modernization of Energy Distribution System – Smart Grid<br><br>Recommend against deployment of smart grid and expansion of privately owned distributed generation systems in lieu of a more "hardened" conventional distribution and investment strategies which focus on public / commercial large renewable energy generations systems. The Affordability objective cannot be generalized when you have certain sectors of your customer base who cannot afford any rate increase due to fixed incomes or lack the ability to take advantage of energy choices such as apartment owners/renters. The model also assumes that privately owned systems will continue to be maintained properly and recapitalized if no tax incentives or subsidized. If privately owned distributed energy providers drop out or become unreliable the economic basis |

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| | for maintaining the advanced energy distribution system becomes irrelevant. Reliability is dependent upon use of the electricity. The majority of users are using electricity for stoves, ovens, refrigerators, hot water, air conditioning and other domestic use which do not require high quality frequency and amplitude constraints . Reliability should be based on minimal disruption from overhead lines being damaged, slap shorts, bird strikes, overloaded or old transformer and substation. A smartgrid system unless physically hardened such as being placed underground, having redundant lines, multiple feeds and the ability to physically reroute power would be just as vulnerable as the current system. The use of conventional protective circuits and controllers in lieu of high tech microprocessor controlled and remote controlled systems would also be less susceptible to cyber attacks, software issues and unknown long term reliability of high density control circuit cards. Energy Choices are not available for all sectors of your customer base which makes this objective limited. As previously stated there must be equitability for those who are not able to have energy choices other than to use less. The premise that 100% renewable energy cannot be achieved without small distributed intermittent renewable energy generators which in most cases are privately owned residential PVs and large public or commercially owned firm power generators needs to be re-examined. What is the incentive for maintaining or recapitalizing small privately owned PVs if there are no tax incentives or subsidies. Affordability of public / commercial generation systems can still be achieved with public / commercial bonds and by rates regulated by the PUC that would more fairly spread the cost across the customer base. The advantages in economy of scale, efficiency, research, sustaining, modernization and recapitalization of large entities would far outstrip those of the small residential suppliers. |

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| Date: | Tue 8/8/2017 5:56 PM |
| Subject: | smartmeters |
| Body of the Email | Dear Hawaiian Electric,<br><br>As a recent visitor to Hawaii for 2 weeks, I strongly urge you to stop smartmeter installation. Ubiquitous smartmeters would basically keep someone like me from visiting your beautiful islands, since I am only able to do so if I can stay at RF-free rentals such as certain VRBOs (Air B&Bs). Regular hotels are filled with RF from wifi, hotspots, etc and I must avoid these due to immediate very bad health effects.<br><br>My husband and I opted out of "smart"meters when our CPUC made that option available, so we have never had to live with a smartmeter, thankfully. The RF radiation such as smartmeters emit has been shown to |

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| | be harmful to humans through numerous studies, and the recently concluded National Toxicology Program's landmark $25 million dollar study demonstrated a clear connection between at least two types of cancer and wireless radiation in rats - they developed two of the same cancers that have increased in humans recently - the aggressive brain cancer glioblastoma multiforme and also schwannoma.<br><br>So please, consider the health of humans and animals, and stop the deployment of any type of smartmeter, "Smart" meters are not smart. They are costing all of us dearly in health deterioration.<br><br>Thank you,<br><br>Nancy Hubert,<br><br>Sebastopol, CA |

## B. SMART METER FORM LETTER

In addition to these individual emails, 8 emails were received that appeared to be copied from a single source. That email is listed below just once for space considerations within this document. It should be noted that the Subject Line of the email varied across multiple of the emails. Other emails appeared to be inspired by the source. Those are included below.

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| Date: | Fri 7/28/2017 3:43 PM |
| Subject: | I am not a fan of smart meeters for the following reasons: |
| Body of the Email | To Whom It May Concern:<br><br>1) Smart meters are a public health hazard, according to Dr. Samuel Milham (physician, epidemiologist), author of Dirty Electricity, as well as over 100 peer-reviewed scientific publications. The World Health Organization has declared EMFs, such as those emitted by smart meters, as a Class 2-B carcinogen (in the same category as DDT, lead and chloroform). What are you going to do to ensure the health and safety of those with smart meters?<br><br>2) Hundreds of fires, several explosions, and two deaths have been linked to smart meters. What are you going to do to ensure the health and safety of those with smart meters?<br><br>3) Swiss RE, the second largest insurance provider in the world, lists "unforeseen consequences of electromagnetic fields" as the highest risk category and EMF |

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| | devices are now excluded (i.e., not insured) across markets. Why do you want to take on this liability and what are you going to do to ensure the health and safety of those with smart meters?<br><br>4) Smart meters will not make for faster grid restoration. BRIDGE recently released their 2015 Outage & Restoration Management Survey Results Summary. Over 20,000 utility employees – executives, managers, and engineers – from 90 utilities across North America were surveyed. 81% of the surveyed utilities had installed "smart" meters, but only 16% use "smart" meters as their primary source of power failure alerts. Customer calls come first. Well before "smart" meters – utilities rely on SCADA systems for outage alerts. SCADA stands for Supervisory Control And Data Acquisition. It is technology employed by utilities for decades and does not involve metering but operates at the transformer and substation level. Why are you installing expensive smart meters when they are not going to improve outage response?<br><br>5) In an official report, one of New England's largest utilities, Northeast Utilities, criticized smart meters in detail, saying there was "no rational basis" for their implementation, and that smart meters did not reduce outages or "modernize" the electricity grid. Why are you installing expensive smart meters, that we will have to pay for when they are unnecessary for grid modernization?<br><br>6) Data collection by smart meters violates privacy and constitutes in-home surveillance. The Hawaii Civil Liberties Union has cautioned against the use of smart meters due to the potential violation of our Fourth Amendment Right to Privacy. What are you going to do to protect the privacy of those with smart meters?<br><br>7) Wireless smart meters make our electrical grid vulnerable to hacking by petty thieves and rogue nations. When even governments and global corporations are regularly hacked, what are you going to do to ensure the security of smart meter data and of our "modernized" power grid?<br><br>8) Smart meters have been shown to cost customers more by forcing people to reduce consumption and pay higher prices. What will you do to keep needy families from being penalized by these meters?<br><br>Signed,<br>Pat Makozak<br>Elizabeth Barris<br>Susan Douglas<br>FJ Forest<br>Peter<br>Mr. & Mrs. Bill Best<br>Keith Raney |

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| | Nai`a Newlight |

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| Date: | Fri 7/28/2017 6:49 AM |
| Subject: | Smart Meter= Class 2 carcinogen |
| Body of the Email | I would like to respectfully express my concern regarding your"Grid Modernization" plan. This is ill advised and I encourage you to protect my health and the well being of all our keiki and community.<br><br>The World Health Organization has declared EMFs, such as those emitted by smart meters, as a Class 2-B carcinogen! Your plan represents a public health hazard. What are you going to do to ensure the health and safety of those with smart meters?<br><br>Remember when cigarettes were considered safe? Nuclear reactors? As people wake up to this, you are going to be in hot water. Please take a leadership role in protecting our health.<br><br>Chris Cruikshank |

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| Date: | Sun 7/30/2017 11:10 AM |
| Subject: | Smart Meters are not safe |
| Body of the Email | All EMFs affect all living tissues. This is either EMFs from nature like lightening or from cell towers, microwaves, cell phones or smart meters. This is a scientific fact---check with any physicist. **EMFs have not been proven safe for human health!** In rat studies one litter was very small and the next was abnormally large. And corporations and even the government (now owned by corporations) have used paid scientists to get the results they want(average the two studies) to try and convince people that then there is "no effect." This is ludicrous and dangerous for us all. An island and its citizens should be allowed to protect itself.<br><br>*[Insert "Form Letter" here]*<br><br>Anne Allison |

## C. PUBLIC COMMENTS

The Companies were made aware of various other comments on press coverage of the draft grid modernization strategy. We were also made aware of the following public comment: https://www.linkedin.com/pulse/hawaiis-grid-modernization-matthew-tisdale

# D. COMMENTS RECEIVED IN DOCUMENT FORM

## 1. County Of Maui – Office Of Economic Development

**ALAN M. ARAKAWA**
Mayor

**TEENA M. RASMUSSEN**
Economic Development Director

**OFFICE OF ECONOMIC DEVELOPMENT**
COUNTY OF MAUI
2200 MAIN STREET, SUITE 305, WAILUKU, MAUI, HAWAII 96793, USA
Telephone: (808)270-7710 Facsimile: (808)270-7995 Email: economic.development@mauicounty.gov

August 9, 2017

Colton Ching, Senior Vice President
Hawaiian Electric Company
900 Richard Street
Honolulu, HI 96813

Dear Mr. Ching:

Thank you for the opportunity to review and comment on your Companies' plan titled *Modernizing Hawai'i's Grid for Our Customers* dated June 30, 2017. The County of Maui offers these comments to help enhance our understanding of the plan when it is finalized. First and as an overarching comment, we find the plan well thought out and that it attempts to address the foundation of what is needed to advance the State's goals while maintaining a safe and reliable grid, modernization.

The grid is in need of both traditional upgrades and modernization. The former is discussed in several locations throughout the report and first noted on page ES-1. Noted in Section 4.1.1 on Page 23, the traditional upgrades are noted to be a part of category A and are prerequisites to investments in categories B and C. It is unclear if the Companies are dismissing the value DER may bring for reliability. At the end of Section 4.1.2 the report does discuss non-wires alternatives which seems to contradict the prerequisite concept noted above but then further suggests a select group of *non-market participants* should be convened to evaluate options. From this it is unclear how the Companies would be *non-market participants* unless excluded from participating in non-wires alternatives. Can the Companies expand on how this system would work and how this differs from California as it is suggested that it is done this way for RPS procurements but in this case it is suggested that it would be done for reliability and transmission purposes which in California is is largely managed by the California Independent System Operator with the Transmission Owners executing the need (except where FERC Order 1000 is transforming the market there).

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Mayor

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Economic Development Director

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It is unclear how the report is considering "Merchant DER" as noted on Page 13. Traditionally, merchant power plants are those that sell power into competitive wholesale markets and are financed by investors. This is in contrast with either rate-base financed plants (which are paid off through utility bills over a long time horizon) or PPA-financed plants (which have a contract with an offtaker who agrees to pay a certain price for power over a period of time). Is the report suggesting a future wholesale market system in Hawai'i? Further, on Page 13, the management of the system is noted that it "will be the most cost-effective for customers and aggregators." Can the Companies elaborate on the Loading Order in the final version of the report and how the direct control of DER devices as a backstop to the market satisfying necessary reliability and security requirements can work if no "market" exists. The report suggests that the Companies are advocating for a market-based system and perhaps an Independent System Operator.

Further to this point, Table 2 on Page 20 defines the Current Status of the company with respect to Modern Grid Functional Evolution. In Section 3, Market it is suggested that Sourcing Energy, Ancillary, and Grid services, Operational Bulk Power & Distribution Grid Services Animation, Operation and Settlement for DER Services, and Program Facilitation Services are a function that the Companies are either at "Walk" or "Not yet Walk" which further suggests that the Companies view their position gearing up to perform the roll of an Independent System Operator.

On Page 10 the report proceeds to define "The Grid We Need" but does not elaborate on resiliency. Low-frequency, high-impact events such as hurricanes affect our island communities and any investment in the grid should address how resiliency is improved or maintained. As the grid evolves from being largely backed by fossil fuels to one that is backed by renewable energy, the management of resiliency needs to be taken into consideration. Can the Companies include in the final version a narrative on this topic and can it be included more deeply in the process going forward?

Smart Meters were noted as an "opt-in" concept at the workshop on Maui but also that if older meters were no longer available, Smart Meters would be deployed in without the communications function if the customer desires. Can

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Telephone: (808)270-7710 Facsimile: (808)270-7995 Email: economic.development@mauicounty.gov

the Companies clarify if there is a lost opportunity cost by not rolling out Smart Meters across the grid?

Throughout the report there seems to be a line drawn between "Legacy" systems and what would be done going forward. Can the final report elaborate further on how the impacts due to the legacy systems and the cost associated with those systems will be quantified and managed and the cost-responsibility allocated? The plan largely relies on the idea that new systems will have advanced technology, be subject to curtailment, and get Marginal Neutral Rates but leaves the "Legacy" systems untouched, disadvantaging new market participants.

In Section 7.3.1 the report elaborates on SCADA technology deployment and it being "a good first step toward improved situational awareness…" Can the Companies elaborate if the further deployment of SCADA technology is the best approach to situational awareness and if newer technologies are already available to allow the grid to identify and respond to grid issues better as the grid evolves. Also, can the final report elaborate on any examples where SCADA failed to identify and respond to grid issues?

Lastly, it is increasingly clear that as every customer becomes a prosumer and the grid evolves that it will take clear management of interconnection and reliability standards. This modernization process makes it increasingly evident that the Hawaii Electricity Reliability Administrator, perhaps the foundation for a Hawaii-specific Independent System Operator is needed to independently oversee the grid evolution in an impartial way.

Should you have any questions, please feel free to contact me at frederick.redell@mauicounty.gov.

Sincerely,

Frederick H. Redell, PE
Energy Commissioner
County of Maui

## 2. Renewable Energy Action Coalition Of Hawaii

REACH
RENEWABLE ENERGY ACTION COALITION OF HAWAII

4188-4 Keanu Street
Honolulu, Hawaii 96816
Tel: (808) 371-1475
www.REACHawaii.org

**RENEWABLE ENERGY ACTION COALITION OF HAWAII, INC.'S COMMENTS ON HAWAIIAN ELECTRIC COMPANIES' DRAFT GRID MODERNIZATION STRATEGY REPORT**

RENEWABLE ENERGY ACTION COALITION OF HAWAII, INC. ("REACH"), hereby submits its Comments on the Hawaiian Electric Companies' Draft Grid Modernization Strategy Report, titled *Modernizing Hawaii's Grid for Our Customers, June 30, 2017* (the "*Draft GMS*").

**EVALUATING BENEFITS OF RENEWABLE ENERGY OPTIONS**

In the Distributed Energy Resources docket (the "DER Docket"), the Public Utilities Commission (the "Commission") asked the parties to answer this question[1]:

Issue No. 3:

How can the utilities' DER integration analyses be improved to more accurately characterize grid capacity for various forms of DER and other renewable resources?

[1] Order No. 34206, filed by the Commission on December 9, 2016, in Docket No. 2014-0192 (the "DER Docket") at 7.

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To answer this question, REACH researched publicly available information about the Hawaiian Electric Companies' integration analyses of renewable energy options[2] (including DER options and non-DER options[3]). REACH summarized its research in a report -- *REACH Overview of Hawaiian Electric Integration Analyses* (the "*REACH Overview*") – that assesses where the people at the Hawaiian Electric Companies seem to stand in their evaluation of system performance benefits[4] and economic benefits[5] of renewable energy options. A copy of the *REACH Overview* is attached as "Exhibit A" hereto.

The *REACH Overview* shows that there are a whole lot of pukas (where the *REACH Overview* says "not yet") in the utilities'[6] evaluations of the system performance benefits and economic benefits of renewable energy options, including DER options:

- The utilities are evaluating *some* of the system performance benefits of *some* options in *some* amounts within *some* categories of options for *some* of the utility grids.

[2] A *renewable energy option* means an energy option that helps achieve 100% renewable energy by increasing the numerator for measuring renewable energy as a percentage of total energy consumption, and/or decreasing the denominator for measuring renewable energy as a percentage of total energy consumption.
[3] *REACH Overview*, Exhibit A at 2.
[4] System performance is measured by maintaining physical properties of electric power (such as frequency at the system-level, and voltage at the distribution-level) within a "reliable" range over time. *System performance benefits* of a renewable energy option are measured by the avoided occurrence of events (for example, "T2 events" or circuit hosting capacity violations) when those physical properties are not maintained within such a range.
[5] *Economic benefits* of a renewable energy option means economic benefits (measured by avoided costs of energy from non-renewable generation and other avoided costs[5]) attributable to implementation of the option, relative to economic cost of the option. Economic benefits of a renewable energy option are measured in dollars ($), or in $/kWh when economic benefits in dollars are divided by kWh delivered (in the case of renewable generation or energy storage options) or by kWh saved (in the case of demand-side management options).
[6] "Utility" or "utilities," as used in these Comments, means the Hawaiian Electric Companies ("Hawaiian Electric").

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- The utilities are not yet evaluating the economic benefits of *most* options within *most* categories of options for *most* of the utility grids.
- The utilities do not yet seem to be evaluating four other categories of benefits (environmental compliance benefits, risk minimization benefits, environmental preservation benefits and energy security benefits) of renewable energy options.

Without evaluations of most of the benefits of most renewable energy options, the people at the utilities cannot be expected to make consensus decisions to implement renewable energy options, including DER options.

Without evaluations of most of the benefits of most renewable energy options, the people at the utilities cannot be expected to make consensus decisions about what tariffs and what interconnection standards they want to procure what renewable energy options in what amounts in what order.

Without evaluations of most of the benefits of most renewable energy options, the people at the utilities cannot be expected to make consensus decisions about what renewable energy options in what amounts in what order they want to deliver optimal benefits for the utility's customers.

The utilities' integration analyses can be improved to help the people at the utilities to more accurately characterize grid capacity for various forms of DER and other renewable resources -- and to more accurately determine what renewable energy options (including what DER options) in what amounts in what order deliver optimal benefits for

the utility's customers – by the people at the utilities coming into consensus on a *planning process*[7] through which they:

(1) *evaluate* the benefits of renewable energy options available to the utility,[8]

(2) *compare* the benefits of those renewable energy options,[9] and

(3) *convince themselves* (and are in consensus) what renewable energy options in what amounts in what order they *want* to deliver *optimal* benefits for the utility's customers.[10]

When the people at the utilities come into consensus on such a planning process, they can be counted on to make consensus decisions on *plans* that articulate what renewable energy options (including what DER options) in what amounts in what order they *want* to deliver optimal benefits for the utility's customers.

When the people at the utilities come into consensus on such a planning process, they can be counted on to make consensus decisions about what tariffs and what

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[7] *See* Renewable Energy Action Coalition of Hawaii, Inc.'s Statement of Position on the Revised PSIPs, filed February 14, 2017, in Docket No. 2014-0183 (*REACH SOP on Revised PSIPs*) at 18–35, accessible at https://oh278.infusionsoft.com/app/linkClick/8901/7185ddf3c2fed776/27539/5fac85946524cc08 (showing what consensus on a decision to implement an energy option might look like; showing what consensus on a planning process oriented to a goal of 100% renewable energy might look like; showing what consensus on a plan to achieve 100% renewable energy and deliver optimal benefits for the utility's customers might look like; showing what consensus on a procurement process oriented to such a plan might look like; and showing what consensus on implementation of such a procurement process might look like, what consensus on achievement of 100% renewable energy might look like and what consensus on delivery of optimal benefits for the utility's customers might look like).

[8] In the Commission's decision & order accepting the utilities' Power Supply Improvement Plans (PSIPs) and closing the PSIPs docket (Decision and Order No. 34696 filed on July 14, 2017 in Docket No. 2014-0183, the "*Final PSIP Order*") at 32, the Commission expected the utilities "to rigorously examine the prudence, timing, cost-effectiveness, affordability, and reasonably available alternatives," that is, to rigorously evaluate the benefits of reasonably available alternative renewable energy options.

[9] In the *Final PSIP Order* at 47, the Commission directed the utilities to make "a fair and transparent evaluation of alternatives," that is, a fair and transparent evaluation of the benefits of alternative renewable energy options, in a way that the benefits of alternative renewable energy options could be fairly compared.

[10] In the *Final PSIP Order* at 47, the Commission directed the utilities to "sufficiently justify how each resource is the best choice," that is, how each renewable energy option identified in the near-term action plans is the best choice because it delivers optimal benefits for the utility's customers.

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interconnection standards they want to procure renewable energy options (including DER options) that deliver optimal benefits for the utility's customers.

When the people at the utilities come into consensus on a such a planning process, they can be counted on to make consensus decisions to implement renewable energy options (including DER options) that deliver optimal benefits for the utility's customers.

When the people at the utilities come into consensus on such a planning process, they can be counted on to "produce actual, concrete plans and begin immediate implementation of those plans" "to upgrade the utilities' distribution systems to enable new clean energy technologies and improve customer service."[11]

**NET BENEFITS ASSESSMENT PROCESS**

In the *Draft GMS*, Appendix C at 32-47, the utility's consultant, Energy and Environmental Economics (E3). proposed a "Net Benefits Assessment" process for using the E3 RESOLVE production cost model to evaluate the economic benefits[12] of utility-

[11] *See* the Commission's order granting the utilities' request for an extension of time to file a Grid Modernization Strategy (Order No. 34436 filed on March 9, 2017, in Docket No. 2016-0087) at 14.
[12] *See* note 5, *supra*.

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provided equipment-based distribution-level mitigation options[13] such as utility-provided reclosers[14] and utility-provided distribution-level energy storage systems (DESS).[15]

The Net Benefits Assessment process for evaluating the economic benefit of a utility-provided equipment-based distribution-level mitigation option can be summarized as follows:

1) *identify* a plausible utility-provided equipment-based distribution-level mitigation option having a specified economic cost
2) *input* assumptions about:
    a. the economic value of "grid services" (system performance benefits) provided by the mitigation option,
    b. the economic value of avoided costs attributable to the mitigation option, and

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[13] In Attachment H to the utility's *Distributed Generation Interconnection Plan* ("*DGIP*") filed on August 26, 2014, in Docket No. 2011-0206, the people at the utilities identified 15 categories of utility-provided equipment-based distribution-level mitigation options:

(1) Energy Storage: Located on Feeder (DESS)
(2) Grounding Bank
(3) Circuit Direct Transfer Trip
(4) Protection Upgrades
(5) Substation Short Switch
(6) Voltage Control: Level Voltage and Adjust LTC
(7) Voltage Control: LTC Controller Replacement
(8) Voltage Control: Regulating Transformers
(9) Equipment Upgrades: Increase Primary Cable Sizing
(10) Equipment Upgrades: Increase Secondary Cable Sizing
(11) Equipment Upgrades: Voltage Conversion
(12) Equipment Upgrades: Upsizing Distribution Substation Transformer
(13) Equipment Upgrades: Adding Distribution Substation Transformer & Splitting Load
(14) Equipment Upgrades: Adding Distribution Customer Transformer & Splitting Load
(15) Capacitor Relocations.

In the *Draft GMS*, at 60, the people at the utilities seemed to identify 3 more categories of utility-provided equipment-based distribution-level mitigation options:

(1) faulted current indicators
(2) remote intelligent switches (reclosers)
(3) secondary VAR controllers (SVCs).

[14] *Draft GMS*, Appendix C at 43-44.

[15] *Draft GMS*, Appendix C at 44-47.

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c. the economic cost of the mitigation option,

into a selected "base case" of the E3 RESOLVE model,

3) use the E3 RESOLVE model to *calculate* the Total Resource Cost of the selected "base case"

a. with the mitigation option, and

b. without the mitigation option

4) *calculate* the difference (in dollars) between the Total Resource Cost of the selected base case with the mitigation option, and the Total Resource Cost of the selected base case without the mitigation option; that difference is a *net economic benefit* to the extent that the Total Resource Cost with the mitigation option is *less than* the Total Resource Cost without the mitigation option.[16]

**IMPROVING THE NET BENEFITS ASSESSMENT PROCESS**

The Net Benefits Assessment process might be improved in three ways that might help people at the utilities make consensus decisions to implement renewable energy options that deliver optimal benefits for the utility's customers:

1. **Proposed Improvement One:** Expand the Net Benefits Assessment process to evaluate renewable energy options from *all* categories of renewable energy options, including combinations of renewable energy options.
2. **Proposed Improvement Two:** Use a process *analogous* to the Net Benefits Assessment process to evaluate the *system performance benefits* of renewable energy options.

[16] That difference is a *net economic detriment* to the extent that the Total Resource Cost with the mitigation option is *more than* the Total Resource Cost without the mitigation option.

3. **Proposed Improvement Three**: Simplify the base case of the E3 RESOLVE model by assuming that a renewable energy option is implemented with the grid as it exists now.

* * * *

**Proposed Improvement One: Expand the Net Benefits Assessment process to evaluate renewable energy options from *all* categories of renewable energy options[17], including *combinations* of renewable energy options.**

> Expanding the Net Benefits Assessment process to evaluate economic benefits of renewable energy options from all categories of renewable energy options helps the people at the utilities make consensus decisions to implement renewable energy options that deliver optimal benefits for the utility's customers.

Using the Net Benefits Assessment process to evaluate economic benefits of renewable energy options in the category of utility-provided equipment-based distribution-level mitigation options helps the people at the utilities to *compare* economic benefits of such mitigation options, and to *convince themselves* (and come into consensus) what mitigation options *within that category* they *might want* to deliver optimal benefits (including economic benefits) for the utility's customers.

Expanding the Net Benefits Assessment process to evaluate economic benefits of renewable energy options from *all* categories of renewable energy options helps people at the utilities to *compare* economic benefits of renewable energy options from *all* such categories, and to *convince themselves* (and come into consensus) what renewable energy options *from all such categories* in what amounts in what order they *actually want* to deliver optimal benefits (including economic benefits) for the utility's customers.

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[17] All categories of renewable energy options include all categories of distribution-level renewable generation options, all categories of distribution-level mitigation options, all categories of system-level renewable generation options and all categories of system-level mitigation options. *See REACH Overview*, Exhibit A at 2.

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When the people at the utilities come into consensus on such an expansion of the Net Benefits Assessment process, they can be counted on to make consensus decisions to implement renewable energy options that deliver optimal benefits (including economic benefits) for the utility's customers.

<u>Expanding the Net Benefits Assessment process to evaluate economic benefits of renewable energy options from all categories of renewable energy options complies with the Commission's expectations and directions expressed in the *Final PSIP Order*</u>

The Commission expects the utilities "to rigorously examine the prudence, timing, cost-effectiveness, affordability, and reasonably available alternatives,"[18] that is, to rigorously evaluate the benefits (including economic benefits) of reasonably available alternative *renewable energy options*. Expanding the Net Benefits Assessment process to evaluate the economic benefits of reasonably available alternative renewable energy options from all categories of renewable energy options complies with the Commission's expectation that the utilities "rigorously examine the … cost-effectiveness … [of] reasonably available alternatives."

The Commission directs the utilities to make "a fair and transparent evaluation of alternatives,"[19] that is, a fair and transparent evaluation of the *benefits* of alternative *renewable energy options*, in a way that the benefits (including economic benefits) of alternative renewable energy options might be fairly and transparently *compared*. Expanding the Net Benefits Assessment process to evaluate the economic benefits of alternative renewable energy options in a way that such benefits can be fairly and

[18] *Final PSIP Order* at 32.
[19] *Final PSIP Order* at 47.

transparently compared complies with the Commission's direction that the utilities make "a fair and transparent evaluation of alternatives."

The Commission directs the utilities to "sufficiently justify how each resource is the best choice,"[20] that is, to sufficiently justify how each *renewable energy option* is the best choice because the people at the utilities *convince themselves* that it delivers *optimal benefits* for the utility's customers. Expanding the Net Benefits Assessment process to evaluate economic benefits of renewable energy options from *all* categories of such options -- in a way that the people at the utilities *convince themselves* (and come into consensus) that a renewable energy option delivers optimal benefits for the utility's customers -- complies with the Commission's direction that the utilities "sufficiently justify how each resource is the best choice."

> Expanding the Net Benefits Assessment process to evaluate economic benefits of *combinations* of renewable energy options helps the people at the utilities make consensus decisions to implement renewable energy options that deliver optimal benefits for the utility's customers.

[20] *Final PSIP Order* at 47.

Of 6 categories of benefits of renewable energy options,[21] the most important category is *system performance benefits*[22] because a renewable energy option that lacks system performance benefits -- because it impairs the performance of the grid -- is not going to get implemented, no matter what its other benefits might be.

A renewable energy option delivers *system performance benefits*[23] to the extent that implementation of the option either maintains or improves the performance of the grid. A renewable energy option that does not maintain or improve the performance of the grid delivers no system performance benefits. A renewable energy option that

[21]

| Categories of Benefits | Measures for Evaluation |
|---|---|
| System performance benefits | Quantitatively measurable in frequency, voltage, T2 events, etc. |
| Economic benefits of: | Quantitatively measurable in dollars ($) per unit of energy (GJ, MWh, etc.) |
| Renewable energy options | Economic benefits (measured by avoided cost of energy from non-renewable generation and other avoided costs) relative to economic costs |
| Non-renewable generation options | Economic benefits measured by lowest economic costs |
| Environmental compliance benefits | Quantitatively measurable in gaseous and particulate emissions |
| Risk minimization benefits | Qualitatively measurable |
| Energy security benefits | Quantitatively measurable in contribution to achieving 100% renewable energy |
| Environmental preservation benefits | Quantitatively measurable in contribution to achieving 100% renewable energy |

[22] System performance benefits are sometimes referred to as "grid services," "ancillary services," "system reliability," or "system security."

[23] System *performance* is measured by maintaining physical properties of electric power (such as frequency at the system-level, and voltage at the distribution-level) within a "reliable" range over time. System performance *benefits* of a renewable energy option are measured by the avoided occurrence of events (for example, "T2 events" or circuit hosting capacity violations) when those physical properties are not maintained within such a range.

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delivers no system performance benefits is not going to get implemented with the grid, no matter what its other benefits might be.

For purposes of evaluating system performance benefits of renewable energy options, such options generally fall into 1 of 2 categories: *renewable generation options*[24] and *mitigation options*.[25] Renewable generation options often deliver no system performance benefits because renewable generation often is variable and non-dispatchable.

A renewable generation option that delivers no system performance benefits is not going to get implemented with the grid, unless the renewable generation option is *combined* with one or more mitigation options. A combination of renewable generation option and mitigation option(s) delivers system performance benefits to the extent that the combination of options either maintains or improves the performance of the grid. For example, 3 MW of grid-export DG-PV generation on Molokai is not going to get implemented[26] unless it is combined with a mitigation option (say, 3 MWh of distribution-level customer-provided energy storage systems), so that the *combination* of renewable generation option and mitigation option delivers system performance benefits because it maintains or improves the performance of the grid.

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[24] Renewable generation options include distribution-level renewable generation options (for example, DG-PV) and system-level renewable generation options (for example, utility-scale PV solar generation). *See REACH Overview*, Exhibit A at 2.

[25] Distribution-level mitigation options include customer-provided inverter-based options, customer-provided energy storage options, utility-provided equipment-based options and demand-side management (DSM) options. System-level mitigation options include renewable generation curtailment options, dynamic load shedding options, interisland transmission options, utility-provided energy storage options, utility-provided energy efficiency options. *See REACH Overview*, Exhibit A at 2.

[26] According to the utilities' *Updated System-Level Hosting Capacity Analysis* filed March 22, 2017 in Docket No. 2014-0192, adding new grid-export DG-PV on Molokai would deliver no system performance benefits for the utility's customers because installed DG-PV on the Molokai grid has already surpassed its system hosting capacity.

Expanding the Net Benefits Assessment process[27] to *evaluate* economic benefits of combinations of renewable energy options (including combinations of renewable generation options and mitigation options that deliver system performance benefits) helps the people at the utilities to *compare* the economic benefits of such combinations, and to *convince themselves* (and come into consensus) what renewable energy options (including what combinations of renewable energy options) in what amounts in what order they *want* to deliver optimal benefits (including system performance benefits and economic benefits) for the utility's customers.

When the people at the utilities come into consensus on expanding the Net Benefits Assessment process to evaluate economic benefits of *combinations* of renewable energy options, they can be counted on to make consensus decisions to implement renewable energy options (including *combinations* of renewable energy options) that deliver optimal benefits (including system performance benefits and economic benefits) for the utility's customers.

Expanding the Net Benefits Assessment process to evaluate economic benefits of *combinations* of renewable energy options complies with the Commission's directions expressed in the *Final PSIP Order*

The Commission directs the utilities to "consider all appropriate technologies, including combinations of technologies, to address system, capacity, and energy needs,"[28] that is, to consider and evaluate the benefits (including economic benefits) of *combinations* of all appropriate renewable energy technology options. Expanding the Net

[27] Economic benefits of a renewable energy option may be evaluated with an improved Net Benefits Assessment process (see *infra*) using a production cost model such as the E3 RESOLVE models or the General Electric Multi-Area Production Simulation (MAPS) models for each of the island grids.
[28] *PSIP Final Order* at 47.

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Benefits Assessment process to evaluate economic benefits of *combinations* of renewable energy options complies with the Commission's directions "to consider all appropriate technologies, including combinations of technologies, to address system, capacity, and energy needs."

**<u>Proposed Improvement Two</u>: Use a process *analogous* to the Net Benefits Assessment process to evaluate the system performance benefits of renewable energy option(s).**

The Net Benefits Assessment process -- as described in the *Draft GMS*, Appendix C at 42–43 -- evaluates the system performance benefits[29] of a renewable energy option by calculating and attaching an *economic* value to the "grid services" (system performance benefits) delivered by the renewable energy option.

Instead of using the Net Benefits Assessment process to evaluate the system performance benefits of a renewable energy option, a process *analogous* to the Net Benefits Assessment process might be used to evaluate such system performance benefits:

(1) *identify* a renewable energy option (including a combination of renewable energy options), having specified physical characteristics (e.g., capacity (MW), frequency response, regulating reserve, etc.)

(2) *input* assumptions about the physical characteristics of the renewable energy option into a "base case" of a system performance model[30]

[29] System *performance* is measured by maintaining physical properties of electric power (such as frequency at the system-level, and voltage at the distribution-level) within a "reliable" range over time. System performance *benefits* of a renewable energy option are measured by the avoided occurrence of events (for example, "T2 events" or circuit hosting capacity violations) when those physical properties are not maintained within such a range.

[30] System performance benefits of a renewable energy option can be evaluated with system-level performance models such as the Siemens PTI PSS/E Power Flow and Transient Stability models or the General Electric Positive Sequence Load Flow (PSLF) models developed for the island grids, and can be

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(3) use the system performance model to *calculate* whether or not implementation of the renewable energy option maintains or improves the performance of the grid, and

(4) a renewable energy option that maintains or improves the performance of the grid *might* be implemented, depending on evaluation of the other categories of benefits (including economic benefits) of the renewable energy option; a renewable energy option that does not maintain or improve the performance of the grid does not get implemented, no matter what its other benefits might be.

Using a process analogous to the Net Benefits Assessment process[31] to *evaluate* system performance benefits of renewable energy options (including combinations of renewable energy options) helps the people at the utilities to *compare* the system performance benefits of such renewable energy options, and to *convince themselves* (and come into consensus) what renewable energy options (including what combinations of renewable energy options) in what amounts in what order they *want* to deliver optimal benefits (including system performance benefits and economic benefits) for the utility's customers.

When the people at the utilities come into consensus on using a process analogous to the Net Benefits Assessment process to evaluate system performance benefits of renewable energy options, they can be counted on to make consensus decisions to implement renewable energy options (including *combinations* of renewable energy

evaluated with distribution-level performance models such as the Synergi Section Incremental Hosting Capacity tool.

[31] Economic benefits of a renewable energy option may be evaluated with an improved Net Benefits Assessment process (see *infra*) using a production cost model such as the E3 RESOLVE models or the General Electric Multi-Area Production Simulation (MAPS) models for each of the island grids.

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options) that deliver optimal benefits (including system performance benefits and economic benefits) for the utility's customers.

The system performance benefits of a renewable energy option are immeasurable in dollars ($) (or in $/kWh) with any degree of certainty. Such system performance benefits are immeasurable in dollars because the system performance benefit is in *not* exposing the utility's customers to the essentially *immeasurable* costs of interrupted and/or unreliable electric power service.[32]

Using the Net Benefits Assessment process to attach a dollar value to system performance benefits that are immeasurable in dollars mixes an economic benefit of uncertain and immeasurable value with other economic benefits[33] that have more certain and measurable values in dollars. To the extent that the people at the utilities do not use the Net Benefits Assessment process to attach a dollar value to system performance benefits that are immeasurable in dollars, the people at the utilities can be expected to feel more certain and have more confidence in their evaluation of economic benefits having more certain and measurable values.

The more confidence that the people at the utilities have in their evaluations of the economic benefits of the renewable energy options available to them, the more they can be counted on to make consensus decisions to implement renewable energy options that

[32] System performance benefits of a renewable energy option may be evaluated by modeling (or measuring) the avoided occurrence of events (T2 events, circuit hosting capacity violations, etc.) – attributable to the renewable energy option – that otherwise would expose the utility's customers to such immeasurable costs. Evaluating system performance benefits of a renewable energy option in this way – separate from evaluating the economic benefits of the renewable energy option -- makes it unnecessary to attempt to evaluate the economic benefits of the system performance benefits of the renewable energy option.

[33] For example, economic benefits measured by avoided costs of energy from non-renewable generation, avoided costs of transmission and/or distribution losses, etc.

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deliver optimal benefits (including system performance and economic benefits) for the utility's customers.

**Proposed Improvement Three: Simplify the base case of the E3 RESOLVE model by assuming that a renewable energy being evaluated is implemented with the grid as it exists now.**

The people at the utilities use a selected "base case" of the E3 RESOLVE model to evaluate the economic benefits of a renewable energy option.[34] The selected "base case" seems to include assumptions that the renewable energy options contained in the Hawaiian Electric Companies' Revised and Supplemented Power Supply Improvement Plans filed on December 23, 2016 (the "December 2016 PSIPs") will be implemented in the amounts and order set forth in the December 2016 PSIPs.[35]

Assuming that the renewable energy options contained in the PSIPs will be implemented means that the evaluation of economic benefits of a renewable energy option – using the Net Benefits Assessment process -- depends on future contingencies (economic benefits and economic costs of renewable energy options contained in the December 2016 PSIPs) that are themselves dependent on other future contingencies (future decisions whether or not to implement the renewable energy options contained in the December 2016 PSIPs).

Evaluating economic benefits of a renewable energy option in a way that depends on future contingencies that are themselves dependent on other future contingencies

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[34] *Draft GMS*, Appendix C at 42-43.
[35] The December 2016 PSIPs, at ES-2, anticipate implementation of 326 MW of new DER (rooftop solar), 89 MWh of customer self-supply (CSS) energy storage, 115 MW of DR (including 105 MWh of DR energy storage), 360 MW of grid-scale solar, 31 MW of FIT solar and 157 MW of grid-scale wind during the next 5 years.

means that people at the utilities can be expected to feel uncertain and lack confidence in their evaluations of such economic benefits.

To the extent that the people at the utilities feel uncertain and lack confidence in their evaluation of the economic benefits of a renewable energy option, they cannot be expected to make consensus decisions about what renewable energy options in what amounts in what order they want to deliver optimal benefits for the utility's customers.

To the extent that the people at the utilities feel uncertain and lack confidence in their evaluation of the economic benefits of a renewable energy option, they cannot be expected to make consensus decisions to implement renewable energy options that deliver optimal benefits for the utility's customers.

The Net Benefits Assessment process might be improved by simplifying the base case of the E3 RESOLVE model by assuming that a renewable energy being evaluated is implemented with the grid as it exists now.[36]

When the people at the utilities come into consensus on such a simplification of the base case, they can be counted on to make consensus decisions on *plans* that articulate what renewable energy options in what amounts in what order they *want* to deliver optimal benefits (including economic benefits) for the utility's customers.

When the people at the utilities come into consensus on such a simplification of the base case, they can be counted on to make consensus decisions about what tariffs and

[36] The grid as it exists now might mean presently-existing generation, transmission & distribution, energy storage and demand-side management components of the grid, together with specifically-identified renewable energy options already in the utilities' procurement process, and excluding renewable energy options contained in the December 2016 PSIPs. *See Hawaii Renewable Energy Report for July 2017* at https://oh278.infusionsoft.com/app/linkClick/9275/521aba37d54bdb65/42437/bbab49c6a0782b4e (summarizing specifically-identified renewable energy options presently in the utilities' procurement process).

what interconnection standards they want to procure renewable energy options that deliver optimal benefits (including economic benefits) for the utility's customers.

When the people at the utilities come into consensus on a such a simplification of the base case, they can be counted on to make consensus decisions to implement renewable energy options that deliver optimal benefits (including economic benefits) for the utility's customers.

When the people at the utilities come into consensus on such a simplification of the base case, they can be counted on to "produce actual, concrete plans and begin immediate implementation of those plans" "to upgrade the utilities' distribution systems to enable new clean energy technologies and improve customer service."

**CONCLUSION**

Here is what an improved Net Benefits Assessment process for evaluating economic benefits of a renewable energy option might look like:

1) *simplify* the base case of the E3 RESOLVE model by assuming that a renewable energy option being evaluated is implemented with the grid as it exists now
2) *identify* a renewable energy option (including a combination of renewable energy options) having a specified economic cost
3) *input* assumptions about:
    a. the economic value of avoided costs attributable to the renewable energy option, and
    b. the economic cost of the renewable energy option,

    into the simplified "base case" of the E3 RESOLVE model,

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4) use the E3 RESOLVE model to *calculate* the Total Resource Cost of the simplified "base case"

   a. with the renewable energy option(s), and

   b. without the renewable energy option(s)

5) *calculate* the difference (in dollars) between the Total Resource Cost of the simplified base case with the renewable energy option(s), and the Total Resource Cost of the simplified base case without the renewable energy option(s); that difference is a *net economic benefit* to the extent that the Total Resource Cost with the renewable energy option(s) is *less than* the Total Resource Cost without the renewable energy option(s).[37]

* * * *

When the people at the utilities come into consensus on improving the Net Benefits Assessment process by:

(1) expanding the Net Benefits Assessment process to evaluate *economic benefits* of renewable energy options from *all* categories of renewable energy options, including combinations of renewable energy options

(2) using a process *analogous* to the Net Benefits Assessment process to evaluate the *system performance benefits* of renewable energy options, and

(3) simplifying the base case of the E3 RESOLVE model by assuming that a renewable energy option being evaluated is implemented with the grid as it exists now,

the people at the utilities can be counted on to:

[37] That difference is a *net economic detriment* to the extent that the Total Resource Cost with the mitigation option is *more than* the Total Resource Cost without the mitigation option.

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(1) *evaluate* the system performance benefits and economic benefits of renewable energy options (including combinations of such options) available to the utilities,

(2) *compare* the system performance benefits and economic benefits of those renewable energy options, and

(3) *convince themselves* (and are in consensus) what renewable energy options in what amounts in what order they *want* to deliver *optimal* benefits (including system performance benefits and economic benefits) for the utility's customers.

When the people at the utilities come into consensus on a *planning process*, which incorporates an improved Net Benefits Assessment process, through which they:

(1) *evaluate* the benefits (including system performance benefits and economic benefits) of renewable energy options available to the utilities,

(2) *compare* the benefits (including system performance benefits and economic benefits) of those renewable energy options, and

(3) *convince themselves* (and are in consensus) what renewable energy options in what amounts in what order they *want* to deliver *optimal* benefits (including system performance benefits and economic benefits) for the utility's customers,

they can be counted on to make consensus decisions to implement renewable energy options that deliver optimal benefits for the utility's customers.

When the people at the utilities come into consensus on such a planning process, they can be counted on to "produce actual, concrete plans and begin immediate

implementation of those plans" "to upgrade the utilities' distribution systems to enable new clean energy technologies and improve customer service."[38]

DATED: Honolulu, Hawaii, August 8, 2017

Erik Kvam, President
Renewable Energy Action
Coalition of Hawaii, Inc.

[38] *See* note ᐧᐧ, *supra*

REACH
RENEWABLE ENERGY ACTION COALITION OF HAWAII

4188-4 Keanu Street
Honolulu, Hawaii 96816
Tel: (808) 371-1475
www.REACHawaii.org

## REACH MEMORANDUM NO. 18:
## OVERVIEW OF HAWAIIAN ELECTRIC INTEGRATION ANALYSES[1]

The purpose of this report is to fill you in on where the people at the Hawaiian Electric Companies stand in their evaluation of renewable energy[2] options available to the utilities.[3]

### ENERGY OPTIONS AVAILABLE TO THE UTILITIES

Before filling you in on where the people at the utilities stand, it might be helpful to understand where renewable energy options -- including distributed energy resource (DER) options -- fit in the structure of energy options available to the utilities:

Energy options available to the utilities include energy options in the following categories:

- Generation options
- Transmission & distribution (T&D) options, including mitigation options for variable renewable generation
- Energy storage options
- Demand-side management options

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[2] "Renewable energy," as used in this report, means electric power generated from renewable sources and delivered through an electric system to serve stationary loads.
[3] "Utilities," as used in this report, means the Hawaiian Electric Companies.

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**Exhibit A**

For purposes of utility resource planning,[4] energy options available to the utilities generally fall into 1 of 2 categories – *renewable energy options*[5] and *non-renewable generation options*:[6]

**Energy Options**
- Generation options
- T&D (including mitigation) options
- Energy storage options
- Demand-side management options

**Renewable Energy Options**
- Renewable generation options
- T&D (including mitigation) options
- Energy storage options
- Demand-side management options

**Non-Renewable Generation Options**
- Petroleum generation options
- Coal generation options
- LNG generation options
- Nuclear generation options

For purposes of promulgating interconnection standards and tariffs applicable to DER options, renewable energy options available to the utilities generally fall into 1 of 2 categories – *DER options* and *Non-DER options*:

**Renewable Energy Options**
- Renewable generation options
- T&D (mitigation) options
- Energy storage options
- Demand-side management options

**DER Options**
- Distribution-level renewable generation options
- Distribution-level mitigation options:
  - Customer-provided inverter-based options
  - Customer-provided energy storage options
  - Utility-provided equipment-based options
  - Demand-side management options
    - Utility-provided demand response options
    - Utility-provided price response options
    - Customer-provided energy efficiency options

**Non-DER Options**
- System-level renewable generation options
- System-level mitigation options:
  - Renewable generation curtailment options
  - Dynamic load shedding options
  - Interisland cable options
  - Utility-provided energy storage options
  - Utility-provided energy efficiency options

[4] Utility resource planning is a decision-making process through which people at a utility decide what energy options (including what renewable energy options) in what amounts in what order they want to deliver optimal benefits for the utility's customers.

[5] A *renewable energy option* means an energy option that helps achieve 100% renewable energy by increasing the numerator for measuring renewable energy as a percentage of total energy consumption, and/or decreasing the denominator for measuring renewable energy as a percentage of total energy consumption.

[6] A *non-renewable generation option* means an energy option that does not help achieve 100% renewable energy because implementation of such an energy option does not increase the numerator for measuring renewable energy as a percentage of total energy consumption and does not decrease the denominator for measuring renewable energy as a percentage of total energy consumption.

2

Each energy option may be evaluated for 6 categories of benefits:

| Categories of Benefits | Measures for Evaluation |
|---|---|
| System performance benefits | Quantitatively measurable in frequency, voltage, T2 events, etc. |
| Economic benefits of:<br><br>Renewable energy options<br><br>Non-renewable generation options | Quantitatively measurable in dollars ($) per unit of energy (GJ, MWh, etc.)<br><br>Economic benefits (measured by avoided cost of energy from non-renewable fuels and other avoided costs) relative to economic costs<br><br>Economic benefits measured by lowest economic costs |
| Environmental compliance benefits | Quantitatively measurable in gaseous and particulate emissions |
| Risk minimization benefits | Qualitatively measurable |
| Energy security benefits | Quantitatively measurable in contribution to achieving 100% renewable energy |
| Environmental preservation benefits | Quantitatively measurable in contribution to achieving 100% renewable energy |

**WHERE DO PEOPLE AT THE UTILITIES STAND IN THEIR EVALUATION OF RENEWABLE ENERGY OPTIONS?**

Of six categories of benefits of renewable energy options,[7] the two most important categories are: (1) system performance & security benefits, and (2) economic benefits (measured by avoided costs of energy from non-renewable fuels and other avoided costs) relative to economic costs.

[7] See REACH Memo No 14 *Creating the Electric Utility We Want* at 8 - 11, accessible at https://qh278.infusionsoft.com/app/linkClick/8643/45809315187f30c8/21439/109f6c7fe3e0b1d6, for a more detailed description of these categories of benefits.

3

Here is where people at the utilities seem to stand now in their ongoing evaluation (through modeling and/or measuring[8]) of categories of renewable energy options for their system performance benefits and their economic benefits:

| **RENEWABLE ENERGY OPTIONS** | **INTEGRATION ANALYSES = DER Issue No. 3** | | |
|---|---|---|---|
| | **Evaluation of System Performance Benefits = DER Issue No. 3.b ("integration capacity")** | | **Evaluation of Economic Benefits[9] = DER Issue No. 3.a ("cost-effective")** |
| **DER Options**: | **Evaluation of System-Level Performance Benefits** | **Evaluation of Circuit-Level Performance Benefits** | |
| Distribution-level renewable generation options (DG-PV) | Modeling: PSIP3[10] Appendix O (2 DG-PV options[11] for each of Oahu, Maui & Hawaii islands) | Modeling: PSIP3 Appendix N (2 DG-PV options for each of Oahu, Maui & Hawaii islands) | Not yet[12] |
| DG-PV amounts beyond which mitigation options are required | Modeling: E3 System Interconnection Limits Analysis (System Hosting Capacity) | Modeling: Circuit Hosting Capacity | n/a |

8 There are 2 ways of quantitatively evaluating the benefits of energy options: *measuring* and *modeling*. *Measuring* means measuring the benefits (for example, the system performance benefits) of a physically-existing energy option (for example, a 1 MW grid-connected distributed energy storage pilot project). *Modeling* means using a computer model of the grid to model the benefits (for example, the economic benefits) of a hypothetical energy option (for example, 100 MW of grid-connected distributed energy storage) as if it were connected to the grid.

9 Economic benefits (measured by avoided costs of energy from non-renewable fuels and other avoided costs) relative to economic costs.

10 "PSIP3" refers to *Hawaiian Electric Companies' PSIPs Update Report* filed on December 23, 2016 in Docket No. 2014-0183 (*PSIP Update Report: December 2016*).

11 The 2 DG-PV options consisted of a "Market" DG-PV forecast amount and a "High" DG-PV forecast amount, for each of the islands of Oahu, Maui and Hawaii.

12 See REACH Memo No 12 *Restoring Hawaii's Market for Customer Grid-Supply PV Systems* accessible at https://qh278.infusionsoft.com/app/linkClick/7989/4364c83a50d73622/11287/d9e078a5ac845c7d (discussing a Value of Solar analysis for evaluating the economic benefits of DG-PV).

4

| | | | |
|---|---|---|---|
| Distribution-level mitigation options: | Not yet | Modeling: PSIP3 Appendix N (7 mixes[13,14] composed of customer-provided inverter-based options, customer-provided energy storage options, and/or utility-provided equipment-based options, for each of Oahu, Maui & Hawaii islands) | Not yet |
| Customer-provided inverter-based options[15] | Not yet | Measuring: Advanced Inverter Grid Support Function Laboratory Validation & Analysis | Not yet |
| | Not yet | Modeling: Voltage Regulation Operational Strategies Project (volt-VAR and volt-Watt options) | Not yet |
| Customer-provided energy storage options:[16] | | | |
| Customer-controlled | Not yet | Not yet | Not yet |

[13] Each mix of customer-provided inverter-based options, customer-provided energy storage options and/or utility-provided equipment-based options corresponded to 1 composite distribution-level mitigation option for modeling purposes.

[14] In the *HECO Companies' Grid Modernization Strategy (Draft) for Stakeholder Review and Comment* ("*Draft GMS*"), filed on June 30, 2017, at 86 – 87, the utility indicated that it expanded the number of mixes to include "an enhanced business-as-usual approach (Wires)" and "a technology-centric approach (Grid Mod)." It does not appear, however, that the utility modeled the circuit-level system performance benefits of the added Wires and Grid Mod composite distribution-level mitigation options.

[15] In Attachment H to the utility's *Distributed Generation Interconnection Plan* ("*DGIP*") filed on August 26, 2014, in Docket No. 2011-0206, the people at the utilities identified 8 categories of customer-provided inverter-based mitigation options:

(1) Reset Existing Inverters: Ride-Through
(2) Reset Existing Inverters: Fixed Power Factor Control
(3) Advanced Inverter Functionalities: Fast-Trip
(4) Advanced Inverter Functionalities: Frequency Response
(5) Advanced Inverter Functionalities: Volt-VAR
(6) Advanced Inverter Functionalities: Voltage-Watt
(7) Inverter Curtailments: Active Power Control
(8) Inverter Curtailments: Turning Off Inverters

[16] To the extent that DG-PV and customer-provided energy storage deliver self-generated energy to the customer, DG-PV and customer-provided energy storage might be characterized as demand management options because they reduce or shift customers' demand for utility-supplied energy.

5

| | | | |
|---|---|---|---|
| Jointly-controlled[17] | Modeling: Grid Modernization Lab Call (GMLC) Hawaii Regional Partnership (frequency-Watt options) | Not yet | Not yet |
| | Measuring: SEAMS for SHINES[18] | Not yet | Not yet |
| | Measuring: Stem Inc 1 MW Grid Response Distributed Storage Pilot | Measuring: Stem Inc 1 MW Grid Response Distributed Storage Pilot | Not yet |
| | Measuring: E-Gear BESS/EMC[19] | Measuring: E-Gear BESS/EMC | Not yet |
| Utility-provided equipment-based options[20] | Not yet | Measuring: Mitigation of Circuit Hosting Capacity violations | Modeling: Proposed Grid Modernization Net Benefits Assessment[22] |

[17] Jointly-controlled energy storage is energy storage that is controlled primarily by a customer to maximize the value of energy generated by the customer's DG-PV system, and that is controlled secondarily by the utility to provide grid services such as voltage and frequency regulation.
[18] System to Edge-of-network Architecture and Management (SEAMS) for Sustainable and Holistic Integration of Energy Storage and Solar PV (SHINES)
[19] Battery Energy Storage System (BESS)/Energy Management Control (EMC)
[20] In the *DGIP*, the people at the utilities identified 15 categories of utility-provided equipment-based mitigation options:

(1) Energy Storage: Located on Feeder
(2) Grounding Bank
(3) Circuit Direct Transfer Trip
(4) Protection Upgrades
(5) Substation Short Switch
(6) Voltage Control: Level Voltage and Adjust LTC
(7) Voltage Control: LTC Controller Replacement
(8) Voltage Control: Regulating Transformers
(9) Equipment Upgrades: Increase Primary Cable Sizing
(10) Equipment Upgrades: Increase Secondary Cable Sizing
(11) Equipment Upgrades: Voltage Conversion
(12) Equipment Upgrades: Upsizing Distribution Substation Transformer
(13) Equipment Upgrades: Adding Distribution Substation Transformer & Splitting Load
(14) Equipment Upgrades: Adding Distribution Customer Transformer & Splitting Load
(15) Capacitor Relocations

In the *Draft GMS*, at 60, the people at the utilities also identified faulted current indicators, remote intelligent switches (reclosers) and secondary VAR controllers (SVCs) as utility-provided equipment-based distribution-level mitigation options.
[22] In the *Draft GMS*, Appendix C at 32-47, the utility's consultant (E3) proposed a "Net Benefits Assessment" process for evaluating the economic benefits of utility-provided equipment-based distribution-level mitigation options such as utility-provided reclosers and utility-provided distribution-level energy storage systems (DESS).

6

| | | | |
|---|---|---|---|
| | Not yet | Measuring: Varentec ENGO+GEMS[21] secondary VAR controllers | Not yet |
| | Not yet | Measuring: Gridco In-line Power Regulator (IPR) | Not yet |
| Demand-side management (DSM) options: | Modeling: PSIP3 Appendix O and Appendix P - Black & Veatch Demand Response (DR) Evaluation (4 mixes[23] composed of DR options and price response options for each of islands of Oahu & Maui; 3 mixes composed of DR options and price response options for island of Hawaii; 1 mix | Not yet | Not yet |

Using the "Net Benefits Assessment" process, the economic benefits of utility-provided reclosers having a specified economic cost (in dollars) would be evaluated by:

(1) estimating the economic value (in dollars) of the estimated amount of "reliability" (system performance benefits) provided by the reclosers,
(2) estimating the economic value (in dollars) of estimated customer outage costs avoided by the reclosers, and
(3) comparing the combined estimated economic value of such grid services and avoided customer outage costs against the economic costs (in dollars) of the reclosers.

Using the "Net Benefits Assessment" process, the economic benefits of utility-provided distribution-level energy storage systems (DESS) having a specified economic cost (in dollars) would be evaluated by:

(1) estimating the economic value (in dollars) of estimated generation capacity and energy costs avoided by the DESS
(2) estimating the economic value (in dollars) of estimated transmission and sub-transmission costs avoided by the DESS
(3) estimating the economic value (in dollars) of estimated transmission losses avoided by the DESS
(4) estimating the economic value (in dollars) of the estimated amount of "ancillary services" (system performance benefits) provided by the DESS
(5) estimating the economic value (in dollars) of estimated distribution capacity avoided by the DESS
(6) estimating the economic value (in dollars) of estimated T&D O&M costs avoided by the DESS
(7) estimating the economic value (in dollars) of estimated distribution losses avoided by the DESS
(8) estimating the economic value (in dollars) of estimated customer outage costs avoided by the DESS, and
(9) comparing the combined estimated economic value of such "grid modernization investment benefits" against the economic costs (in dollars) of the DESS.

[21] Edge-of-Network Grid Optimizer (ENGO) + Grid-Edge-Management-System (GEMS)

[23] Each mix of demand response options and price response options corresponded to 1 composite utility-provided demand-side management option for modeling purposes.

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| | | | |
|---|---|---|---|
| | composed of DR options and price response options for each of islands of Molokai & Lanai) | | |
| Utility-provided demand response (DR) options[24,25] | Measuring: DR Demonstration Projects[26] 600 kW | Measuring: DR Demonstration Projects 600 kW | Measuring: DR Demonstration Projects 600 kW |
| | Measuring: Shifted Energy Grid-Interactive Water Heater (GIWH) Pilot Program 3 MW | Measuring: Shifted Energy Grid-Interactive Water Heater (GIWH) Pilot Program 3 MW | Not yet |
| Utility-provided price response options[27] | Measuring: Interim Time-of-Use Program | Measuring: Interim Time-of-Use Program | Not yet |
| Customer-provided energy efficiency options | Not yet | Not yet | Modeling: Hawaii Energy rebate program |
| **Non-DER Options** | **Evaluation of System-Level Performance Benefits** | | **Evaluation of Economic Benefits**[28] |
| System-level renewable generation options: | | | |

[24] Demand response (DR) mitigation options include: curtailable and/or dispatchable (grid-interactive) water heating, central air conditioning, electric vehicles, pumps and other motor loads, lighting, refrigeration, ventilation and customer-sited generators (i.e., DG-PV).

[25] The utility intends to develop a "DER Phase II program" that incorporates "specific [photovoltaic curtailment] options." *PSIP Update Report: December 2016* at A-27 to A-28. The utility is planning to pilot a "ConnectDER" device that "can provide remote monitoring, visibility, configurability and on/off control of PV systems." *PSIP Update Report: December 2016* at 7-5.

[26] Instead of identifying DR options and evaluating the system performance benefits and economic benefits of the identified DR options, the utility people were ordered by the PUC (in Order No 33027 filed on July 28, 2015 in Docket No. 2007-0341) to identify the system performance benefits (called "grid services") provided by DR options, and were ordered by the PUC, for purposes of selecting "Demonstration Projects," to procure the identified grid services, rather than procure the DR options providing the grid services. The utility people selected four demonstration-scale DR options – denominated as "Demonstration Projects" to provide four categories of system performance benefits (capacity, fast frequency response, regulating reserve and replacement reserve) – for "Phase I Implementation" during 2017.

[27] Price response mitigation options include: real-time pricing (RTP) options, day-ahead load shift (DALS) price options, time-of-use (TOU) rate options, critical peak pricing (CPP) options and minimum load options.

[28] Economic benefits (measured by avoided costs of energy from non-renewable fuels and other avoided costs) relative to economic costs.

8

| | | |
|---|---|---|
| PV solar generation options | Modeling: PSIP3 Appendix O (all 5 islands) | Not yet |
| | Modeling: Hawaii Solar Integration Study Final Technical Reports for Oahu and Maui (2012) | Not yet |
| Wind generation options | Modeling: PSIP3 Appendix O (all 5 islands) | Not yet |
| | Modeling: Oahu Wind Integration Study (2011) | Not yet |
| Geothermal generation options | Modeling: PSIP3 Appendix O (Maui & Hawaii islands) | Not yet |
| Biomass generation options | Modeling: PSIP3 Appendix O (all 5 islands) | Not yet |
| Hydropower generation options | Not yet | Not yet |
| System-level mitigation options: | | |
| Renewable generation curtailment options | Not yet | Not yet |
| Dynamic load shedding options | Not yet | Not yet |
| Interisland cable options | Modeling: PSIP3 Appendix O (Oahu island) | Not yet |
| | Modeling: Oahu Wind Integration & Transmission Study (2011) | Modeling: Oahu Wind Integration & Transmission Study (2011) |
| | Modeling: Stage 2 Oahu-Maui Interconnection Study (2013) | Modeling: Stage 2 Oahu-Maui Interconnection Study (2013) |
| Utility-provided energy storage options | Modeling: PSIP3 Appendix O and Appendix P – Ascend Optimal Resource Analysis (Oahu, Maui & Hawaii islands) | Not yet |
| | Modeling: Maui Energy Storage Study (2012) | Modeling: Maui Energy Storage Study (2012) |

| | | |
|---|---|---|
| Utility-provided energy efficiency options | Measuring: Amber Kinetics 25 kWh Flywheel Pilot Project<br><br>Measuring: Hitachi JumpSMART Pilot Project<br><br>Modeling: PSIP3 Appendix O and Appendix P – Ascend Optimal Resource Analysis (Oahu, Maui & Hawaii islands)<br><br>Modeling: Maui Electric System Improvement and Curtailment Reduction Plan (2013) | Not yet<br><br>Not yet<br><br>Not yet<br><br>Modeling: Maui Electric System Improvement and Curtailment Reduction Plan (2013) |

The table above shows that there are a whole lot of pukas in the utilities' ongoing evaluations of the system performance benefits and economic benefits of renewable energy options, including DER options:

- The utilities are evaluating *some* of the system performance benefits of *some* options in *some* amounts within *some* categories of options for *some* of the utility grids.
- The utilities are not yet evaluating the economic benefits of *most* options within *most* categories of options for *most* of the utility grids.
- The utilities do not yet seem to be evaluating the other four categories of benefits (environmental compliance benefits, risk minimization benefits, environmental preservation benefits and energy security benefits) of renewable energy options.

Without evaluations of most of the benefits of most renewable energy options, the people at the utilities cannot be expected to make consensus decisions to implement renewable energy options, including DER options.

Without evaluations of most of the benefits of most renewable energy options, the people at the utilities cannot be expected to make consensus decisions about what tariffs and what interconnection standards they want to procure what renewable energy options (including DER options) in what amounts in what order.

Without evaluations of most of the benefits of most renewable energy options, the people at the utilities cannot be expected to make consensus decisions about what

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renewable energy options (including DER options) in what amounts in what order they *want* to deliver *optimal* benefits for the utility's customers.

When the people at the utilities come into consensus on a *planning process* through which they:

(1) *evaluate* the benefits of renewable energy options available to the utility,

(2) *compare* the benefits of those renewable energy options, and

(3) *convince themselves* (and are in consensus) what renewable energy options in what amounts in what order they *want* to deliver *optimal* benefits for the utility's customers,

the people at the utilities can be counted on to make consensus decisions on *plans* that articulate what renewable energy options in what amounts in what order they *want* to deliver optimal benefits for the utility's customers.[29]

When the people at the utilities come into consensus on such a planning process, they can be counted on to make conseusus decisions about what *tariffs* and what *interconnection standards* they *want* to procure renewable energy options (including DER options) that deliver optimal benefits for the utility's customers.

When the people at the utilities come into consensus on such a planning process, they can be counted on to make consensus decisions to implement renewable energy options (including DER options) that deliver optimal benefits for the utility's customers.

**CONCLUSION**

An overview is provided of where the people at the utilities stand in their evaluation of renewable energy options.

When the people at the utilities come into consensus on a *planning process* through which they:

(1) *evaluate* the benefits of renewable energy options available to the utility,

[29] *See* Renewable Energy Action Coalition of Hawaii, Inc.'s Statement of Position on the Revised PSIPs, filed February 14, 2017, in Docket No. 2014-0183 (*REACH SOP on Revised PSIPs*) at 18–35, accessible at https://qh278.infusionsoft.com/app/linkClick/8901/7185ddf3c2fed776/27539/5fac85946524cc08 (showing what consensus on a decision to implement an energy option might look like; showing what consensus on a planning process oriented to a goal of 100% renewable energy might look like; showing what consensus on a plan to achieve 100% renewable energy and deliver optimal benefits for the utility's customers might look like; showing what consensus on a procurement process oriented to such a plan might look like; and showing what consensus on implementation of such a procurement process might look like, what consensus on achievement of 100% renewable energy might look like and what consensus on delivery of optimal benefits for the utility's customers might look like).

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(2) *compare* the benefits of those renewable energy options, and

(3) *convince themselves* (and are in consensus) what renewable energy options in what amounts in what order they *want* to deliver *optimal* benefits for the utility's customers,

they can be counted on to make consensus decisions to implement renewable energy options (including DER options) that deliver optimal benefits for the utility's customers.

## 3. Energy Freedom Coalition of America

Yamamoto Caliboso
A LIMITED LIABILITY LAW COMPANY

August 9, 2017

**Via Email: gridmod@hawaiianelectric.com**

Hawaiian Electric Company, Inc.
Hawaii Electric Light Company, Inc.
Maui Electric Company, Limited

Re: **Draft Grid Modernization Strategy**
*Modernizing Hawaii's Grid For Our Customers*, dated June 30, 2017

Thank you for inviting comments to the above-referenced Draft Grid Modernization Strategy, issued by Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited.

Attached are comments and recommendations from the Energy Freedom Coalition of America, LLC. Please let us know if you have any questions or need any additional information.

Very truly yours,

Carlito P. Caliboso
for
YAMAMOTO CALIBOSO
A Limited Liability Law Company
Counsel for Energy Freedom Coalition of America, LLC

Enclosure

1099 Alakea Street | Suite 2100 | Honolulu, Hawaii 96813 | Phone (808) 540-4500 | Fax (808) 540-4530
www.ychawaii.com

Energy Freedom Coalition

**Feedback of the Energy Freedom Coalition of America on HECO's Draft Grid Modernization Plan**
**August 9, 2017**

**Introduction**

The Energy Freedom Coalition of America (EFCA) respectfully submits this feedback on HECO's[1] draft Grid Modernization Plan, which the utility issued on June 30, 2017 (Plan).[2] As the state of Hawaii continues to transition toward increasing reliance on renewables to meet its energy needs, it is important the utility make appropriate investments in the distribution and transmission system to ensure the grid is capable of handling the operational realities that come with this laudable policy objective.

In addition to the state's longer term goal of meeting 100% of the state's energy needs with renewables, growing numbers of customers are deploying a variety of behind the meter resources, including solar photo-voltaic system, energy storage, electric vehicles and other distributed energy resources (DERs). EFCA fundamentally believes that widespread adoption of these systems represents a significant opportunity for the state. More generally, EFCA believes that HECO should be thinking expansively about what resources might be used to address their systems' and customers' needs rather than defaulting to business-as-usual solutions.

For example, DERs, by virtue of their location on the grid, can provide a broad range of grid services, which, if properly utilized, can reduce the costs of the system by reducing and/or deferring investments in traditional infrastructure that would otherwise be needed. Large scale storage systems have already demonstrated in Hawaii their ability to support renewable integration efforts, by acting as a means to store renewable energy when it is abundant and less valuable to the grid and discharge it back to the grid when that energy is more valuable. Beyond Hawaii, storage projects are increasingly being looked to as a means to avoid inefficient peaking generation to address reliability concerns.

In the following pages we offer specific feedback to HECO that we believe would strengthen the Plan by ensuring the utility more fully considers ways that DERs and energy storage can be used to address grid needs.

Before turning to those suggestions EFCA first wants to acknowledge and commend HECO for a number of elements in the Plan. Specifically, the Plan proposes an integrated grid planning framework that would seek to identify the most cost-effective solution to address system needs. EFCA is particularly gratified to see that one of the outputs of this process would be "identification of resource and grid

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[1] "HECO" herein refers to collectively Hawaiian Electric Company, Inc., Hawaiian Electric Light Company, Inc. and Maui Electric Company, Limited.
[2] *Modernizing Hawaii's Grid For Our Customers*, June 30, 2017.

Energy Freedom Coalition of America, LLC
601 Thirteenth Street, NW - Ninth Floor North - Washington, DC 20005

**Feedback of the Energy Freedom Coalition of America on HECO's Draft Grid Modernization Plan**
**August 9, 2017**

needs that may be met by more traditional utility 'wires' or a 'non-wires' solution[.]"[3] This puts Hawaii on a similar path as New York and California, both of which are in process on efforts to reform utility planning practices specifically to ensure these processes support and fully take advantage of cost-effective opportunities to utilize these newer technologies in place of conventional investments. EFCA also appreciates that HECO is currently looking at ways to reform demand response programs to clarify and expand on the types of services that DERs can provide.

**Recommendations**

<u>The Plan should consider opportunities to leverage DERs to address efforts aimed at improving visibility of DER operations and situational awareness</u>

The Plan envisions the deployment of additional sensing, measurement and telemetry equipment. For example, the Plan calls for the deployment of a second advanced meter to measure DER production[4], as well as installing distribution transformer measurement devices on secondary systems with legacy inverters. In the case of both of these proposals, EFCA contends that DERs themselves could be used to provide the information and data that HECO is seeking to obtain. For example, pursuant to IEEE P1547-2017 we anticipate that inverters will be required to communicate operational data back to the utilities, including voltage, power, frequency, and operational state. As a result, the second advanced meter will likely be duplicative in the relatively near future and unnecessary in many instances. Similarly, DERs themselves may be able to serve in lieu of the transformer measurement devices included in the Plan. Rather than selecting this particular solution *a priori*, EFCA encourages HECO to consider whether incentivizing the replacement or retrofit of existing inverters or the installation of energy storage with an accompanying advanced inverter could more cost-effectively address the need. Advanced inverters can provide this measurement function as one of their many additional capabilities. Further, the Plan does not discuss or contemplate how DERs might be used to support and provide greater situational awareness and support outage management. This capability should also be explored and expressly recognized in the Plan.

<u>The Plan should recognize the ability of energy storage and power electronics to provide voltage and reactive power support</u>

The Plan discusses future methods that HECO envisions using to address voltage and reactive power support. Among the technologies the Plan identifies to address these needs are synchronous condensers and the repurposing of deactivated generators. EFCA believes the Plan does not (but should) specifically recognize that these same services can be provided by energy storage and power electronics. Similarly, HECO proposes to scale up their use of Varentec's secondary var controller in 2018. While EFCA does not necessarily oppose this proposal, we think it is important to ensure that the Plan recognizes and HECO considers the capabilities of energy storage and advanced inverters to provide secondary reactive power and voltage management services.

[3] Plan, at 27.
[4] Plan, at 15

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The potential role of advanced inverters in providing voltage management as a part of integrated volt-var control (IVVC) is also under-represented in the Plan. While the Plan references this as an emerging area, EFCA believes that a more actionable plan should be developed and included in the Plan to ensure that HECO is fully exploiting opportunities to leverage the capabilities of DERs by integrating them into volt-var controls systems. Such an action plan should provide key milestones and an associated timeline to achieve those milestones for realizing this integration.

<u>The Plan should more fully consider the role of electric vehicles in achieving the state's clean energy vision.</u>

According to the monthly energy trend highlights for July 2017, the number of passenger electric vehicles (EVs) in Hawaii was 6,084, an increase of 34.1% (1,548 vehicles) from the same month last year.[5] While still representing a relatively small number of total vehicles in Hawaii, this data demonstrates a strong upward trend of EV deployment and customer interest throughout the state. With new models of EVs consistently being released by global automakers that address some of the initial customer concerns with switching to an EV, such as cost and range anxiety, it can be assumed that total EV deployment will only continue to grow over the next five to ten years. It is therefore important for Hawaii to prepare now for a future of potential larger scale EV deployment across the state.

EVs, and the associated Electric Vehicle Supply Equipment (EVSE), also represent a key opportunity to extend the positive impacts of Hawaii's ground-breaking commitment to renewable energy to significantly reduce emissions in the transportation sector and further reduce the state's reliance on imported fuels. Additionally, and synergistically, EVs could also serve as a sink for excess renewables helping Hawaii manage increasing amount of solar generation being deployed both behind and in-front of the meter. Properly incented, EVs can also help improve the load factor of the system, actually serving to reduce rates by spreading the utility's fixed costs over more energy throughput.

Given all of the above EFCA encourages HECO to more fully incorporate EVs and charging infrastructure (EVSEs) into the Plan. As drafted, EVs receive only passing mention in the Plan with part of that discussion related to how any costs associated with the deployment of EVs, including the costs of supportive infrastructure should be borne exclusively by EV customers.[6] This perspective, while intuitively appealing, appears to ignore the important role that EVs can play in facilitating a host of policy objectives that benefit all customers.

The utility has a significant role to play in supporting EV adoption and helping to ensure that such adoption yields benefits to all ratepayers. For example, through rate design and providing support for accelerated deployment of charging infrastructure, the utility can encourage charging during times when renewable energy is abundant and/or times when there is excess capacity on the system. The utility could also leverage ongoing efforts to create hosting capacity maps to help EV charging solution providers identify where on the grid higher capacity charging can be readily deployed without requiring

[5] From "Monthly Energy Trend Highlights", Research Economic Analysis Division, p. 2; http://files.hawaii.gov/dbedt/economic/data_reports/energy-trends/Energy_Trend.pdf
[6] Plan at 7.

system upgrades. Finally, the utility can assist with charging infrastructure deployment in market segments, such as multi-unit dwellings (MUD), that have traditionally faced a higher barrier to adoption but can have a widespread customer benefit.

EFCA encourages HECO to work with stakeholders to explore EVs and EVSEs more fully, both to provide a more comprehensive understanding of the opportunities EVs present as well as what specific steps HECO can take to support their adoption and use to best realize those opportunities.

**Conclusion**

EFCA wants to again thank HECO for the significant effort and thought that has gone in the Plan and for soliciting feedback from the stakeholder community. As discussed above, we believe the plan could be improved by more expressly acknowledging the opportunity to leverage DERs, energy storage, and EVs to address a number of grid needs. We look forward to continuing to engage with HECO and other stakeholders on these important issues.

## 4. Environmental Defense Fund

EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

August 9, 2017

Colton K. Ching
Senior Vice President, Planning & Technology
Hawaiian Electric
PO Box 2750
Honolulu, HI 96840

**Re: Public Comment on Hawaiian Electric Companies' "Modernizing Hawai'i's Grid for Our Customers" Report**

Dear Mr. Ching:

Environmental Defense Fund ("EDF") appreciates the opportunity to comment on the Hawaiian Electric Companies' ("Companies") Draft Grid Modernization Strategy report titled "Modernizing Hawai'i's Grid for Our Customers" ("Draft Report").[1] EDF is a non-profit, non-partisan, non-governmental environmental organization that combines law, policy, science, and economics to find solutions to today's most pressing environmental problems.

EDF has participated in various grid modernization proceedings across the country and is pleased to share our perspective to help advance Hawai'i's grid modernization efforts in a strategic, customer-centric, and environmentally sustainable manner. We look forward to further engaging as the Companies consider next steps and respectfully submit these comments on behalf of our more than 2 million members who support cleaner air and climate security.

EDF commends the Companies for developing a near-term strategy for performing "the work required to update Hawaiian Electric Companies' energy network in the next six years, and how it will help the five islands served by the company achieve a renewable portfolio standard of 48 percent by 2020 and ultimately 100% by 2045."[2] EDF would also like to thank the Companies and facilitators for engaging customers and stakeholders in an effort to address the unique needs of the State in meeting its energy goals.

EDF offers the following recommendations on the main topics of the Draft Report as the Companies finalize their Grid Modernization Strategy:

[1] "Modernizing Hawai'i's Grid for Our Customers" Draft Report, June 30, 2017, available at: https://www.hawaiianelectric.com/about-us/our-commitment/investing-in-the-future/grid-modernization-strategy
[2] Draft Report, p. ES-1

## I. Customer & Stakeholder Engagement

Hawai'i's ambitious renewable energy goals and, in particular, the existing high percentage of customers with rooftop solar, place the state in a very unique position. The state's grid is currently grappling with various conditions that others have yet to encounter. Yet, it still must maintain the service and reliability needs customers have come to expect, especially as our society and economy becomes more reliant on electricity.

Given these factors, the report's focus on near-term issues related to the management and integration of renewables is understandable but alone would not be enough to address the complex system interdependencies associated with a modern grid. Greater emphasis should be placed on coordination with other aspects of grid modernization that can advance the State's energy goals and meet the evolving needs of electric customers, through parallel efforts that emphasize energy management strategies, and the development of a long-term Integrated Resource Plan.

A prime opportunity currently exists for the Companies to engage customers on energy and cost management strategies to the benefit of all customers. As a result of the Companies' customer and stakeholder outreach, the report notes that as customers were presented with information that allowed for a better understanding of the grid "they were able to engage in deeper discussion about incorporating renewables into the grid, energy storage, and other timely issues reflected in the feedback."[3]

The report also states that "without specific programs to test, however, residential customers do not express this same interest, nor do they display any awareness of the usefulness of real-time data" and that "residential customers remain focused on other issues that have (currently) identifiable benefits to them, such as the incorporation of more rooftop solar and features that they believe can reduce their monthly bills."[4]

Given the existing and growing level of customer interest in energy related issues and opportunities, now would be the ideal time to develop the programs, services, and education currently not available to customers to help them manage their energy related costs. Energy conservation, load shifting, demand response, and price responsive strategies can complement the Companies' current Distributed Energy Resources ("DERs") integration approach. Most customers in the state still don't have rooftop solar, but their active participation in developing a comprehensive portfolio of energy management strategies could enhance the state's ability to meet its energy goals in a cost-effective manner.

[3] Draft Report, p. 6.
[4] Draft Report, p. 7.

## II. Integrated Grid Planning with Stakeholder Engagement

The Report acknowledges that "the opportunity to understand the impact of policy decisions and adjust as needed is seen as a critical application of this type of integrated grid planning process to address affordability. This approach has been advocated by consumer advocates, the Natural Resource Defense Council, the Environmental Defense Fund, and other stakeholders in Hawai'i and other states."[5]

EDF, of course, agrees with this approach and the focus on grid investments required to enable pricing, demand response and other energy management strategies that help meet the on-going needs of the transmission and distribution system. Strategic modernization investments allow for greater system efficiency and energy management strategies that may be facilitated through enhanced communications, visibility, and control.

## III. Grid-Facing Technologies

On the subject of "Integrated Voltage Management Strategy," the Draft Report identifies that "[v]oltage management involves coordinated control of both real (watt) and reactive power (var) either with grid-side equipment and or customer devices such as inverters associated with DGPV and battery energy storage." However, a comprehensive voltage management strategy can provide benefits beyond the integration of distributed energy resources ("DERs") to include the reduction of delivery losses, energy conservation, lower greenhouse gas emissions, and the potential deferral of capacity expansions.

EDF notes that Volt-VAR Optimization ("VVO") generally has been an integral component of grid modernization efforts across the country. VVO involves the management of various electric distribution system assets and advanced control technologies to "right-size" voltage levels delivered to electric customers. VVO can be used to reduce overall voltage levels, while ensuring these voltages remain within acceptable standards for electric distribution, through the practice of Conservation Voltage Reduction ("CVR"). Reductions in distribution system voltage have been demonstrated to result in reductions in energy consumption across the electric circuits on which this practice is applied and provide tangible savings to customers.[6]

In November 2012, the National Association of Regulatory Utility Commissioners ("NARUC"), adopted a resolution encouraging "[s]tate public service commissions to evaluate the energy efficiency and demand reduction opportunities that can be achieved with the deployment of Volt-Var Optimization (VVO) technologies."[7] Remarking on the importance of VVO as a grid modernization component, NARUC stated that "VVO technology serves as a platform for potential future grid modernization initiatives that can deliver operational visibility, efficiency, and control of the electric distribution grid,

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[5] California PUC Rulemaking 14-08-013 - Response of Environmental Defense Fund to Utilities' Applications for Approval of Distribution Resources Plans, available at: http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M154/K305/154305338.PDF

[6] Evaluation of Conservation Voltage Reduction on a National Level. Pacific Northwest National Laboratory. July, 2010 available at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-19596.pdf

[7] EL-2/ERE-3Resolution Supporting the Rapid Deployment of Voltage Optimization Technologies, adopted November 14, 2012, available at http://pubs.naruc.org/pub/53A0D9D5-2354-D714-51C7-09A3F27DACAE

improving reliability and customer service for a relatively small incremental investment."[8]

Various states are actively pursuing strategies and making cost-effective investments in voltage management for energy conservation. The Indiana Utility Regulatory Commission recently approved a seven-year deployment of voltage optimization technologies across roughly 50% of Duke Energy Indiana's circuits, where voltage optimization was deemed to be cost effective as a result of a rigorous benefit cost analysis assessment.[9] In Illinois, Commonwealth Edison ("ComEd") performed a voltage optimization feasibility study, which found voltage optimization was cost-effective for viable feeders, with a voltage reduction potential for ComEd was between 3.0% and 3.8%.[10] Similarly in New York, Consolidated Edison is deferring investments in a new substation and capacity expansion through the "Brooklyn-Queens Demand Management Program" —a non-wires alternatives to meet increasing energy demands in three New York city neighborhoods through a menu of customer-side and non-traditional utility-side solutions. A recent company report[11] on the project indicates that the program is expected to provide "a target voltage reduction of 12MW" for 2017 in contributing to the demand reductions required for the deferral of the otherwise needed capacity expansion.

EDF encourages the Companies to pursue the full range of benefits for voltage optimization across its system, and to outline a pathway that identifies the potential for energy savings and carbon reductions that can be achieved with strategic, cost effective investments. Deferring or eliminating future customer costs in energy and capacity can offset investment expenditures required to build the modern grid we need - potentially reducing future rate impacts.

## IV. Customer Facing Technologies

The Draft Report notes that "meters will be deployed to customers opting to install distributed generation or battery energy storage or who want to participate in a responsive demand program or tariff" and will be made "available" to other customers under other criteria.[12] We are aware that rather than the "surgical" approach to deployment of advanced metering infrastructure ("AMI") proposed in the report, the "Smart Grid Foundation project had proposed the rollout of advanced meters to all customers" initially.

AMI is often considered a foundational technology of the modern grid in providing various visibility and control capabilities that had been missing from the electric system from most of its existence. A system-wide deployment of AMI undoubtedly requires a sizeable investment no matter the region where this is being considered. For reference, we highlight that the New York Public Service Commission in its "Order Approving

[8] Ibid.
[9] Duke Energy Indiana TDSIC Final Order, IURC Cause 44720, June 2016 https://iurc.portal.in.gov/legal-case-details/?id=964a6e87-db81-e611-8107-1458d04eabe0
[10] Commonwealth Edison Voltage Optimization (VO) Feasibility Study Final Report. 2015 AIPR Attachment A, at A-9, Applied Energy Group, January 2015, available at https://www.icc.illinois.gov/downloads/public/2015%20AIPR%20Appendix%20A.pdf.
[11] BQDM Quarterly Expenditures & Program Report, Con Edison, Q1 2017 http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterSeq=45800
[12] Draft Report, p. 83.

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Advanced Metering Infrastructure Business Plan Subject to Conditions"[13] for Consolidated Edison determined that "full deployment is necessary to achieve the full operational savings that AMI can provide."[14]

This Commission arrived at the decision to require the "Company to not favor particular customers in the roll-out process, but to proceed expeditiously and fairly to replace all meters in the particular geographic area where the work is being performed" after evaluating various stakeholder positions on the topic and determining that "customers are faced with the high cost of electric commodity and a targeted deployment would deprive these customers of the ability to benefit from system flexibility and access to innovative pricing and DER services, including those that may minimize rate increases associated with load relief work."[15]

While each state and jurisdiction is different and should consider its own objectives to chart its own path, these investments should be made with knowledge of the full implications of the proposed approach. An "opt-in" targeted deployment may keep costs down in the short term, but one may be foregoing the customer benefits and economies of scale that a system-wide or geographical approach to AMI deployment may provide. A long-range plan for the full deployment of AMI following this "opt-in" approach may in turn be more costly compared to a geographic deployment strategy.

The Draft Report also notes that "some customers feel that PV owners are not paying their fair share now." [16] While the Draft Report does not specify how the costs of the proposed DER-related investments would be allocated, utility investments that are primarily directed to photovoltaic ("PV") owners, and not the customer base at large could exacerbate these customer sentiments. Providing AMI primarily to customers with DERs and not the customer base as a whole, may also have the inadvertent result of creating further disparities between customers that are already have the means to manage their energy use (especially through the use of PV, electric vehicles ("EVs"), and battery systems) and customers who don't have access to these options.

On the other hand, if the costs of grid modernization investments are imposed on primarily customers pursuing options like self-generation and storage and DR to more optimally manage their energy use, it could inefficiently increase the cost burdens on those customers and encourage them to pursue non-interconnected energy options, which would be sub-optimal for the grid as a whole. These issues underscore the importance of a holistic view and plan for grid modernization that goes beyond addressing DER integration considerations in making meaningful progress on the State's energy goals.

EDF commends the Companies' exploration into energy data access options for "enabling customer choice and control," including the Green Button standard. We note that providing customers with access to their energy consumption data not only empowers them to lower their utility bills, but data access is also integral to realizing a

[13] NYS PSC, Case 15-E-0050, Order Approving Advanced Metering Infrastructure Business Plan Subject to Conditions March 17, 2016 ("NYS PSC 2016 AMI Order") available at : http://documents.dps.ny.gov/public/MatterManagement/CaseMaster.aspx?MatterCaseNo=15-e-0050&submit=Search

[14] NYS PSC 2016 AMI Order p.29.

[15] NYS PSC 2016 AMI Order p.29.

[16] Draft Report, p.7.

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more efficient and cleaner electricity system that can smoothly integrate new DERs, including EVs and rooftop solar. In addition to these capabilities, data access also spurs the development and adoption of innovative technologies, products and services designed to support consumers in managing energy consumption and expenditures (e.g., demand response, energy efficiency, and conservation programs).[17]

As the electric power system evolves from a one-way grid into a flexible and dynamic network, it is crucial to engage all customers so that we succeed in optimizing the use of smart technology investments. A major lesson from prior state deployments of AMI is that full realization of consumer benefits from efficiency or time-shifting of energy usage will not occur unless consumers have convenient access to their own energy data made available by advanced meters.

Innovative third-party products and services can provide tremendous support to customers navigating this evolving energy landscape by translating the abundance of data into actionable insights and potential dollar savings. It is therefore paramount that customers are able to share meaningful data with third-party service providers of their choosing. Considering third party engagement in tandem with designing comprehensive meter data access policies for customers can prevent unnecessary delays and costs. In this context, the emerging industry standard Green Button Connect My Data ("GBC") functionality should be considered as a basic service to all customers. GBC has been adopted by utilities in regions with AMI including California, Illinois[18] and will soon be launched by Con Edison in New York.

[17] Most recently the New York Public Service Commission made this point in the March 2016 NYPSC Order approving Con Edison's AMI plan (p. 19) stating: "AMI can empower customers to become active in their energy usage by providing them with information to assist in the management of their usage, which will allow them to better manage their electric and gas costs."
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B8C26CF58-5669-4A16-85BC-7D4AE21BFF8D%7D

[18] Exelon subsidiary Commonwealth Edison launched Green Button Connect for its smart meter customers in 2016. Com Ed Press Release, May 24, 2016, available at
http://www.businesswire.com/news/home/20160524006420/en/ComEd-Customers-Green-Light-Share-Energy-Data

## V. Conclusion

EDF appreciates the opportunity to comment on this important step in the Companies' effort to modernize the electric grid for the benefit of electric customers in Hawai'i'.

Respectfully Submitted,

/s/ Ronny Sandoval
Director, Grid Modernization
Climate & Energy Program
Environmental Defense Fund
257 Park Avenue South
New York, New York 10010
rsandoval@edf.org

## 5. Smarter Grid Solutions


smarter grid solutions

**Stakeholder Feedback**

SGS Feedback on "Modernizing Hawai'i's Grid For Our Customers"

**Prepared by:** Chad Abbey
**Date:** August 8, 2017
**Contact:** cabbey@smartergridsolutions.com
+1 (347) 345-6262

## Contents

## Background

We are pleased to provide feedback to the collective companies serving the islands of Hawai'i on their Grid Modernization Strategy (GMS) document entitled "Modernizing Hawai'i's Grid For Our Customers". The document itself represents a comprehensive description of the challenges facing the islands and the proposed approach to meet these challenges through the integration of Grid Modernization solutions. The approach is thoughtful, well-structured, and encouraged a lot of reflection on our side. Fundamentally, the companies (Hawaiian Electric, Maui Electric, Hawai'i Electric Light) present a rational, pragmatic approach towards the 100% renewables 2045 target.

We have attempted to provide constructive commentary on the initiatives most relevant to our areas of expertise but do digress into a deeper technical level on certain occasions, aimed at information sharing even though we understand the comments themselves may not impact the structure or content of a revised version of the document. In support our expertise in the area, we'd like to first provide some brief background on Smarter Grid Solutions (SGS).

SGS delivers real-time control software, referred to as active network management (ANM), for the integration of DER in very high penetration scenarios (>100% circuit peak load) and currently manages more than 300 MW of DER across the UK, North America, and Europe. In continental United States, SGS is currently working with many of the utilities at the forefront of this industry transformation including AVANGRID, Consolidated Edison, Southern California Edison, San Diego Gas & Electric, and Riverside Public Utilities, among others. We regularly provide consulting and technical expertise to projects at the leading edge of innovative technology and policy, including having been recently selected as a key participant in two U.S. Department of Energy (DOE) Sunshot projects under the Enabling Extreme Real-time Grid Integration of Solar Energy (ENERGISE) program. Additionally, the team has extensive related experience in the UK working with DER integration and island power systems and has collaborated with five of the six distribution network operators (DNOs) to bring innovative solutions to the market. Most relevant to Hawai'i's context, the islands of Orkney and Shetland are live examples of how SGS's technology has greatly increased the hosting capacity of distribution networks and island power systems in a reliable manner, commensurate with the constraints of the system.

In addition to providing grid modernization technology solutions, SGS has worked on commercial aspects, business models and future system concepts with its customers and through industry working groups. SGS worked with many of the DNOs and DER developers in the UK in the establishment of commercial agreements to facilitate what has become known as managed or flexible interconnections. Likewise, in the UK we are engaged with DNOs on the development of the distribution system operator (DSO) concept, and similarly contribute to the Distribution System Platform (DSP) concept in NY State as part of the Reforming the Energy Vision (REV) proceedings.

We hope that the feedback provided will offer a somewhat different but useful perspective and will contribute positively in the finalization of the companies' grid modernization document and will provide useful input to internal debate. Should you have any specific questions or comments, please reach out to us directly.

# SGS Feedback

## Introduction

We have organized our feedback into three main topics: Integrated System Planning, Grid Architecture, and Other Considerations. They relate to issues mentioned directly in the GMS document and represent our views based on some of our learnings from other jurisdictions.

## Integrated System Planning

### *Hosting capacity*

Our experience has been that the technical factors that determine hosting capacity on island systems are often more complex but they generally are dominated by voltage and stability constraints, as was highlighted in the GMS. As with other applications of ANM, stability and voltage constraints can often be appropriately managed, using intelligent curtailment and leveraging other smart inverter functions, and leads to "enhanced" or "dynamic" hosting capacity that can be many times the static limit identified in the first instance by our utility customers. Given ANM's inherently scalable nature, it can be deployed for a single generator or generators across multiple substations, we can accommodate much higher levels of PV in a much more cost effective manner, slowly building out intelligence according to needs.

Methods for analyzing the additional hosting capacity are well established and could be used to develop inputs to the cost effectiveness framework presented. These methods include considerations of the number of legacy inverters without monitoring and control and therefore, are pragmatic and not limited to greenfield installations with the latest technology.

### *Probabilistic Planning*

It was promising to see the GMS mentions the use of probabilistic methods in load and DER forecasting, although the integrated system planning methods have not yet gotten to that stage. It would be also interesting to consider the probabilities of outages as well in order to consider capacity requirements from a risk-based perspective as well. We have employed these methods for assessment of asset exceedance risks both in the presence of DER and in its absence and has demonstrated quite interesting results compared with deterministic approaches.

The document also mentions of electric vehicles (EVs), yet it is unclear how important a role these will play in shaping load growth. Given EVs arguably represent one of the most significant sources of uncertainty in load growth, addressing this uncertainty using these same methods could become a very viable approach.

## Grid Architecture

### *Operational Architecture*

The companies reference the architecture from PNNL in section 4, but the solutions being pursued (DMS, centralized DERMS) seem to be dominated by a central command and control architecture, with reliance on an accurate as-is distribution model. We wonder whether distributed controls, apart from the distributed VAr devices, should not also form part of the strategies. Although DERMS is cited, most DERMS solutions we've reviewed follow a traditional centralized paradigm.

### *Leveraging AMI investments*

Distributed control architectures can leverage parts of the advanced metering infrastructure that is planned as part of the Grid Modernization Strategy. For instance, these control algorithms can be

hosted on the NIC associated with concentrators as part of the Silver Springs Network (SSN) infrastructure. In the past, we have deployed projects that have used the meshed network with SSN for some operational data of the ANM distributed control. Although it is bandwidth constrained there are some, less time critical applications that could use this infrastructure, thereby helping the overall business case for AMI.

### Interfaces

We are using the IEEE 2030.5 (Smart Energy Profile 2.0) as a standard interface to aggregator systems now as part of projects in California and while it is not generally supported at present by most vendors (only one that we could find) these deployment projects should lead to greater adoption. Again, a distributed control system can use these aggregator interfaces to dynamically set curves mentioned in the GMS (p. A-D 17). Features of the standard that will become particularly useful include: Grouping functions (particularly considering multiple topologies and for associating dynamic VAr assets with inverter groups) and the aggregator curves already mentioned.

We are also beginning work on the use of OpenFMB as a peer-to-peer standard for facilitating data exchange between field devices, including DER, dynamic VAr devices, and distribution apparatus. Coupled with the previously mentioned concepts of hosting distributed control logic on field hardware, we see greater use of OpenFMB as an evolving initiative to follow, particularly seeing as Hawai'i and elsewhere will continue to experience integration more at the grid edge.

### Advanced controls

As mentioned above, the GMS seems to be dominated by back-office technologies (Table 6, p. 59) although we'd encourage the companies to consider distributed control as part of the overall solution. Our experience has been that part-distributed architectures such as those associated with ANM can scale better and have shown much better performance in operational systems, with systems operating successfully for close to a decade now at very high penetration levels. Learnings from other areas have shown that the inability to translate transmission level concepts, such as state estimation and accurately maintain the distribution system model represent serious shortcomings of model-centric operational approaches. Furthermore, the latency of such controls mean that if curtailment is required, this translates to much higher amounts than that required using real-time (second-by-second) control such as that characteristic of ANM.

That being said, we were pleased to see the discussion of the Varentec pilot (p. 46) demonstrating investigation into distributed control concepts. Building on the above statements, we feel that some coordination using distributed control across distributed VAr assets, such as the Varentec product, and the smarter inverters using would be a natural evolution and would optimize the use of these distributed assets.

Distributed control provides a compelling compliment to the central DMS through a low-cost, critical-location first, grid-edge approach. This distributed control architecture can be deployed in advance of the DMS and eventually cooperates with the DMS and gradually provide more, better data to back-office systems.

### DER participation

Utility-scale batteries are being deployed by third parties, as the companies are certainly aware, in multiple jurisdictions and learnings coming out of projects we are involved with in California (SCE/AMS) and NY State (GI Energy Con Ed). Both these projects will demonstrate coordination of the third-party objectives with those of the wires owner and the transmission system operator. We

encourage the companies to keep abreast of these developments and we would be happy to provide information as milestones are met.

## Other Considerations

### *Commercial agreements*

Controlling DER, in the form of curtailment or reactive power control, usually leads to specific commercial terms to address these issues. In the UK, managed interconnection has led to specific commercial agreements that define how curtailment should be treated. Curtailment assessments are often required as part of the interconnection process, whereby commercial projects are provided an estimation of the level of curtailment they should experience over the project lifetime. Interestingly, these estimates have been impacted by organic growth of behind the meter projects, further complicated these agreements.

The main point we would like to raise is that commercial agreements can become another delicate piece when dealing with customer assets and this strategy unfolds. Various learning reports has been put forth by the regulator Ofgem to capture best practice learnings that may be of value to the companies.

### *Cost Estimates*

As a final observation, in the cost estimate table (p. 88), the business as usual (BaU) solution still requires 185M$ of investment in advanced technology solutions versus 205M$ in the Grid Mod Alternative. We would simply question why only 20M$ more would be expected in the Grid Mod Alternative and what does the incremental 20M$ represent (IT/OT technologies, communication, other)? The PUC may have the same question.

## 6. Elemental Excelerator (EEx)

ELEMENTAL EXCELERATOR

Thank you for providing Elemental Excelerator (EEx) with the opportunity to comment on Hawaiian Electric's Draft Grid Modernization Strategy, submitted on June 30, 2017. We appreciate Hawaiian Electric's efforts to collect and incorporate broad stakeholder input.

EEx innovation companies partner with Hawaiian Electric to provide solutions that improve voltage regulation, load shifting, distributed energy interconnection, energy storage, system mapping – and many of these projects were discussed in the strategy. In reviewing the strategy, we were particularly interested in what the proposed approach would mean for **innovation, new ideas, and new technologies**. We reached out to our portfolio companies and other innovators to collect their thoughts, with the goal of leveraging their experience in Hawaii and other markets. We synthesized their comments and our own thoughts as follows:

1) **We think it would be helpful to provide a clear timetable for the rollout.**

   **Why?**
   The timetable laid out in the strategy lacks detail, which discourages companies from engaging in Hawaii. One of the best ways to attract the best solutions, which are often developed by nimble companies who are innovating on the grid and at the grid edge, is to provide clear market signals and timetables. These companies generally follow 12-18 month product roadmaps. In order to encourage these companies to address Hawaii's challenges and invest in our unique market, we need clear and predictable timetables. For example, Figure 24 and Table 8 provide little visibility into 1) how the utility plans to roll out programs and technologies, and 2) what the estimated procurement timelines are and for what.

   An idea from EEx crowdsourcing:
   Lay out a clear timetable to attract the best solutions and best talent to Hawaii.

2) **We think a faster, comprehensive AMI rollout makes more sense than a slower, "surgical" AMI rollout.**

   **Why?**
   - Slow rollout favors big companies with deep pockets, which is fine for core metering and network technologies. However, for related technologies and solutions, innovative companies won't be able to ride out the long implementation schedule and extended procurement processes.

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- Surgical rollout means incomplete data for utility program development, such as rate development, electrification of transportation, demand response, and distributed energy resource (DER) market development. For instance, it would likely be difficult to develop effective time-of-use rates – as well as to change behavior and measure results – if the utility and regulators only have data for people with solar or electric vehicles.
- Surgical, opt-in rollout means incomplete data for new solutions. Companies who have the best solutions need access to data that comes from AMI. If Hawaii doesn't have this data, the best talent and ideas will likely go elsewhere.

Two ideas from EEx crowdsourcing:

- Share a third scenario that is more expansive than the opt-in surgical rollout model proposed.
- Present both the capital and lifecycle costs of each scenario so that they can be more comprehensively understood.

**A question we have related to the rollout timing:**
It seems to us that having meter-readers (for analog) and data analysts (for AMI) would require duplicate staffing and resources. Would keeping the legacy metering system around add extra cost for the many years it would take to completely switch over – and keep Hawaiian Electric from spending time/money on things that make more sense for the future?

3) **We think it's important to provide customer offerings along with AMI rollout.**

Why?
AMI has the potential to provide real benefits to customers – more choices, more visibility, lower energy bills, etc. We would love to see customer offerings such as personalized bill disaggregation for homes and businesses, smart home devices and controls, and other solutions even for customers who don't have solar and other DERs. **We think this is especially important to provide benefits and bill savings to low- and medium-income customers who haven't had the means to purchase solar and others DERs.** From our experience working with utilities who compete for customers in deregulated markets, it is clear that customers value being able to see immediate benefits from new investments. Translating this to Hawaii, we also believe that such benefits will make non-energy nerds (we know they're out there!) more likely to support such an expensive – and largely invisible – modernization of the energy system.

Two ideas from EEx crowdsourcing:

- Require smart meter and network vendors to design and offer a bundle of customer- and grid-facing products for Hawaiian Electric to white-label upon deployment as a condition of their award (e.g., personalized bill disaggregation, safety devices). Ensure that low- and medium-income customers are included.

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- To better communicate the value to customers, highlight earlier in the document (prior to Page 88) that the strategy shows that AMI saves money in the long run compared to business-as-usual.

4) **We would love to see the strategy create a foundation for innovation and include a process for piloting and operationalizing new technologies.**

**Why?**
Technology is changing quickly and the success of the strategy depends on Hawaiian Electric rapidly identifying and scaling the most effective solutions. Without a mechanism to pilot and scale technologies to achieve the priorities identified in Section 8, companies offering these solutions will not know how to engage with the utility – and the utility won't have a clear process for finding, evaluating, and operationalizing new technologies.

**An idea from EEx crowdsourcing:**
Allocate funding (e.g. $20-30 million) for $1-2 million awards in project funding to technologies that are proven beyond the proof-of-concept phase and have potential to scale across the companies. Alongside this funding, establish a process with clear metrics for success and a pathway for successful pilots to scale to full deployment.[1]

We appreciate Hawaiian Electric's thoughtfulness in crafting this plan and consideration of assorted – and at times conflicting – stakeholder input. We view a modern grid with full AMI deployment as essential to unlocking tools, technologies, and talent to reach 100% renewable energy. We encourage the parties involved to work together to help Hawaii maximize this investment early.

With aloha,

Elemental Excelerator

[1] One model for this is Pacific Gas & Electric's proposal to the California Public Utilities Commission, as part of the California Triennial Electric Program Investment Charge (EPIC) Investment Plan, that maps investments to the electric system value chain in grid operations/market design, generation, transmission, distribution, and demand side management. http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M185/K576/185576316.PDF

# 7. Gridco Systems (GRIDCO)

GRIDCOSYSTEMS

## Gridco Systems Comments to Hawaiian Electric regarding the Grid Modernization Strategy Draft

Gridco Systems (GRIDCO) is focused on solving new grid challenges that arise with increasing penetration of distributed energy resources (DER), such as rooftop solar and electric vehicles. We provide voltage management capabilities located on the low voltage secondary side of the network. These capabilities enable utilities to decouple the challenges of managing the medium voltage system from those of resolving localized issues due to clustering of DER.

As a supplier to Hawaiian Electric, we have followed with great interest both the PSIP and Grid Modernization proceedings. The team at Hawaiian Electric is breaking new ground in defining how to transition the combined generation, transmission and distribution system so that it will service the islands with safe, reliable power while achieving the 100% renewables objective. There is no existing model at any other utility to follow.

We believe that combining both medium voltage and low voltage "volt-var" technologies is the crux of an effective long-term strategy for grid modernization. In addition to the basic technical benefits of stabilized voltage and minimized system losses, this approach provides additional grid visibility that can unlock stranded capacity of the legacy wires system. The approach is capital efficient and can be leveraged to defer specific large "wires" capital expenditures.

GRIDCO offers the broadest range of systems and solutions focused on the unique problems in the low voltage segment of the grid. These products include power electronics-based In-line Power Regulators (IPRs) and Static Var Compensators (SVCs), as well as supporting software, data management and communications platforms that can be integrated into any broader system management plan.

GRIDCO has reviewed Hawaiian Electric Company's (HECO) Grid Modernization Strategy (STRATEGY) and offers comments for HECO's consideration, based on our knowledge and experience, on the draft STRATEGY. We look forward to playing a role in addressing these challenges being experienced in the current grid operations leveraging our set of new technologies to resolve them. As part of an overall solution, we believe that it is entirely possible to ensure voltage stability while paving the way to support the 100% renewables objective for the state of Hawai'i.

1. **Support of the Grid Modernization Principles**

   While the draft STRATEGY discusses an architectural framework and specific principles before proposing the near term plan, we feel the final STRATEGY would benefit, and provide a more clear linkage between these and the investment recommendations if HECO provided additional information. These elements of a plan may already exist and may have been omitted for brevity in the draft. In any event, we believe it would help both the commission and other stakeholders understand the STRATEGY more clearly if they were added.

Phone: +1.844.4GRIDCO • +1.781.897.7500
10 L Commerce Way • Woburn • MA 01801
Fax: +1. 781.933.4195 • www.gridcosystems.com • info@gridcosystems.com

GRIDCOSYSTEMS

A. GRIDCO ***suggests*** that HECO include a structural and functional blueprint of the proposed modernized grid design that supports the stated Grid Modernization Principles, as well as a workplan/roadmap, detailing sequential technology investments to achieve the functionalities.
B. GRIDCO ***also suggests*** that HECO extend the STRATEGY beyond the near-term activities that attempt to solve immediate issues to a cost effective evolution of its distribution system to a grid that will empower all customers as participants in an integrated energy system. This should include the flexible integration of distribution generation (DG) resources, demand response (DR), batteries, EVs, fuel cells, and Home/Business Energy Management Systems.
C. GRIDCO ***further suggests*** that HECO provide a breakdown or explanation of the timing of expenditures that matches the plan, with the additional detail as mentioned in the previous sections.

**2. Voltage Monitoring**

It is our opinion that stabilized voltage is a critical foundational element in any grid modernization plan, especially when both DER and grid-side energy efficiency initiatives (including conservation voltage reduction, CVR) are taken into account. As such, and recognizing that HECO has invested efforts in developing an improved understanding of the state of voltage (including reactive power aspects) in your distribution networks, ***we recommend***:

A. HECO include, as part of a final grid modernization plan, a voltage analysis of primary and secondary distribution circuits. This is consistent with DOE's recommendation to conduct a power flow analysis to identify potential constraints on the system and scope the need for system investments based on operating criteria, such as voltages outside acceptable limits or overloading of equipment. This would inform HECO and your stakeholders regarding what is required to stabilize the grid prior to any grid modernization efforts.
B. HECO make a point of emphasis in the final plan that secondary voltage control is an essential tool not only as it relates to DG hosting capacity and simplifying the rooftop solar interconnection process, but also to support electric vehicles, CVR and overall voltage stability. Voltage stability is a critical function that should be integrated into a modern grid design, and provides beneficial flexibility by relieving constraints on the medium voltage control systems.
C. HECO include a discussion of the potential for volt/var optimization, or conservation voltage reduction (CVR), to produce savings that can reduce the cost to ratepayers in support of the overall grid modernization effort. There are a number of commercially available voltage control technologies that could be integrated to achieve maximum CVR savings and ensure voltage stability all the way to the customers' meter, several of which are already involved in trials at HECO. We believe it would be valuable to document the current understanding, trial results, pros and cons of each of these offerings as part of an evaluation of options, as part of this discussion section.

GRIDCOSYSTEMS

**3. Technology Solutions**

While we are not an AMI solution provider, we believe that the benefits of such a system are significant enough in the long run to include in a more forward looking version of any grid modernization plan. There is growing evidence from a number of utilities to support this position. So while we realize there may be opposition from some stakeholders to such a plan, we encourage HECO to continue to explore the option and push the industry to offer viable solutions.

Visibility to load/generation and voltage by customer, in near real-time will become more and more important for achieving 100% renewables in a cost-effective manor. It is hard to imagine optimizing the system without impact to ratepayers while leaving in design margin to account for the lack of localized visibility, such as would be helpful in the case of rooftop solar or electric vehicles, and with no mechanisms for control.

A. GRIDCO ***suggests*** that HECO include a long-term plan for wider AMI deployment. We believe AMI meters will be necessary to deliver the capabilities and functionality as outlined by the Commission. AMI provides the best means of voltage monitoring by gathering voltage readings at the point of interconnection at the edge of the grid – at customers' meters. Data from an AMI system can be used as part of an active, comprehensive secondary grid stabilization system, while providing information to customers that empowers them to adapt consumption behavior and enhance demand response programs, for example.

B. GRIDCO ***recommends*** that HECO broaden the discussion of voltage solutions in the grid modernization STRATEGY to include Volt-var management software, distribution secondary regulator devices (including both IPR and SVC classes of device), and other voltage management technologies that have successfully completed trials at HECO. A number of these have demonstrated their commercial viability for supporting roles in the near term, while laying a foundation for grid architecture that leverages their complementary capabilities.

C. GRIDCO ***strongly urges*** HECO to clearly articulate how secondary voltage regulation devices are intended to support the grid – whether for resolving local issues that are difficult to manage from the medium voltage level or for feeder voltage shaping. In both cases, the STRATEGY should consider whether conventional alternatives, such as medium voltage capacitor banks with modern controls, might offer a compelling alternative to achieve the same objective. Our opinion is that secondary voltage regulation is most cost effective and offers the greatest return when used for localized purposes.

## 8. Silver Spring Networks

Silver Spring NETWORKS

**August 9, 2017**

**Hawaiian Electric Companies**
PO Box 2750
Honolulu, HI 96840

Attention:

**COLTON K. CHING**
Senior Vice President, Planning & Technology
colton.ching@hawaiianelectric.com
*Notice Delivered Electronically*

**SUBJECT: SILVER SPRING NETWORKS COMMENTS TO JUNE 30 DRAFT MODERNIZING HAWAI'I'S GRID FOR OUR CUSTOMERS**

Colton and Team:

In the spirit of our continued strategic and long term partnership Silver Spring Networks supports and is able to execute against the requirements contained within the context of the Draft Plan. We have provided examples and additional support materials for your consideration.

We are all are working toward the same goal. A Grid Modernization Strategic Plan that can be executed with minimal risk and that also maximizes customer value. The final plan must be: affordable, reliable, and provide *all* customers with energy choice while accelerating the attainment of State of Hawai'i's 100% renewable portfolio standard by 2045.

Silver Spring offers the following comments and suggestions to the recent June 30, 2017 draft titled: Modernizing Hawai'i's Grid For Our Customers.

- **Support and Execution:** Silver Spring supports and is able to execute a proportional strategy. We have experience with several other customers and have successfully implemented strategic deployments that target select customers across diverse geographic regions, target specific program participation or other parameters for the basis of inclusion onto the network.

- We are proud of the results from the technology demonstration over the past few years. This project provides Hawaiian Electric and all stakeholders with direct evidence of our security, connectivity performance, reliability, and flexibility – all of these are foundationally important and reduce the risk for any future large-scale programs.

- **Considerations:** It may become challenging to maintain or lower business operational costs with an "Opt-in" implementation strategy. This model will potentially increase the complexity of core business practices and require redundant or non-concurrent processes. Other Factors:
  - A proportional deployment does not provide a comprehensive view of the distribution grid, which is a core objective of the strategy.
  - Does not enable all the 'typical and customary' financial benefits

Silver Spring NETWORKS

- A proportional deployment strategy has the potential to drive a deeper divide between customer rate structures
- Given the substantial time an effort required to develop a Strategy and Implementation Plan of this magnitude, we suggest consideration for more tactical implementation. For example, an accelerated tactical grid modernization plan that will enable Molokai to reach 100% RPS by 2020.
- We strongly support the convergence concept outlined in the Plan. However, its success is typically predicated on directives or incentives that catalyze stakeholders to work together to adopt a common communications platform.

- **Final Consideration:** Given the substantial time an effort required to develop a Strategy and Implementation Plan of this magnitude, we suggest consideration of a concurrent tactical implementation while the process evolves and reaches conclusion. For example, an accelerated tactical grid modernization plan that will enable Molokai to reach 100% RPS by 2020.

- **Stakeholder and Business Benefits of a Molokai First Approach:**
  - Demonstrates immediate leadership across multiple stakeholders
  - Ability to explore alternative Business Models and Capital Investment Requirements
  - "Jump-starts" the process and sets Hawaiian Electric up for additional success and learning
  - Demonstrates immediacy and concern for action towards Molokai's 2020 100% renewable goals
  - Leverages current Foundational Investments (e.g., headend and back office)
  - Demonstrates expanded convergence of multiple applications on one network:
    - Electric and Water Meters
    - Streetlights
    - Distributions automation / sensors
    - Smart invertors and/or "upgradeable" invertors to facilitate more DER's
      *note: Silver Spring networks is in an active large scale pilot using IEEE 2030.5 standards to connect invertors using our IOT router*
  - Provides additional energy use data to facilitate new rate structures for "Opt-In" and other system and circuit level upgrades that can be supported with actual and real time data
  - Directly targets low-income users for participation and value
  - Enables ability to structure a rate design that motivates low-income participation
  - Provides a concurrent test procurement path to accelerate timelines and process for the larger scale RFP efforts across all islands

As a reminder Silver Spring is a networking Company. This is our core business. We design, build and operate networks that connect the internet of *important* things. We have never left a customer stranded with legacy technology or without a compatible path for newer generation releases. This is a bold statement and we are proud to be recognized by many industry leaders as the only "Future Proof" provider of IoT sensors that exists today. This includes sensors that exist today and those that have yet to be thought of for tomorrow.

Silver Spring Networks, Inc. • 230 West Tasman Drive • San Jose, California 95134 • T +1 669 770 4000 • ssnl.com

Moreover, we continue to make significant R&D investments into broadening and improving our IoT network and platform of applications and services. We hope this information is helpful and has provided additional insight as the Hawaiian Electric team continues to solidify its Grid Modernization initiatives.

We appreciate the opportunity to earn your business and look forward to the successful adoption by the PUC of Hawaiian Electric's Grid Modernization strategic and tactical plans.

The entire Silver Spring Network's team remains available at your convenience.

Regards,

Jeff Wright
(Digital signature)

Jeff Wright | Vice President Western US
Silver Spring Networks

***Attachments:***

- *Foundational Accomplishments*
- *Foundational Charts and Results*

Silver Spring Networks, Inc. • 230 West Tasman Drive • San Jose, California 95134 • T +1 669 770 4000 • ssnl.com

## 9. Cisco Systems

# Cisco Systems, Inc., Response to Request for Comment

**Hawaiian Electric Company
Grid Modernization Strategy**

Hawaiian Electric
Maui Electric
Hawai'i Electric Light

**August 9, 2017**

cisco

Cisco Systems, Inc.

CISCO

## Legal Disclaimer

Thank you for the opportunity to submit this non-binding (other than pricing for now-available products listed in our quotes) proposal for your consideration. Please note that this proposal may include proprietary, confidential, and/or trade secret information which, if included, will be clearly marked as such in the proposal. Any information that Cisco considers to be a trade secret will not be subject to disclosure under any public records act.

We [may] have referenced information about future technology such as products and features under development that are not generally available from Cisco today. Because this technology is in various stages of development, all information concerning this future technology, including whether we will continue development, its availability, pricing, and included features, is subject to change and will be offered on a when- and if-available basis.

This proposal is valid for a period of ninety (90) days from the date of proposal submission.

## Trademarks

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CISCO

## Introduction

The purpose of this document is to comment on the telecommunication aspects proposed in Hawaiian Electric Company's (HECO's) Grid Modernization Strategy. Within the Strategy, Section 7.5 addresses Telecommunications necessary to support Grid Modernization. Section 7.5.2 proposes a two-step mesh network build-out approach to support edge devices as one option and then follows by describing an all-cellular network as a second option. Comments in this document attempt to show how the mesh option offers greater strengths and minimizes risk whereas the all-cellular option may not be capable of meeting evolving functional requirements and therefore contains business risks. This is not to imply that cellular has no place in HECO's strategy since it can accommodate some business requirements. These observations are being offered to HECO for consideration and stand as material subject for future discussion with HECO professionals.

The three most important suggestions made in this document are:

1. **Choose telecommunication architectures that can support increasing sectionalization.** Whether for performance, flexibility, or security reasons, network sectionalization is a key capability for mitigating future risks and constraints.
2. **Choose telecommunication architectures that can support increasing deterministic qualities measured as latency and predictability across time.** Even if the present distribution grid only calls for moderate deterministic features, the future distribution grid will likely demand significantly more real-time control capabilities.
3. **Choose telecom architectures that can support distributed computing.** The future electric grid is losing its dependence on centralized generation and instead generation will be distributed. It seems imperative that the telecom and control systems also become de-centralized.

## The Need for Sectionalization

The Grid Modernization Networking Strategy calls for a layered architecture including Wide Area Network (WAN), Field Area Network (FAN), and Neighborhood Area Network (NAN). At a basic level, splitting the network into WAN/FAN/NAN layers is the first step toward sectionalization. Layered networks help facilitate performance, reliability, and security – which are the hallmarks of control systems networking. This presumes HECO is in full control of each network layer and that each layer has been architected or can be re-architected to effectively support HECO's unique and evolving requirements. Otherwise, the network will appear to the distribution grid operator as a monolithic infrastructure incapable of HECO's optimization.

A review of current networking activities among US-based electric utilities would reveal most utility WANs, FANs, and NANs lack many important features and are incapable of supporting modern grid needs. This sentiment seems to be echoed in HECO's statement that "each tier of the modern electric grid communications network requires pervasive data communications at higher rates and lower latencies than utility communications networks have provided in the past." If this interpretation is correct, it

provides evidence that grid requirements are evolving and that they are increasingly demanding. Capabilities such as sectionalization are critical for accommodating evolving and ever-demanding business needs. Furthermore, mesh network sectionalization permits the network operator to just optimize the areas where needed without burdening the areas where further optimization might not be needed.

The Grid Modernization Strategy calls for the implementation of various grid devices that can sense the state of the grid and be used to control its operation. The presumption is that these devices will be capable of sensing and responding to anomalies in sufficient time such that electric service delivery can be sustained. These new devices are planned to be deployed at substations, out on the distribution grid, and within customer facilities. Therefore, an improved WAN is needed to the substation. New FANs and NANs are needed to support modernized distribution facilities for HECO-controlled devices, and an Extranet is needed to support third-party service suppliers such as Aggregators for interacting with non-HECO controlled devices. What is unclear however, are the performance requirements for these devices and the applications they support.

This uncertainty begs the question as to whether 'best-effort' networks (WAN, FAN, and NAN) could accommodate Grid Modernization or if 'high-performance' networking is required. The spectrum of options and the associated cost structures between these two extremes can be extensive. One report on IEEE 1547 and IEEE 2030 [Report: *IEEE Smart Grid Series of Standards IEEE 2030 (Interoperability) and IEEE 1547 (Interconnection) Status*] describing system requirements for Distributed Energy Resources (DERs) states, "For significant levels of penetration…, it is practically assured that the initial stabilization action has to be independent of critical communications having long latency." Another report (Report: *IEEE COMMUNICATIONS SURVEYS & TUTORIALS, VOL. 15, NO. 1, FIRST QUARTER 2013*) indicates, "The Demand Resource (DR) must detect the unintentional islands and cease to energize them within two seconds." It goes on to say, "The latency in the case of anti-islanding was estimated to be maximum six cycles or 100 msec." Please note that these values reflect overall operation, whereas the communications portion might only be half. Although it might be too early to set specific latency specifications for high renewable penetration situations, it should be noted that even these values are quite close to the fringe of what some networking technologies or network services are capable of providing. For those technologies, the risk HECO faces is what to do if the distribution grid demands even greater determinism, if those network services become congested, or if growth on those networks increases faster than remediation projects can accommodate. (Note: Determinism should include latency measured using worst-case situations, including nominal distances, network loading, and circuit establishment.)

## Suggestions for WAN Communications

Regarding WAN communications, HECO indicates that all of its generation facilities and transmission substations are connected using fiber optic, point-to-point microwave, point-to-multipoint wireless, leased wired, and commercial cellular data modems, and that approximately 53 percent of distribution substations are connected. It is further stated that, "Substation WAN deployment would be expanded to incorporate prioritized

distribution substations and would use leased wire line." HECO's position that "pervasive data communications at higher rates and lower latencies" will be necessary for Grid Modernization indicates an expectation that some of the existing WAN systems will need to be upgraded. What seems unclear are the technology choices HECO expects to make to remediate these shortcomings.

Fiber technology has expressly large capacities and capabilities, therefore where it exists it is likely that the supporting fiber electronics may need upgrades. Any replacement fiber electronics should be based on packet technology (the choice for modern communications systems) rather than traditional Time Division Multiplexed (TDM) technology. What might not be so obvious is that most WAN sites will still require isochronous services. Therefore it is necessary to choose packet solutions that can support isochronous TDM-based services. In addition, many electric utility companies are advancing their grid systems by utilizing specialized time-based and deterministic services such as synchrophasors and advanced forms of teleprotection. Therefore, HECO should give preference to packet-based WAN communication systems having high deterministic characteristics as well as TDM adaptation services.

This point raises two key questions around HECO's stated WAN strategy. First, 'What is the impact of Grid Modernization on substations that use point-to-multipoint wireless, leased wired, and commercial cellular data modems?' Point-to-multipoint wireless and commercial cellular data modems do not typically provide isochronous, time-based, or deterministic services. Second, assuming they can still be acquired, 'How long will leased wired services having the necessary capabilities be available?' Leased wired services that are isochronous or deterministic are being discontinued by public service providers. Replacement leased wired services are packet-based and generally do not provide deterministic capabilities. While the emphasis on the proposed Grid Modernization solutions focus on the FAN and NAN, care should be taken in the WAN such that any new investments or service contracts be sufficiently strategic to accommodate evolving grid applications.

## Suggestions for FAN and NAN Communications

Whereas most FAN and NAN applications do not typically require isochronous services, proper distribution grid control may indeed demand some degree of deterministic capabilities, albeit perhaps not to the same degree that applications in the WAN might require. HECO's Figure 19 shows relative bandwidth and latency requirements of various applications. Situational Awareness, Strategic Field Area Network Infrastructure, and Distribution Grid Management have the greatest need for low latency — perhaps approaching the millisecond range. This seems consistent with the IEEE reports mentioned above. It should be noted that the need for low latency is not just for control; awareness (or sensory information) is also dependent on low latency. This raises the following questions: 'How much deterministic performance is necessary for distribution grid applications?' and 'What communication systems are capable of supporting such performance?'

Unfortunately, little historical information exists to help answer these questions with high specificity. This is partly due to legacy distribution grids not having to function at the same performance level as those with high amounts of distributed generation and

distributed storage systems. To exacerbate the matter, future distribution grids in Hawaii will have increased levels of distributed generation and storage, likely requiring even higher degrees of controllability. Mechanisms such as centralized inertia, which help keep distributed things functioning properly, seem to be becoming marginalized. If this is the case, then might system determinism for grid applications become even more important for sustaining quality electric services? Should communications supporting the evolving distribution grid also be capable of greater determinism and reliability, or can lesser-capable communications systems adequately support the grid? These questions must furthermore be considered in the context of increasing quantities of devices out on the grid. HECO presently has few devices supporting the distribution grid and its Grid Modernization proposal calls for the addition of more utility-owned and -controlled devices along with many more third-party owned, but utility controlled devices (such as smart inverters). It seems likely that the growth in device quantity will be orders of magnitude greater than what exists today. What is the impact of tens or hundreds times more devices burdening the communication and control systems in terms of performance and capacity? These questions are even more important to consider for shared access, non-deterministic communication systems such as point-to-multipoint radio and commercial cellular. Therefore, HECO should plan for how any proposed FAN or NAN could accommodate higher performance and significant growth.

## Strategies and Contingencies for Accommodating Sectionalization and Determinism

Private communication systems can be engineered for high performance and accommodating growth. Fiber optic systems have high bandwidth and low latency, and as such offer significant margins for variation in forecasted needs. Radio systems can be engineered for degrees of performance and offer adequate margins for variation. Should abnormal grid-device growth occur, private radio systems can be re-engineered to accommodate capacity and performance. Radio systems that use radial topology can be re-sectored or new towers can be constructed. Mesh-based radio systems can easily be improved by adding inexpensive take-out points. Advanced mesh systems such as WiSUN can achieve best performance by optimizing hop counts. The cost structure for upgrading each of these technologies varies widely. A ranking exercise of each could prove informative. Yet all of these private network systems would be under HECO's control should the need for modification or alteration arise.

Where HECO utilizes commercial cellular, it should factor the risks of evolving deterministic requirements of distribution applications and for accommodating growth of grid-supporting devices. Commercial cellular performance is not under HECO's control. Therefore, should distribution grid applications demand unique determinism (whether initially or eventually) that commercial solutions cannot provide with acceptable reliability, private network solutions might be required. This evaluation should be made in critical situations. In average situations, users of commercial cellular systems enjoy broadband services with acceptable latency. But in abnormal situations such as emergencies or during social-driven events, mobile users can temporarily overwhelm the systems thereby preventing communications to critical infrastructure. Therefore, it

might benefit HECO to diversify any dependence on commercial services for supporting critical grid operations such as situational analysis and grid control.

The Grid Modernization Strategy contemplates two options for building out the telecommunications infrastructure. Its first option would utilize a combination of WiSUN for NAN communications and commercial cellular service for initial backhaul, which will eventually be supplanted by a private backhaul solution. The other option uses an all commercial cellular solution. When contrasting the two options, HECO describes support for peer-to-peer communication, Quality-of-Service (QoS), and system reliability are necessary networking capabilities.

Peer-to-peer communications on WiSUN networks can be extended between devices across different NANs using routing functions provided by the FAN. Although the strategy indicates peer-to-peer is not supported by cellular, commercial service providers have indeed begun to offer peer-to-peer routing. There are several key differences between the two options: First, peer-to-peer routing on commercial cellular systems generally occurs centrally as opposed to occurring at the remote cell site. This is largely due to the architecture of cellular systems in addition to the predominance of Internet traffic that is interconnected to the Internet at central locations. Second, centralized peer-to-peer routing is burdened with the service provider's backhaul systems. This reduces reliability and inserts transport and switching delays should deterministic traffic be required. Third, peer-to-peer routing is under the control of the service provider rather than the electric utility. This becomes a weakness for potential security architectures. HECO's strategy goes into great detail regarding the concern for security as new devices get added and more third-party devices become part of HECO's control responsibility. WiSUN mesh architectures offer HECO the ability to control security centrally, at aggregation sites, and at the edge. If peer-to-peer routing were deployed by the commercial cellular provider, HECO would the loose the ability to maintain direct security control at the central and aggregation sites. This could present very complex security remediation constraints should any edge node become compromised.

Private WiSUN mesh networks have the advantage of providing localized routing if it is needed and are under the control of their owner (HECO) for specialized performance, reliability, and security needs. They work in conjunction with commercial cellular as the FAN backhaul as HECO's Grid Modernization Strategy describes. And although HECO envisions supplanting commercial backhaul with a private solution, it might be worth considering operating both private FAN as well as commercial cellular for FAN backhaul as some other electric utilities have chosen. This can help sustain performance and uptime in critical situations while diversifying operational risks. In those hopefully rare situations, certain features may not be optimal.

Quality-of-Service services could be offered by commercial cellular providers through the use of priority Bearer services. However, doing so can adversely impact system capacity for the growing user base as wireline users continue to move to mobile networks. Instead, some commercial cellular service providers are offering lower quality services such as narrow-band LTE for machine-to-machine traffic, which would decrease the burden on general data services. While narrow-band LTE services might be great for sensory applications, it remains questionable whether it can adequately

support control application requirements described in the above-mentioned reports on distributed resources.

The Grid Modernization Strategy also noted reliability as a concern. HECO reminds us of two high-profile occurrences when weather anomalies caused commercial cellular network failures. Other growing concerns include social situations where crowds (whether at known venues or at random places) can overwhelm commercial systems. Ironically, these places can be where electric service is most needed, yet if the public overwhelms the communication systems, any dependent electric systems could suffer.

## Cybersecurity Concerns

HECO's Grid Modernization Strategy includes the implementation of a "two-prong approach" at cybersecurity. While the security challenge of IEEE 1547 has been identified, a solution does not appear to have been offered. DER devices under control of HECO via its FAN and NAN could benefit from the implementation of layered security services. Due to the nature of layered networks under HECO's direct control, security services could be deployed at the DER endpoint, the NAN aggregation site, the substation, and at the central control site.

The benefit of layered services is greatly apparent when considering the remediation process, expense, and impact of a cyber-event. Rather than use a single centralized control point for security where the entire distribution grid would need to be isolated (causing what would likely be overwhelming detriment to any grid that was predominantly renewables-oriented), sections and even subsections of the distribution grid could be quickly isolated and then restored. The analogy is of a checkerboard where blocks represent individual NANs covering individual neighborhoods containing perhaps sub-100 devices. This approach would not only minimize the impact of electric service delivery, it would also keep security remediation costs low since the zone of potentially cyber-impacted devices would be marginalized. Security is further improved by using the network as a cybersecurity sensor. There are multiple ways a distributed control system could be deployed in which the data could be examined and cyber-events kept to a minimum.

## Distributed Compute

While sectionalization and determinism have been the focus of this paper, the tightly associated concept of distributed compute is of equal importance. In fact, it is somewhat related to achieving sectionalization and determinism. By transitioning from centralized decision making to distributed decision making, the performance of the network (measured in determinism) can increase. However, this necessitates communications architectures that can accommodate sectionalization. Some centralized architectures such as commercial cellular cannot be (or will not likely become) sectionalized. They are huge hub-and-spoke architectures. As such, they resemble the legacy centralized generation grids that electric utilities are moving away from as they move toward decentralized and increasingly autonomous distributed systems.

As a technology, distributed compute systems are growing rapidly due to the popularity of publish/subscribe systems on the Internet. But the mechanisms can also be accommodated over private networks. Smart devices publish information that is

consumed by those systems that subscribe to the information, and the information that is published can be subscribed to by multiple applications. This lessens the burden of interoperation between applications. They can run autonomously or in federation with other grid applications. Metering, Demand Response, Fault Location Systems, and Distribution Management Systems can each subscribe to the data coming out of sensors across the grid.

It becomes necessary for distributed compute to be available to achieve this level of autonomy, interoperability, independence, and performance. This is exactly the kind of future envisioned by the OpenFog movement and being tested by utilities such as Duke Energy and CPS Energy. The movement is not merely supported by electric utilities, it appears to be becoming a widely adopted framework for software-defined solutions.

## Acronyms

| | |
|---|---|
| DER | Distributed Energy Resource |
| DR | Demand Resource |
| FAN | Field Area Network |
| HECO | Hawaiian Electric Company |
| IEEE | Institute of Electrical and Electronics Engineers |
| LTE | Long Term Evolution |
| NAN | Neighborhood Area Network |
| QoS | Quality of Service |
| TDM | Time Division Multiplexed |
| WAN | Wide Area Network |

# 10. Verizon

## I. General:

Verizon found the information presented within the draft report regarding customer and stakeholders issues and interests to be both informative and valuable.

As to the information presented on telecommunications technologies, Verizon believes this section is inaccurate and is lacking with respect to cellular communications with a predisposition towards legacy RF Mesh communications. In addition, the information on cellular communications contains mistatements (e.g., cellular systems do not enable peer-to-peer communications, and cellular systems do not support quality of service) and mischaracterizations (e.g., cellular systems may not provide adequate reliability during storm conditions, and cellular networks as shared public infrastructures only solutions).

The draft report presented no information on LTE Category M, which is the leading, global, open standards-based, cellular communications technology for private IP-based machine-to-machine networks (or the Internet of Things). Verizon's conclusion is that this omission is due to an "information-gap" within the utility industry with respect to current advanced cellular machine-to-machine networking for both licensed and unlicensed spectrum. Verizon would like to provide HECO, and its regulators and any interested stakeholders, with a focused technical workshop where Verizon telecommunications networking and smart grid solution experts can provide detailed and factual information on 4G / 5G Long Term Evolution (LTE) telecommunications, on the broad adoption of LTE Category M throughout the world as the leading Internet of Things communications platform, and on how HECO (and the State of Hawai'i) could leverage an island-centric Verizon Grid Wide Private IP LTE Category M network as a service platform. Verizon believes that this information and knowledge transfer is fundamental for HECO, it customers, and its regulators to make both an informed and obsolescence de-risked decision on the future of HECO's grid modernization telecommunications.

## II. LTE Primer:

While the primary goal of Long Term Evolution (LTE) is to increase the capacity and speed of wireless data networks using new DSP (digital signal processing) techniques and modulations that were developed around the turn of the millennium, a further goal is the redesign and simplification of the cellular network architecture to an IP-based system.

Today, there are over 521 LTE cellular networks deployed in 170 countries, that cover a high percentage of the those target populations. In addition, there are 1,000s of LTE devices, available from a wide ecosystem of suppliers, that seamlessly work and communicate together over these IP-based LTE networks.

The 3rd Generation Partnership Project (3GPP), whose scope includes the development of the LTE standards, is a collaboration between the following groups of global telecommunications associations, known as the Organizational Partners:

| | |
|---|---|
| • Alliance for Telecommunications Industry Solutions (ATIS) | USA |
| • Association of Radio Industries and Businesses (ARIB) | Japan |
| • China Communications Standards Association (CCSA) | China |
| • European Telecommunications Standards Institute (ETSI) | Europe |
| • Telecommunication Technology Committee (TTC) | Japan |
| • Telecommunications Standards Development Society (TSDSI) | India |
| • Telecommunications Technology Association (TTA) | Korea |

The participants in the development of LTE include the world's leading network operators, telecommunications equipment suppliers, and consumer products companies.

The 3GPP uses a system of parallel "Releases" which provide developers with a stable platform for the implementation of features at a given point, and then allows for the addition of new functionality in subsequent Releases.

The goal of LTE Category-M, specified in LTE Release 13, is to provide an open, IP-based, Low Power Wide Area Network (LPWPA) internetworking solution for the myraid of devices that make up the Internet of Things. The core design principles of LTE Cat-M are to (i) be compatible with existing LTE networks, (ii) provide support for both non-rechargeable battery and powered devices, (iii) extend radio coverage for hard to reach devices like smart meters and smart inverters, and (iv) enable the cost of LTE Cat-M modules to be under US $5 by the end of 2019.

Some notable features available in LTE CatM that are required to realize a self-adaptive, self-optimizing, and self-healing 100% renewable energy-based electric grid, are:

- Peer-to-peer device communications using standard IP-based unicast routing, with an average communications latency of a few hundred milliseconds between the two devices, regardless of the data payload size or their location on the network.
- Peer-to-multipeer device communications using IP-based broadcast multicast services, which are fundamental for the near-real time signaling of both grid events (e.g., voltage levels and frequency imbalances) and energy market pricing to participating smart devices.
- Point-to-multipoint communication path, which is fundamental for providing reliable, deterministic, power outage and restoration signaling that is not impacted by "broken" communications hops due to the outage event.
- Dedicated "machine only" frequency band within the LTE network, thereby enabling machines to communicate without interference or contention from consumer mobile devices (e.g., phones, tablets, vehicles).

- **Quality of service communications, which enables grid protection and operational control messages to take priority over best effort data reports (e.g., daily consumption meter reads).**
- **Integrated, mutually authenticated, secure channel communications based upon the leading government and industry guidelines, standards, technologies, and algorithms.**

## III. Verizon Grid Wide Platform:

The Verizon Grid Wide platform is a secure, private IP-based LTE CatM network that is segmented from the Verizon LTE network that is used by Verizon's retail and enterprise customers. As such, Grid Wide provides each utility customer with their own "virtual private network" infrastructure.

As previously discussed, given the critical nature of the Hawai'i's Grid communications, Verizon is willing to extend its LTE network infrastructure on Hawai'i such that these communications would never leave the islands. In addition, Verizon is willing to collaborate with HECO to design, build, and implement a joint disaster-recovery program to ensure around-the-clock availability and reliability of the Verizon LTE network in Hawai'i.

The draft report questions the reliability of a cellular networks during emergency conditions, without raising similiar concerns for RF Mesh networks (which have more pole and building mounted collector devices that are subject to the same storm conditions). This is where it is important to distinguish between networks, because no two networks are the same. At Verizon, we take reliability personally. We have invested on average $6B per year in our network infrastructure since we became Verizon Wireless, and plan to invest an additional $11B in 2017. There is no public cellular carrier in the US who has invested more in that same time. The result is a highly reliable and resilient network. We can provide specific details in terms of architecture, design and network performance in emergency situations in a confidential setting. We have evolved our network through decades of experience and learnings including disasters such as hurricanes, wild fires, flooding, earthquakes and tornados.

We have attached a document that outlines our Business Continuity-Disaster Recovery (BC-DR) strategy and approach (It is named VZW BC-DR customer content February 2017). The question isn't what the impact of an unexpected event was, it is how we respond. We bring the weight of a $130B, global technology company with over 160K employees to the table.

Further, the draft report also mischaracterized "cellular network oversubscription" in these times of emergency conditions. We can, in a confidential discussion, discuss how we architect our network to address this or how we have numerous assets ready to deploy in emergency situations to support the LTE network availability and reliability needs of all of our customers. The draft further stated that Quality of Service (QoS) is "only now developing" and "if QoS becomes available". Verizon Wireless released QoS capability in its LTE network late 2016. This capability utilizes standardized IP-based Differentiated Service Code Points (DSCPs), that enable the Verizon Grid Wide platform to deliver a seamless, end-to-end quality of service across its wireless and wireline network components.

### 11. Navigant

Navigant also provided comments, but the body of the email is included within this report due to the size of the attachment, which provided in-line edits on the nearly 250 page draft Grid Modernization Strategy. Those comments were noted and incorporated into the final version of the Strategy as appropriate.

| | |
|---|---|
| Date: | Tue 8/8/2017 5:56 PM |
| Subject: | Grid Modernization Strategy - Edit Suggestions and Comments |
| Body of the Email | Colton,<br>Attached is the grid modernization strategy document with some suggested edits/comments. My general impression is that the document is very well structured and provides a lot of information necessary to educate the different stakeholders. In general, my main comments are directed at connecting, explicitly, every Grid Mod investment to customers benefits, and the accomplishment of the PSIP and State policy as planned (meeting the milestones along the way).<br>The two questions I kept asking during the review were:<br>• What's in it for me (from the customer perspective), and<br>• how is the 100% renewable target affected (delayed, or missed) if the investments proposed in your plan are not approved by the PUC, or approval is substantially delayed.<br>I am happy to discuss further with you and your team. Further, I offer my help, and Navigant's if you think it may be of value.<br>All the best.<br>Hector |

## E. IN-PERSON COMMENTS

In addition to the Town Hall meetings, the Companies met with various stakeholders in person between the filing of the Draft Strategy document and the completion of the final filing. Input from all of these meetings helped to educate the final Grid Modernization Strategy filing.

### 1. WiRE Meeting

The Companies attended a meeting with the Women in Renewable Energy forum on Oahu. Notes from that meeting are below.

**WiRE Breakout Session Notes**
**August 4, 2017**

**Topics generated through "popcorn style" group activity**

- What are the pros and cons of full vs. partial rollout? (10)
- How are we handling cybersecurity? (22)
- Who is responsible for interconnection costs?
- What is the relationship between smart grid and smart cities? (15)
- How are we prioritizing rollout – who gets it first?
- What level of visibility and control of DER does the utility need? (14) (16)
- How will the utility handle households that want to go off-grid? (14) (13)
- What public policies can facilitate smart grid? (8)
- Should advanced inverter features be implemented before DERMS, etc.?
- Timing of technologies roll-out? (12)
- Visibility and accountability of data – what's utility's responsibility?
- Will there be penalties/costs for customers who "opt out" (renewable obligations for customers)?
- How will this impact rates? Cost/benefit/commercial/residential and interconnection? (40)
- What would you like to be able to do as customers after rollout?

Following the initial group brainstorming, the WiRE facilitators conducted an initial voting by hand to evaluate the issues of greatest interest (three votes per attendee, initial votes in parentheses above), grouped similar questions and issues, and sought consensus among attendees as to the final four topics of greatest interest. The members were allowed to self-select which group they would join based on the topic and they could also move among the groups during the breakout session.

**Breakout Sessions**

1) **Cost: How will costs be allocated?**
   - What is the methodology behind the Company's cost allocation plan?
   - What costs will be fixed vs. variable?
   - What benefits can be monetized?
   - Concerns regarding allocation of shared costs initially bore by individual customers
   - Take up to higher level, how fits with GMS
   - Incentives not leave grid, make grid attractive
     - Exit fees, standby charges
   - Transparency of partnership between utility and customers
     - Need to enhance confidence and relationship
     - Provide monetary incentives to stay on the grid
2) **Cybersecurity: What is the plan?**
   - 5 elements
     - Identify, detect, protect, respond, recover
     - Each element of grid needs its own cybersecurity
   - Issue – no standardized body/requirements for cybersecurity
   - HECO can't control all the individual homes/companies
     - Can only control at aggregation points
     - This is vulnerability
   - Can no longer look at this as a perimeter that can be protected, now there are multiple entry points
   - HECO's standard contracts have cyber security requirements
   - HECO is working on revised standards for new IPPs to include in PPAs
   - Standard requirements vendors must meet
   - Business systems and operational systems need protections. Systems are converging. Before these requirements were separate and different, but now that systems are converging HECO has to look at how to merge the protections.
   - Hoping industry standards advance for pieces that can't be controlled (e.g. – DER), but HECO is increasing monitoring program until industry develops standards
   - Electric grids around the world have been compromised
     - Ukraine example – HECO taking lessons learned
     - One thing HECO is doing is monitoring who is logging-on on-site vs off-site

- Hawaiian Electric has an incident command team and a cybersecurity response plan in the case of a cyberattack
- HECO monitors internet probing
- Can isolate events at endpoints (user, server)
- Section 7.6 of plan discusses cybersecurity
- Adopting best practices from throughout the industry, not just looking in one place or one recommendation.

3) **Visibility and Control of DER**
   - Data accountability (visibility) ownership - who is responsible to determine? Access to data is critical for competitive positioning for businesses
   - Data – responsibility lies with both the utility and the customer/user to share. Examples from other industries.
   - Data must be acted upon and utilized to have value
   - Customers must be allowed to opt-out rather than opt-in
   - Communication is critical – between utility and customer and customer/DER and utility
   - New tools and software are needed for data management – new intelligence needed
   - Identification of sources of data and sharing
   - Need clarity – don't know what data you need until you know what you need it for
   - When is visibility needed to protect public?
   - When does public interest come into play?
   - Take what aggregators do to analyze to achieve meta level information - exchange signals instead of data
   -

4) **Grid Defection: How should the utility handle customers who wish to go off-grid?**
   - Why is this important?
     - Going off-grid is becoming more and more popular, and affordable; it's a growing population
     - Going off-grid affects costs for utility and prices/rates for customers; GMS needs to be economical – should utilize public policy to manage grid defection
     - At a high level, aside from our state mandate, Hawaii has pledged to do what we can to meet the Paris Agreement.
     - To be successful as a state (reaching RPS goals) we all need to cooperate and make sure we are heading in the same direction

  - There is an economic impact to people leaving the grid, and as a result, equity issues that need to be addressed (only rich can afford to leave, placing burden on those who stay connected/cannot afford to go off-grid)
- How should the utility handle grid defection?
  - Make staying connected more cost effective than leaving the grid
  - Increase the value of staying connected / provide added value through services offered
  - Utilize demand charges (e.g. – if you defect and then want to reconnect, make the connection fee higher than if you were a customer who never left the grid)
  - Hawaiian Electric should look at entering the battery market
  - Include grid defection as a choice for customers
  - Changes in policy to leverage external incentives/financial programs (GEMS)
- What are the specific suggestions for HECO on how to handle this in GMS?
  - Provide option for customers to purchase smart meters
  - Rate impacts (e.g. – require TOU rates to influence behavior)
  - Build grid defection into GMS as an option that also creates a financial opportunity for the utility, find a way to use grid defection to manage utility costs so that customers who stay connected do not shoulder the burden of those who leave.

## Key Takeaways

- Include grid defection as a customer option and build it into the GMS
- Use grid defection as a financial opportunity for utility to manage costs
- There is a difference between information and data; need to educate customers/public on the difference; data analytics are critical in seeking good information
- Important to communicate to customers about data use; use lessons learned from other utilities and banks
- Cybersecurity is a nascent industry, currently no set standards that can be easily adopted for utility application