Bruce Hedman: All right. It looks like people are starting to come in. Hello everyone. Welcome to the 2020 Better Buildings, Better Plant Summit Virtual Leadership Symposium, and specifically to the Package Combined Heat and Power Systems panel session. Clifton, if you've got – thank you. I want to thank everyone for being with us today. We have a great session prepared for you and some really good speakers that I will introduce in just a minute.

But before we dive into things there are a few housekeeping points I'd like to cover. First of all, please note today's session will be recorded and archived on the Better Buildings Solution Center Website. We'll follow up with everyone that's signed up for today's session when recording and slides are made available. And, so you know, attendees are in listen-only mode, and your microphones are muted. If you experience any audio or visual issues anytime throughout today's session, please send a message in the chat window, which is located on the bottom of the Zoom panel, and there are some folks that'll take care of that right away.

If you go to slide three, please, the next slide. I'm your moderator. My name is Bruce Hedman. I'm a contractor to DOE's Advanced Manufacturing Office and Lawrence Berkeley National Lab. And I'm serving as a technical advisor to the DOE CHP Deployment Program. And I'm coordinator for DOE's Package CHP Accelerator Program, which I'll describe a little bit later. Next slide please, Clifton.

Today's session is all about package CHP and DOE's efforts to promote this efficient approach to providing electricity and thermal energy, both heating and cooling, to manufacturers, commercial businesses, and institutional facilities in the US, mainly to help reduce operating costs, increase energy efficiency, and enhance energy reliability.

We have three great speakers on the agenda. I'll introduce them and their topics in a few minutes, you'll see. And we will be leaving plenty of time at the end of the session for questions and follow-up discussion. So we're gonna leave all questions to the end, and I'll talk a little bit about how you get the questions to us in a second. And, in fact, that is the next slide, please, Clifton. Thank you.

We're excited to announce today – and if anyone has been to some of these previous summits in the last couple days, this has really worked quite well – but that we're using this interactive platform called Slido for questions and answers. What you need to do is go

to www.slido.com using your mobile device or by opening a new window in your Internet browser. You'll see a list of – well, first of all, you have to put in the event code, which is bbsummit. And it can be uppercase or lowercase. It's not case sensitive.

Once you enter this event code, then you select today's session title in the dropdown menu, which is Packaged CHP eCatalog. If you want, like, to ask our panelists any questions, you can submit them anytime throughout the presentation by the question session in Slido here. We will be answering, again, all the questions near the end of the session. And as questions come up, you can also select the thumbs-up icon for questions that you like, and you want to make sure that it's clear to us that they're popular so that we move those to the top of the cue.

I guess right now, Clifton, we should give everybody a few minutes just to open up Slido and select a session. Okay. And while you're getting in, we're gonna start off with really two polling questions. The first one is what type of company do you represent. You'll see a number of categories underneath. We'll spend some time here and make sure people have time to designate what type of company. Right now we're over a hundred participants. That keeps going up, so we need to spend a little bit more time to make sure everybody signs in as to their industry or company type.

A lot of industrials are represented. That's great. We've got energy service companies, packagers, governor – and government entities. Mm-kay, we'll give a few more seconds for people to log in as to their …

Clifton if we go onto the next polling one, can people also go back to this and add to it, or does it have to be active?

Clifton: I think it has to be active, unfortunately.

Bruce Hedman: Okay. We'll just give it a few more seconds. All right. Industrials are highly represented at 26 percent. We can see energy service companies, schools, colleges/universities. This is great. So we've got quite a diverse group here. Okay Clifton, why don't we go to the next one, please.

This is trying to get a sense of, for those of you that have experience with CHP, either from the supplier side or from the user side, what do you see the biggest barriers to installing CHP at facilities? Project complexity, high first costs, I'm a little bit

unfamiliar with CHP and the benefits it can bring, grid interconnection issues. Okay, we'll go a few more minutes and see if we can approach 75 or 100 responses on this. High first costs, project complexity are the two right now. All right. I appreciate that. Thank you. Clifton, why don't we go to the next slide, please.

There we go. Before we get into this, I also want to urge you to follow the Better Buildings, Better Plants program and the virtual summit on social media. And you can see the Twitter lines here and Linked In as well. The next slide, before we get to the panelists, I just want to share a couple of slides to set the stage for this session.

This slide shows a set of bars. And the bars represent specific either industrial or commercial or institutional market sectors or applications. You can see chemicals, refining, mostly industrial on the left side. And getting into commercial buildings, colleges/universities, district heating, hospitals and healthcare on the right: commercial institutions. And the blue sections of the bar represent existing CHP and their combined heat and power. And it's about 81 gigawatts of existing CH capacity. You can see a lot of that capacity is in the major industrial applications to the left, chemicals, refining, pulp and paper, food processing, and metals.

The commercial institutional sectors on the right, not as much market penetration as in the industrials. And you would expect that. It's, you know, CHP co-generation has long been in industrial, you know, in technology for industrial use. And in face of this 81 gigawatts of existing CHP, about 86 percent of it is located – of that capacity – is located in industry, industrial plants.

The green part of the bar represents the technical potential. And you can see that there's quite a bit of technical potential even in the industrial plants that have the bulk of today's existing CHP. But certainly huge potential in commercial buildings and district and colleges/universities, hospitals, and healthcare, and things like that. And I've been calling these these nontraditional CHP markets, mainly because they're not the typical industrial with the large steam load and power load. But this is the potential that's in small to mid-side industrials or in commercial institutional, institution, government, and military applications.

And many of these applications utilize smaller CHP systems: CHP systems that are conducive to pre-engineering and pre-packaging before they get to the sites. A lot of these applications have very limited experience in CHP. There aren't a whole lot of examples in

some of these commercial institutional market sectors of CHP installations that you can go and kick the tires on. And many of these facilities have limited technical resources to understand how CHP can fit into their operations and really to evaluate how CHP would work for them. And quite frankly, in some of these sectors there have been in the past a history of issues with CHP system performance and sort of fragmented CHP sales and service support.

And what has resulted in, for these markets, there are a lot of perceived risks by both users and suppliers to really promote CHP in these sort of nontraditional markets. However, if you look at that, you know, that blue blurb on the bottom there, over since 2008 these nontraditional markets are represented 35 percent of the capacity and 75 percent of the projects installed. So it is a growing market. There is interest in it. And CHP can do a lot of good in making these commercial operations more competitive and reducing energy costs and providing resiliency. Clifton, if you'd go to the next slide, please.

And with that, what DOE has done is put in place a DOE packaged CHP accelerator. And these better buildings accelerators are high-level programs, partnerships with DOE and private industry, that are trying to demonstrate innovative policies and approaches to accelerate investment and energy efficiency and energy efficient practices. And the objective of this particular one is really to promote packaged CHP in markets such as the nontraditional ones, as I pointed out, as well as traditional CHP markets, and also serve as a way to populate, launch, and publicize the eCatalog, which is a tool that Rich Sweetser, the first presenter, will get into.

The goals of this accelerator really are to verify package CHP system performance in different applications and locations. And the accelerator is made up of two type of partners. There's CHP engagement partners, and these are utilities and states that are committed to promote package CHP through CHP deployment and our incentive programs. And right now you can see the map. On right we have 16 engagement partners. That is a mix of electric and gas and combo utilities and three or four state energy agencies that are engagement partners.

And then the other partner category is CHP supplier partners. And these are CHP packagers and solution providers that are participating in this national eCatalog, this new resource to promote package CHP that you'll hear about. With that as background if we could go to the next slide, please.

All right, these are today's panelists. Let's get into the session. Remember, if you have any technical issues, please message our tech support team by using the chat function at the bottom of the Zoom panel. But I'll introduce all three panelists right now, very briefly. And again, as I said, we've got some great speakers this afternoon.

The first speaker will be Rich Sweetser. He's president of Exergy Partners. Rich will talk about the origins of and will demonstrate the packaged CHP eCatalog. And again, this is a new tool for identifying viable CHP options for particular sites and locations and really for reviewing comparable performance characteristics among various options.

Next will be Aaron Tasin, who is vice president of sales for 2G Energy. 2G is a leading packager of CHP systems. Aaron will talk about 2G's approach to this packaged CHP market, including the challenges in implementing CHP in these nontraditional markets that we just talked about and the role the eCatalog can play in reducing risk, not only to potential users, but to the CHP suppliers like 2G as well.

And our final speaker will be Brandon Bowser. Brandon is an energy program manager for the Maryland Energy Administration, and he'll discuss how the State of Maryland's support of CHP is a key part of its vision for an efficient and low-carbon future and really how the eCatalog has been incorporated into their existing CHP and resiliency incentive programs.

With that, next slide please. We will start with the first presentation. Again, Rich Sweetser will do this. He has, Rich has, spent 48 years commercializing advanced energy, power refrigeration, and HVAC technology. He founded Exergy Partners Corporation in 1998 as a consulting firm focusing on opportunities coming out of utility restructuring and climate change. And Rich is also a senior advisor to the US CHP Deployment Program and is also part of the USDOE's Mid-Atlantic CHP Technical Assistance Partnership. Rich is also the USDOE coordinator for the package CHP systems eCatalog. And with that, Rich, I'll turn it over to you.

Richard Sweetser: Thanks, Bruce. Clifton, can we just go to the next slide? And we're gonna actually skip this slide and go to the next one, 'cause let's jump right into this.

Basically what I've been asked to do is to really present the eCatalog. But before we get there, I'd like to present a little bit about the background. I've got a few definitions that I want to make sure we all understand. Then we're gonna go to a live demo. But before we get there, this whole approach is all about risk reduction. And how DOE helps in this risk reduction is by literally reviewing and recognizing the packagers, the solutions providers, and all the packages that appear in the eCatalog. And we'll talk more about that in just a minute. Next slide, Clifton.

Bruce mentioned these nontraditional markets and even some of the traditional markets. Again, we have a whole host of things that these nontraditional markets need to understand. First and foremost, these are discretionary purchases. When you're in a business, you're in the business of doing what that business does: making widgets; selling services; not creating energy in any way, shape, or form.

Bruce mentioned the lack of awareness in the, particularly, the nontraditional markets. And there's lack of developed sales and service infrastructure trying to service these various markets. And it all results in a little bit of higher risk, which usually results in higher soft costs and generally more end-user responsibility. And that's what we're trying to reduce. Next slide, Clifton.

So, DOE didn't come up with this concept. Our friends at the New York State Research and Development Authority have had a longstanding CHP program that goes back to the 2000 range. They worked through the process, and they came up with this concept in actually 2013, after many years of working in the CHP world. And they really discovered that an independent endorsement based on independent analysis or analytical review of technologies and packagers was really important.

They also went one step further to understand that single-point responsibility for these slightly more complex systems was a real critical piece in the customer-vendor relationship. And you can see, they started in 2013 with eight vendors and 36 systems. And they ended up in 2017 with 26 vendors and 253 systems in their paper catalog. And that's really what got DOE interested. Next slide, Clifton.

The real thing, though, that got DOE interested is when they started looking at the results that NYSERDA was able to capture. And if you look at the first graph, it was average project cost. They saw the average project cost drop from about $4200.00 an installed

kilowatt to somewhere around $3000.00. That's a very significant reduction. Similarly with cycle times, what they saw is going from an average of 600 days to about 400 days. And a cycle time for them was when a project was first identified to when a CHP plant was commissioned.

And the last graph really looks at the number of projects. The uptake in projects from 2013 to 2017 was remarkable, especially when you consider NYSERDA, which was a grant-making entity in the State of New York, was reducing it's grant programmer, or dollars per kilowatt, in their grants. So all of these three results really spoke to DOE and said that there is something here. Next slide.

But again, I think Bruce mentioned that having this vetted data or recognized data is not sufficient. And I sort of really saw that in spades. And they created public events, educational opportunities. They did – the state did – pre-screening. They provided technical assistance. And they provided something that they called concierge access during the process to navigate the permitting process, looking at financing and other support resources. Let's deal with those in a little bit more depth. Next slide.

They had a series of public events literally were designed to engage the CHP end users with project developers and the CHP package system suppliers. And it was a remarkable situation that created a lot of information transfer as well as creating an interesting view of competition or competitiveness. It also helped keep the prices sharp. Next slide.

They had a very systematic education and outreach that really started from, you know, addressing common misperceptions, dealing with other decision-makers, not just the technical folks, but looking at the C-suite and the financial groups within various organizations and enterprises to make sure they understood why you may want to have a CHP system.

They also did a critical thing identifying the project champions. 'Cause if you don't have a project champion in the organization, it is a critical, critical importance, particularly when you deal with these types of systems. Anyway, let's move on to the next slide.

And this is an important slide. When you don't have project champions and you don't have the right information at the right time, you typically will run into a brick wall or two, because these are complex projects. And once a customer will lose interest in a

project, it's gone forever. So basically many projects still need this, the whole hand holding from the, literally, from the bid process through proposal review to really creating the meaningful, accurate data that the customers need to make the decisions. So that's a holistic approach that I sort of took that was extremely successful. Next slide.

So, before we get into the live demo, there's a couple things I want to deal with with the eCatalog. Next slide.

First thing is just a few definitions. We have a CHP packager. They assemble and basically support what we call recognized package systems. That can be the actual manufacturer, or if you have a dealer network, that could be the dealer that represents the package system in a certain area.

We also have solutions providers. They install, they commission, and they service package CHP systems. They may also be a packager. Many of our solutions providers are packagers and some are not. And then customer engagement partners: that is basically the utilities and the state energy offices that have deployment programs focusing on CHP.

The key concept is you will see equipment. And these are pre-engineered, pre-tested, packaged, or modular systems. They don't have to be a single skidded system that meet – importantly – meet DOE performance requirements. That's what it takes to get into the catalog.

Our focus for the catalog basically is end-users and design engineers, and they will be able to search using applicable CHP system characteristics, and we'll get into those in a minute. And they get connected to packagers, installers, and customer engagement programs all through the use of the eCatalog, and it allows the user to compare technology options based upon common standards.

For example, our hot water systems are all based on 180-degree hot water supply. Our chilled water systems are based on 54 supply – 54 return, 44 supply. Our steam systems are either 15-pound steam or 125-pound steam. So you can compare one system to the next of equal kind. Next slide.

As far as statistics are concerned, the eCatalog was launched at Power Gen last year on November 8th. From since the launch we've got 31 recognized packagers, 19 recognized solutions

providers. And as of Monday we have 201 packaged offerings. As of today we have 205 and growing. And we have 9 registered customer engagement partners. Those are the statistics. Next slide.

Now we're going to switch screens. So we have to ask Clifton to stop sharing your screen. I will share my screen. And we're going to go live.

This is the landing page for the eCatalog. And you can see up here we've got it, at the top, we have a banner. And that banner, basically, is where we advertise. In this particular case we're advertising the session that we're doing right now. The purpose of the landing page first here is to really show the whole idea of the importance of package recognition and how that will reduce risk for anyone who uses the eCatalog and uses package systems that they find in here.

Now, before I get to a little bit more on the landing page, I'm gonna run through just a few of the key pages. I'm gonna skip the search page, 'cause that's where we're gonna spend the bulk of our time. If you want to learn about the catalog, you can learn about the catalog here. And you can find any notion on any page and what everything means, 'cause it's all defined in this area.

If you want to learn about CHP and get connected to a few sites, you can come here, and you can see the sites that you get connected to. If you want to know what packagers are in the system, the packagers that are in the system are all located here. And below you can see what it takes to be a packager, the responsibilities and the requirements. So it gives you a quick idea of what it takes to become a packager.

And then if you are here as a packager, you can click on that. You get contact information, you got company description and service information, and you can go then directly to the packager Website.

If you go to solutions providers, these again are the installers and such. You can do the same here. You have the solutions providers. At this point you have information on the solution providers, the responsibilities and the requirements, so you have a good idea of what a solution provider is by going at this point. And same with the customer engagement partners that are registered in the catalog at this point. You can go to there, find out the information, for example, here. We can find out that Brandon Bowser will be speaking later, is right here, and you can figure out how to contact him here.

The next tab is for the technical assistance partnerships. Bruce mentioned I am, I do, participate in the mid-Atlantic here. What you can see is this is what the technical assistance partnerships do. They provide free services to the end-user engagements to stakeholders and provide certain technical services. And you can find out how you can contact the tabs here. And then the last tab here is, just, it lets you know in real time what has been updated when. So you can see what has been updated to the catalog at this point.

So now I'm gonna take a quick step back to the main dashboard and point to you in the upper righthand corner you see where it says "sign in." It is good for you to become a registered user, because then you can sign, save all your queries, and they can go to a dashboard, and you can recall them. And just to create an account all you need to do is put your name, E-mail address, create a password, and your zip code, and register, and you're in. That's all it takes.

Now quickly back to the main page. This black quick start is really designed for people that can't – do not know exactly the size CHP system they would need to use for their particular site. The CHP systems in the catalog are listed by electric power, which is a bit unusual, since we basically do thermal load matching. But it's designed for people who have a good idea of what sized system they want to look for. So we've created "Help Me Choose." And to help me choose we basically inputted a great many applications with known thermal to power loads.

So, for example, a hospital. The only fact you need to know, two facts, is you need to know how many kilowatt hours you use in a year, and you need to know what your operating hours are. Oops. Whoa, it's not – pardon my typing – 8760 for the hospital. You can see it's about a megawatt-sized unit. You can click "Use This Estimate." It populates here. And you can go search based upon that. So that's basically what the landing page is for.

Now, if we go into search, the general search piece is just like you're on Amazon. Down the left-hand column you get to search by certain priorities. The first priority is supplier. Do you want just a packager, or do you want someone to install, commission, and provide a minimum of five-year maintenance – service and maintenance agreement? That will determine whether you're through a packager priority, solutions provider priority.

We also have something called an assurance plan. That adds a availability number. And it also – a requirement – and it also adds a maximum time for unattended outage – response time to unintended outage. And then we also have an option here for solution providers offering energy services such as an ESCO or power purchase agreement. That prioritizes by that listing.

Here, if you want to prioritize by programs that are already recognized by utilities or state energy offices, that will do that here. In this particular chase, you've got "Help Me Choose" by your power output. I put in 1400 kilowatts. And that gives you a range of 980 to 680. It's 70 percent to 120 percent. Now, there's also this interesting button here that you can push, and you can consider multiple units. And you can immediately see I've just changed the selection. So one 2G unit here will match it at 1500, and two CAT units at 784 will match.

You can prioritize by reciprocating engines, combustion turbines and microturbines. You can prioritize by what type of thermal output you have. You see we've got hot water, steam, chilled water, or any combination of those three. We've got fuel types of natural gas and digester gas in the catalog right now with systems in.

We have the capability to do landfill gas and propane right now, and we're looking at other gasses in the future. Grid connection type, grid parallel only or grid island with auto transfer in this particular case. There is one for manual transfer. Outdoor insulation if that’s required. You can check here. It'll change the order of selections. Packaged in the US, not made in the US but a final packaging is done in the US. And then we've got if there are any footprint limitations of width, length, or height.

So I'm sorry if I'm talking fast, but I've got a lot to cover in little time. So in this particular case – whoa, wait a minute. Did I skip one? I did skip one. No, I didn't. Okay.

I wanted to show you the largest system we have, so I put in knowing the largest system is a gas turbine, it's seven-and-a-half megawatts. The smallest system we have it 24 kilowatts. So if we move down the pike a little bit further, I wanted to go in, and I wanted to show you a bit of a detail. Now, I will tell you this. All of these systems are qualified systems. They're all been reviewed. So we like, you know, we like all these systems in the catalog.

I'm just gonna pick Unison, which happens to be providing energy services. So they're an energy service company. And I'm gonna pick this one because it's also 2G, which is my friend Aaron, who's gonna speak right after me. And what you see here is detailed information. So on the right-hand column this is detailed contact information. So you get, in this case Unison, which is a solutions provider that provides a 2G package in this case, this is their assurance plan. And this is the technical assistance provided by the US Department of Energy.

Now, if I had been smart and put 2G in there, rather than Unison, because they've been recognized by BG and E, you'd have Baltimore Gas and Electric system here as well, their contact information for their program. They just haven't gotten around to recognizing Unison in this. And for that, my apologies.

What you have coming down here is you've got the general information on the system, and then you've got a description of Unison, which is a solutions provider and what they offer. You have 2G, the packager. And then you have here installation experience. Now, this is installation experience by Unison. This is the number that they've installed in Maryland.

And I apologize that we're just getting this stuff loaded for this particular system there will be several units that Unison will have here also. They're just not properly loaded yet. We're dealing with some coding issues. And by the way if you go to 2G's they have 3850 installs. So you're gonna see installs of this package is gonna go up quite a bit due to the 2G part company installs of this package will go to a handful that Unison's done.

And then you get performance data. This is the only place I know of anymore where you can get performance data like this that you get the full output of the system at 100 percent gross power, 75 percent gross power, 50 percent gross power, and three ambient temperatures. So you can get really good information here on the performance, again, against the standardized hot water of 180-degree supply.

But not only that, you will get – on lean burn engines – you will get emissions for NOx and CO, which are required. And this is with no after treatment. Obviously, you put after treatment on this, you can get this down to meet any standard. You can meet South Coast Quality Air Management District standard if you put oxidation catalysts and SCRs on it. So that is also available.

Whoops, I apologize. My friends at Microsoft are giving me problems.

So we move down further, you get more details on the generator, hot water recovery system. You get sound pressure. You get weights and dimensions of the system, and you get a simplified schematic drawing that shows you what is being provided and basically the manufacture and model number, where they have it available, of the various components in this package system. That's a great deal of information. And you also have the capability to download this as well.

I do want to show one other thing here, just to show you. This is a package that has power, it's got hot water, again, at 180 degrees, it has steam supply, and it also has just below here chilled water information. So in this particular case, as with most engines – this is an engine – the steam is always supplied. The hot water and the chilled water would be supplied at – this is at full load capacity. It's one or the other or a blend of the two. And we actually do explain that, so we don't get out of balance here, so people understand what that is. And in every case, all you need to do is talk to the manufacturer to get the details.

And basically, Clifton, I think I'm gonna hand it back to you at this point, because that's where I wanted to stop at this point on my live demonstration. So pick it up, Clifton. Thank you. Next slide.

Bruce Hedman: Yeah, I think we're – great. Rich, that was great. Thank you for that. It was a good demo of the eCatalog.

So, second speaker is Aaron Tasin. Again, Vice President of Sales of 2G Energy. Aaron has over 20 years of natural gas engine experience spanning management, business development, project management, and service. He's actually been involved with well over a hundred CHP projects with both engines and turbines over that time. Prior to 2G Energy, he held positions with Wartsila, GE Distributed Power, and Capstone. Aaron has a coast guard assistant engineer license, which I didn't know that before today, and a BS in marine systems engineering from the Merchant Marine Academy in King's Point. And with that, Aaron, I'll turn it over to you. Thank you.

Aaron Tasin: All right. Thank you, Bruce. And I'd like to welcome everybody here. And as I'm sure you've probably heard about 268 times the last two or three days, really interesting to be doing this by Webinar. Wish we could be doing this in person. But I think the

last few Webinars I've been in and involved in have really hit the points, and I think they've been successful. You can go to the next slide, Cliff.

So I was, as Bruce mentioned very early at the 1:00 turnover point, I'm focused speaking just on the packaged solution and how about it is the process flows through and why you'd want to do that. Next slide, Cliff.

So just a little about 2G first. The company itself is 25 years old. It was founded in Heek, Germany and headquarters are still in Heek, Germany. We do have offices in Florida – that's the North American headquarters – the DC area, and Maryland. And then we have some people working from home for additional sales and service support. And for Canada we have an office out of Toronto area. And we do have some support in Mexico, and we do have a couple partners as well that sales partners and service partners throughout the North American market.

Our intent and focus is 60 kilowatts to 2.5 megawatts. And we can put multiple units in parallel. You do dye here. Richard mentioned that you could select multiple units. Oftentimes you might see two units or three units, maybe even more for some of the package suppliers.

2G does have its own R and D department. We do focus on and try and develop and keep abreast and ahead of the market, including we are and have released a 100 percent hydrogen engine as well as try and design some other aspects that do fall along with CHP in the future as we start moving towards a carbon-reduced world.

There are the ten subsidiaries. I mentioned that. We are listed on the Frankfurt Stock Exchange since 2007. We have 650 employees. And over the last 25 years we have installed over 6000 CHP plants in over 50 countries. You can go to the next slide, Cliff.

So, the market trends. First – and this is really my only side outside of why a packaged solution is not something that is really becoming more popular and beneficial – but the market trends are definitely moving towards the more nontraditional applications. A pretty common business term, you know, "low hanging fruit," well CHP has been in the US for 20-plus years, probably even 30-plus years, absolutely. So, some of those easier projects where it's engine hot water, turbine hot water, those – they were doing projects a long time ago with the great sparks for it.

Resiliency. There's the hurricanes, there's tornadoes. CHP is offering a method of having a backup solution, not necessarily always a emergency solution, because you might not be able to have a system online in ten seconds. And if you're a hospital, that is a different application. But the resiliency is there. A grocery store, power is lost, the grocery store can have power and not have to throw away $100,000.00 or $200,000.00 of refrigerated or frozen foods.

Complete solutions is also something that packaging is really able to offer that was a little bit more difficult and complicated in the past. I will get into that. Flexible financing solutions: there are now a handful of providers that are willing to finance solutions.

Bruce Hedman: No, you did good. You got it just around 20, so thank you.

Aaron Tasin: As well as what we were calling a no-touch solution. So there's also some companies out there, and Rich mentioned one of them, Unison Solutions – or Unison Energy. I'm sorry, Unison Energy. They'll offer to come in, own the equipment that's no cost to the end user. They are able to benefit on the cost or the savings of CHP without putting money out on their own.

CO2 is also offering carbon reduction. I was looking at some of the Slido comments, and we can get into the question directly later on, but CHP right now in any circumstance is a lower CO2 energy source than utilizing power from the grid and a boiler. By the time we get to 2050 the dynamics change a little bit. But by some studies that have been started, it looks like the only two states by 2050 under the absolute ideal scenario of their carbon reduction where CO2 would not be a net benefit would be California and New York. So we still have 30 years of CO2 benefits if you install a CHP system now. And the CHP systems are offering a lower risk with a packaged solution, which you'll see as we go into this. Next slide, Cliff.

So the traditional CHP installation, as you heard Bruce mentioned, I've been doing this about 20 years. The initial projects were always a ship loose engine, then you build everything around it. And one of my favorite stories – and this was very early on – I was a project manager, and it was a stick build solution. There was something that was done incorrectly by the contractor. We'll go to the customer, and of course the customer is livid. It's gonna delay. It's gonna have additional cost overruns. And add some colorful language – won't, can't quote exactly what he did say – but

basically the gist of it is he said, "My last name is Plastics. Your last name is Energy. You need to figure it out."

So stick build solutions have been done. They can be done. But there are definitely some challenges. You have to find an electrical contractor, a mechanical contractor, a general contractor, civil works, third party engineering. So this is like the concept of the packaged solution. And I'm so glad the DOE and NYSERDA and Rich and Bruce have been such great champions of this. It is something that has made CHP a lot less risk-averse and even brought the price down. Next slide.

So what a packaged CHP system is, is essentially it's a standard repeatable design. Now, obviously, it doesn't have to be exactly identical. But your contracting and working with a group of professionals that do this day in, day out. It's gonna be 100 percent pre-wired. It's gonna be 100 percent pre-piped. The intent is to have four connections: a gas connection, an electrical connection, and then your hot water connection for supply and return. There may be some additional items in there that make it a little bit more complex, but it is gonna be provided so the on-site requirements are gonna be minimalized.

Some of the aspects of the CHP being packaged is – that have made some of the ship loose stick build in a building systems have issues – is they don't have enough ventilation being pushed into the room. With this we know exactly what ventilation to provide. It's sound insulated. I'll show you some examples later. The insulation has a fire rating. There's already gas detection and smoke alarm.

It's not considered a building, so you don't have to comply with every single building code. Now, these were built to meet any kind of standards that are required, but you're not gonna have a building inspector come into a container and say you have to meet this building code. The container is built to handle any kind of fluid containment if there were to be some kind of an issue with oil or antifreeze. One hundred percent of that would be contained inside of it.

Some of the other benefits are you know absolutely that the auxiliaries are sized. Going back to some of my project management days, I've seen silencers that were sized wrong for noise. I've seen radiators that couldn’t remove all of the heat. This is a packager, and any packager in this – in the catalog – they know what sized radiator needs to go with their system. They know what size silencer needs to go with their system. And it's

already gonna be pre-wired and insulated and ready to reconnect back up when it gets to the facility.

And then there's the bulk purchasing power. We purchase at a minimum of 1500 radiators a year, 3000 pumps a year. We're gonna have purchasing power that a local contractor installing a CHP isn't gonna have. So we're able to carry those savings on as a packaged solution. All right, next slide, Cliff. I think you actually have to hit it about four times. I think it's – maybe it's only three. You might jump to the next one if you hit it four. You can hit it one more time. There you go.

So a lot of – I did mention very early on in this that hot water is, you know, it's kind of the low-hanging fruit. Hot water is definitely your best economic solution. Most of you – I did look at the initial poll. Some of you put on here that you don't really understand the premise of CHP. Well, combined heat and power, I don't want to go into all of the details of it and go over my time either, but you're using the one energy source of natural gas to provide electricity and some kind of thermal.

A lot of people just think that hot water is the only thermal aspect you can utilize, but you could actually use the exhaust to provide steam. There's multiple, multiple projects. A lot of them are hospitals, industrial, where the exhaust is making steam, 15 psi, 90 psi, 125 psi, 150 psi. It could even potentially go higher. You have to look in the economics, but 350 psi is not impossible. There's not really a limit on that.

Absorption chilling, for those that might not be familiar, with absorption chilling you're actually utilizing the hot water or potentially even the exhaust directly to the absorption chiller. And through a chemical reaction, the heat is actually creating cool, chilled water, whether it's 54, 44 like Rich has in the catalog as standard, or maybe 52, 42, you're gonna hit a limit where you can only get about 39 or 40 as your chilled water temperature out.

There is ammonia chilling. There's actually, there's a company in Maryland that does ammonia chilling – there might be others – where they can hit negative 18, negative 20 degrees with ammonia chilling. And you would use the exhaust as well to provide that chilling source.

Thermal oil is not as common, and pressurized hot water not as common. It's something that don't really want to go into any kind of specifics, but those are options as well. And then one that isn't

on here, if you have absolutely no use of waste heat in any of these methods, there actually is a unit called an organic ranking cycle so that the heat from the engine or turbine could go to an organic ranking cycle, and that could generate some additional power. And that would essentially be emission-free power for that aspect of the heat recovery. All right, next slide, Cliff.

So now I'm just kind of getting into the packaged solutions and some of the concerns that I hear and see over the years and how really the packagers have been able to overcome this through their designs and just growing in the industry.

Sound emissions is obviously one that's pretty big. A standard packaged solution you're gonna find is 65 decibels at 33 feet. A lot of times you'll hear at 10 meters, which is actually quieter than a vacuum at 3, 4 feet. It's quieter than being next to a highway. Some packagers have the ability to go all the way down to 45 decibels at 33 feet, which birds flying overhead and chirping loudly is probably louder than 45 decibels.

So sound emissions is something that has been able to – been eliminated for the most part. There has even been a few in Europe – haven't done any in the States here – where we've gone as low as 35 decibels at 10 meters. And at that level you can't even tell if an engine's running or not when you're standing outside of it. Next slide, Cliff.

So this is just showing how a packaged CHP is being built. A lot of times people are thinking that it's just a container that you see going down the highway, an engine's thrown in there. I'm gonna show you the steps and the processes that we took some pictures of on manufacturing one of the systems. Next slide.

So first – and this is part of the standard repeatable -we don't just take an engine that we've never dealt with and throw it in, even in a – the pictures you'll see after this, this is the first step. And then that step just continues on because we keep using the same engines. We don't just go from one engine to another into the next engine, hoping the container is designed right.

So the initial design, it is gonna take the actual container that is gonna be used. And it's fully analyzed for stress analysis, wind loads, snow loads, the static and dynamic forces that are gonna be on it. And it includes all the ancillaries that are gonna be associated with it, whether it's SCRs, or radiators, or chillers, or piping that's attached to it. And we can tell and identify if there's any weak

points and even any weak points that may come into play when you're gonna put it on a crane to put it in its final location. Last thing you want is to be putting a system in its final location and crack the container, or even worse, have it break. Next slide.

So once all that is analyzed and decided, including where the holes in the container are gonna be, the insulation is put into the panels, and the panels are then fabricated. You can go to the next slide.

And then the base and the top of the system are gonna be welded together according to that stress analysis and where the holes and the openings need to be for that specific design. And everything starts getting welded together. So this is not just some simple iso container that you can stack eight high and then you throw an engine in it and insulate it. Next slide.

Then some of the components are gonna be critical to the system operating are gonna be initially installed. I think I missed a couple pictures in between the first one on the left and the middle picture. But once we get some of those additional items in that including plate and frame heat exchangers or items that you might not want to have to walk past the engine, and for maintenance purposes you wouldn't have to bring out past the engine again. Then the engine is put in. And then you start building and wiring and doing everything around the engine that's installed. Next slide.

And obviously you will notice that some – there's many more pictures that could've gone into this process. I didn't want to go and have ten slides of nothing but every time an item was added to the system: generator breakers and plater frames and expansion tanks and pumps and all that. But this is the finished product, the container. And actually that air conditioner that you see is placed onto a rack once it gets to site. But even the control room of this system has an air conditioner so that the control room never gets above a temperature that would cause problems to the electronics.

But the system – and Rich did mention this – the system is completely assembled, and it is tested so you know that everything actually is welded properly. There's no leaks. You know that electrically all the relays are wired, that everything is functioning. Once it's tested, it's broken apart, and all the components that are outside of the container would then be put into an additional container and shipped to site with the container that the engine is in. Next slide.

I'm gonna throw out some container options, 'cause some of you might be thinking, well what if it's really cold or really hot or you have some other issues that you might have to worry about. Next slide.

So there are some different options. The compact container is one where you have a really small engine, and you don't need anything that's ten feet wide or ten feet tall. Try to keep the costs down, the shipping cost down, the – everything involved with it as small a footprint as possible. So we have the compact container. Next slide.

Then this one does still say compact container, but it is one step up. This is the ten-foot-wide by ten-foot-tall. I apologize on the misnomer on the compact. But this is basically what you did see in that process there, although that, what you saw, was a 40-foot container. This one is 23 feet. But it's the industrial look. We can add carbon vessels for cleaning gas, biogas. We can add blowers or dehumidification. Have different options on noise as well. Next slide.

Some of these CHPs, the economics are usually justifiable but maybe you're a grocery store or it's a upscale hotel, a Ritz Carlton or something of that nature, and the slide you saw before, that's not the most ideal thing that you want somebody staying and looking out their window at a Ritz Carlton and seeing a – just this power generation unit. So we came up with a design that has a much more visually appealing look. We have these outside of many grocery stores and hotels throughout the country.

And the noise is also lower as well, because typically if you do want the visual appealing design, then noise is something that's a little bit more concerning as well. So the standard noise on this is 55 decibels with the option to go down to 45 decibels. Next slide.

Then the heavy container is really when you start getting into the bigger engine systems. The 600 kilowatts, the 1 megawatt, the 2 megawatt. And this does have, again, the industrial look. Usually when you're in that size range, you're more of an industrial customer anyways. So you could put something like this somewhere in the parking lot, somewhere out in the company lot that is probably acres and acres for the industrial facility. But same thing here, 65 decibels. If noise is a concern, 55 decibels. Maybe you're close to the property line where you're gonna place the CHP container. Next slide.

And as I was mentioning earlier, what if it's a really hot area? You might be out in Arizona or the deserts of California or Texas. Well, we can oversize the radiators. We can look at potentially having something to blow colder air that's directed straight to the air intake of the engine, where typically you'd have the air go over the generator, then over the engine, then into the air intake. We have different designs to handle this. So this is something that we've – that it's been thought about and engineered right into the design of the … Next slide.

And then cold country versions. In the US we're not really ever gonna see this unless it's Alaska. But there is the ability to have a cold country version where we have additional methods of making sure if the engine's off that we can close off and heat the container to make sure that when it needs to be restarted the inside of the container isn't negative 30 degrees. We can preheat the air where we might use some inner cooler water or jacket water. Next slide.

And a couple case studies. The next slide. And I see I'm coming close to my time here. Here's – I have three case studies in here. Peninsula Regional Medical Center is one of them. It's two 1560 kilowatt units. Unison Energy is just the owner of this, and they have a energy savings agreement with the hospital where they do save 17 percent in energy costs. And it can also operate the hospital if there is a grid outage. And it did reduce the gas emissions, or it reduced the greenhouse gas emissions by 50 percent for the facility. Next one.

Gaylord National Resort and Convention Center. It's right in the DC area, National Harbor. There we have three two-megawatt systems out there. The facility has a ten-megawatt peak load. But they did have potential and the concern that the convention center, if grid power is lost, would be black. So this can operate the convention center if it goes black. It also offers them savings in energy savings, and it also has a 59 percent of greenhouse gas emission reductions. Next slide.

And then Erlinger Hospital. This is one where you can see the steam generators. So the exhaust is going from the engine to the steam generator with the exhaust from two engines going into one steam generator. It's eight megawatts, four by two two-megawatts. The customer liked the idea of a packaged solution so much that they put the packaged solution inside a building. They're producing 52 million kilowatt hours a year annually. At the gas price they're buying gas at, it's a little over five cents a kilowatt hour. And they

are having additional energy savings and emissions savings as well. And next slide. I think it's my last one.

So then, the DOE catalog. You did hear from Richard on this, so obviously we wanted to be part of it, 'cause it does showcase how 2G packaged systems can benefit customers. And it obviously expands our presence and allows us to have a new market audience that we may not have had without being in the catalog. So we do appreciate that being put together. The next slide is the last one, Cliff.

Clifton: Yep.

Aaron Tasin: All right. Well thank you, and I will go ahead and move it on to Brandon.

Bruce Hedman: Aaron, thank you. Appreciate that. That was a great summary of many different options so how packaged CHP could fit just about any application.

The third speaker is Brandon Bowser, Energy Program Manager at the Maryland Energy Administration. He manages the state's CHP grant program and also its newly launched Resilient Maryland Program. The CHP provides state grants for qualified CHP systems and a number of different applications, and Brandon led the design of and manages this, the new Resilient Maryland Program, which provides grants to Maryland organizations to help offset the cost of feasibility analysis, engineering, and design for energy resources – distributed energy resource systems that are focused on resiliency and energy reliability.

Brandon holds a BS in Energy Business and Finance from Penn State University Park and, I guess, this month is going to be graduating in a virtual ceremony from Penn State with a MS in finance from Penn State World Campus. With that, Brandon, it's yours.

Brandon Bowser: Thank you, Bruce. Yeah, as Bruce mentioned, I'm Brandon Bowser with the Maryland Energy Administration. And today I'm gonna focus on a couple of the programs that Bruce just mentioned: our CHP grant program as well as our Resilient Maryland Program, how that bakes into our state's overall goals for energy resilience improvements and where the DOE eCatalog can help us get there. So without further ado, could I ask to advance to the next slide, and we'll get things started.

Yeah, so CHP and Resilience. Resilience has taken center stage in our state, as far as our overall energy management strategies are concerned. Maryland has always been one of the leading states at the forefront of energy efficiency and renewable energy development. And now we're focusing into the next sphere of energy management, and that's using these resources that we provided incentive dollars to over a number of years to bolster the state's energy resilience. Next slide, please.

So what does resilience mean for us, and why is it important? I've got three core areas that I'd like to focus on.

So I think the first one should pop up there. It's one of those animations. So grid threats are probably the leading reason why we're pursuing this take on energy management for our state. We're no stranger to these, just as other states are no stranger to them either. We face severe storms. I'm sure everybody's familiar with a derecho that blew through Maryland in the late 2000s, early 2010s, which caused significant disruption to our state's energy grid.

As we become more of a cyber world, a more online world, especially now in the wake of the global pandemic as everything has transitioned to a digital interface, there's an increasing threat of cyber-attacks as well. And as we've seen in instances past, there was a prime example in 2013 back in the Ukraine where a large electricity switch that provided power to, I think, about three million residents was taken offline by hackers. We recognize that if it can happen anywhere in the world, that means it can happen here in Maryland as well. And so beefing up our resilience through the integration of distributed behind-the-meter resources is one way we're hoping to mitigate against that threat in our own state here.

Not only that, Maryland is subject to high summer temperatures with high humidity. If anybody who's in attendance right now is living in or familiar with the region, I'm sure you're feeling that especially over the past few weeks with the 80s and 90-degree temperatures that we've had. We're also subject to frigid winter temperatures, especially when polar vortexes blow through. And we want to make sure that our energy grid has the assets that it needs to ensure power is always available, especially for vulnerable communities facing temperature threats. Next bullet point, please.

And so, through this, we've run a number of programs over the years, I had mentioned, for energy efficiency improvements and

renewable energy improvements. And we've worked with a number of different entities across various sectors of our state's economy. So under both the CHP grant program and the Resilient Maryland Program we're targeting those organizations that have more often than not answered the call to our incentive programs with very nice projects, very replicable projects, and impactful projects. And those are our businesses, our healthcare facilities, higher learning campuses like colleges and universities and institutional organizations.

Our local government facilities I like to showcase. You see there in the background, that's an image of the Montgomery County, Maryland Public Safety Headquarters microgrid. They have a solar PV canopy system they have over the parking facilities there in pair with a battery storage system and a combined heat and power unit to provide them with a resilient microgrid solution at the building level. It's sort of become our poster child for resilience marketing at our agency. So there's an example of a government facility making use of those resources.

Also, multifamily housing has definitely come out of the woodwork in the most recent years of our program offerings as being interested in bolstering resilience. And I'll touch on that more here in a moment. Next bullet point, please.

And obviously, we have an overall goal through all of our programs, namely Resilient Maryland, to increase these type of technologies, their deployment across the state that you see before you now. So distributed energy resource development, solar PV, battery storage, CHP, and using those with advanced control systems and AI technology to create grid-interactive solutions. So right now that's where we're focusing our efforts in a lot of our programs. And together these items create a resilience value proposition for the state and why we justify offering the programs that we do. Next slide, please.

So we offer a number of different incentives. We have grants and we have low-cost financing mechanisms, such as our Jane E. Lawton Conservation Loan Program that helped offset the costs of deploying clean energy solutions and energy efficiency upgrades. As I mentioned today, we're gonna focus on the CHP grant program and Resilient Maryland Program and how they factor into our overall state's vision for increasing our energy resilience.

And I also want to discuss a little bit more in detail how the US DOE CHP eCatalog will help expedite the project design of the

systems we're looking to incent. MEA has been an engagement partner of the CHP eCatalog for a number of years. We've already identified it as a critical resource to CHP adoption in our state. And we're even seeing some of our applicants and grantees mention it in their proposals and how it's become a vital and useful resource in helping them make decisions on technologies that they pursue. Next slide, please.

So our CHP grant program: we've offered the CHP grant program since fiscal year 2015. And at its inception it was more closely targeted at those critical infrastructure facilities such as hospitals and wastewater treatment plants, because they produce the most obvious load profile and need for any energy resilience out of all of the different entities we could consider across the State of Maryland. Even back in 2015, CHP uptake and adoption in the state was relatively low, just because it was a new concept at the commercial scale that had not quite been considered by entities throughout the state before.

Obviously, CHP technology has been around for a long time, but it's that commercial replicability, scalability, and marketability that was the primary challenge to getting it started. And so, in the inaugural year of the program, I think, mainly it was all hospitals and a couple of wastewater treatment plants that were selected for awards. And over the years we've seen a massive uptake across different sectors of our economy, which I'll speak to more detail in a moment.

But the program operates like this: you can get up to $500,000.00 toward the equipment and installation costs for qualified CHP system. We calculate incentives based on a dollar per kilowatt of installed capacity. It's a tiered structure. It ranges anywhere between $575.00 per kilowatt down to $425.00 a kilowatt. We leverage economies at scale. As capacity increases, that dollar per kW goes down, just because we do have a finite budget, we wanted to stretch our dollars as far as we can. And so, integrating the strategic deployment of economy to scale in that calculation is a way we've been able to do that. But the maximum award that any project can receive is currently $500,000.00.

When we consider all types of CHP, so your traditional reciprocating net gas engine with heat recovery system is absolutely our most popular expected solution that comes through the program. We see some turbines for the larger systems, but we also encourage more innovative designs like those that leverage biogas for anaerobic digestion and agricultural operations, for

example. We encourage CHP fuel cell systems where they make the most sense. We want to be responsive to technologies that are both promising at the marketable scale and replicable scale because we see ourselves not only a facilitator of installation, but a market driver for promising technologies as well.

As far as technical requirements go, the largest one is that fuel use efficiency requirement. At the very minimum, any qualified CHP system has to meet 60 percent annual fuel use efficiency. And I'd like to take a moment and define what we consider that figure, because in different incentive programs like utilities, and other states, and the like, all have their own way of identifying what fuel efficiency is.

We simply mean, in annualized terms, taking the output on the electricity side, adding the thermal energy that has recovered, and dividing that by the input, the fuel input, all on annual turns and higher heating value. So as long as that 60 percent figure is met, this core technical requirement is what really drives whether or not a technology is going to be acceptable under the CHP program. And obviously, systems have to comply to all federal, state, local, jurisdictional as applicable requirements in their design and installation.

The program is offered on a first come, first served basis. MEA offers incentives under this first serve – or first come, first served model and a competitive structure. The CHP program has been run under both structures, and we found that the first come, first served model works best to address the needs of the industry. As nobody in this panel is a stranger to, CHP faces that hallmark challenge of getting over that initial design and planning hurdle. And included in that is securing your capital channels as well.

So we have realized that ensuring the availability of capital when performing this grant early on will help contribute to the project's overall success down the road. And so we anticipate continuing to offer the CHP grant program under the first come, first served model.

Grants have traditionally been paid out into phases. A 30 percent of the overall incentive can be obtained when a project groundbreaking begins. And we consider that, and the CHP equipment is delivered on site, and construction of the system and its facility has begun. The remaining 70 percent is then paid out after the system is fully commissioned and commences commercial operation with all associated approvals being given at

that time, so things like, you know, the local permitting state permitting and the authority to operate from the utility after the interconnection has been completed.

The incentive is also stackable with other incentives and capital sources. I mentioned earlier our Jane E. Lawton Conservation Loan program. That's our low-cost energy efficiency and CHP financing product available with a two percent per year rate. Very difficult to find any APR like that on the commercial markets. So we strongly encourage applicants if they're looking to, if they don't quite have their capital stack put together to strongly consider the Lawton Loan program in conjunction with the CHP grant.

We also actively encourage applicants to also apply to the utility incentives. Maryland has five major investor in utilities known as our empower utilities, which provide incentives with dollars received from the empower surcharges on rate payers' bills. So that incentive can be stacked along with everything MEA provides, as well as with private sources as well and sort of quasi-governmental sources like C-PACE, too. So we actively encourage, if there's money on the table, don't leave it there. Next slide, please.

So going into a little bit more detail about what we've seen since fiscal year 2015, as you can see on the slide before you with that oh so handsome individual on the left-hand side *[clears throat]*. Could you click the – there should be an animation there. We have incented 42 active and completed projects since the project's inception in 2015. Next point.

This has a combined value of over $13 million dollars of state incentive investment. And as I mentioned, we have a broad appeal across many different sectors of our economy. We've seen applicants come from the agricultural sector, county governments and local governments. Like I mentioned, critical infrastructure, so your hospitals, wastewater treatment plants have always been strong uptakers of this technology.

Interestingly enough, we've seen a noticeable uptake in hospitality services, so things like hotels and motels, the industrial sector, manufacturing entities. The multifamily housing community, especially within the past couple of fiscal years has been a huge uptaker of CHP as they look at it as a holistic energy management tool, which I'll touch in a little bit more detail here in a moment. And of course, universities, colleges, and other related institutional organizations can benefit from this technology.

And we have a number of awardees, especially some local universities in the Baltimore city region, which have planned CHP solutions which deal mainly with meeting the domestic hot water demands of their residence halls. But there's a whole different host of solutions that they're pursuing. Next slide, please.

So here's a breakdown of those 42 awards that I mentioned of what we're seeing in the different sector uptake. Not surprisingly, the hospital, medical, and critical infrastructure facilities make up the bulk of this as far as individual sectors are concerned. But we see a large distribution between other sectors that I mentioned. That multifamily housing community has quickly become a major player at 14 percent of our portfolio. The agricultural is also growing at 7 percent. And some of those other sectors that I mentioned there as well that you see before you.

I see that we're getting close to the end of the session, so I'll try to speed things along. Next slide, please.

So what insight have we gained out of this program through the awards that we've incented? We've seen a definitely influx in the demand for those smaller packaged solutions that the CHP eCatalog helps users identify for their operations in the multifamily housing community.

There are a number of new construction multifamily housing units going in in Maryland, and they're integrating packaged CHP as an overall energy management solution from the get-go. So they're putting in efficiency technologies paired with this distributed generation resource to meet the thermal load and a good portion of their electric load as well. We've always considered this best practices at MEA, and I know the industry echoes that same point.

To that point, the developers themselves that are working with these entities are integrating these packaged CHP units as part of their clean, efficient facility management strategies like those that I just mentioned. So not only is there a demand for that from the entities themselves, but the developers have realized this is a replicable business model that can most effectively meet the demands of their customer base. And we like to see that. It's encouraging to see that it's translating across multiple parts of energy management, this mindset.

There's a growing emphasis on the resiliency benefits of the CHP over the economic benefits. The economic benefits and the paybacks and the associated revenue streams of CHP systems are

certainly still important. But a lot of the reasoning that we're seeing in the proposals that we receive year over year are that users are very, very concerned with the energy resilience of their facilities. Because we're – downtime means lost revenue for a business. And especially for a vulnerable community or a critical infrastructure facility the absence of power can mean the difference between life and death. And so we're definitely seeing a growing call for resilient, clean, sustainable solutions. And we definitely see CHP as meeting that goal.

And as I mentioned there at the beginning, we're seeing an increase in the thermal load following systems to enhance fiscal year '20, particularly with those multifamily housing units. That thermal load following is becoming more of a solution that we haven't quite seen in the past. So that's where the tradeoff between economics and the resilience comes into play. Economics are slightly eroded when you're doing thermal load following versus that comprehensive solution to make it the most valuable. But we think the tradeoff is definitely worth the investment, especially when it comes to vulnerable communities. Next slide, please.

And quickly I'll touch on our Resilient Maryland program, so if you could click the next animation there for us. So our – I'm gonna – I like this quote that we've put here in this slide for you, because it really echoes what we've seen stated across the energy industry, especially in Maryland over the most recent years. Our grantees, applicants, and the energy industry stakeholders and influencers we've worked with and partnered with over the year have noted that surmounting that initial planning and design hurdle is typically the make-or-break point on whether or not a project goes forward.

Organizational decision-makers and capital providers need that proof of concept through vetted designs and model performance, savings, and return on investment to provide for buy-in. And in order to do that, you have to have quality, detailed, and vetted designs, economic projections, and greenhouse gasses and sustainability benefits from the outset to get that buy-in. If you don't sell the technology to the entities that are gonna make the decision on whether or not you can go forward, the idea is always gonna remain just that, a conceptual idea that will never come into reality.

MEA has decided to answer this call this year through our Resilient Maryland Program. Resilient Maryland provides dollars toward that critical engineering and design phase of a project to

help bring it from conceptual nature to shovel-ready status. Next slide, please.

So the program operated – we had four areas of interest this year in its inaugural year. We devised these areas of interest based on the complexity of the projects we're looking to incent and the scale of them as well. The first area of interest is for your large-scale solutions. So your community and campus microgrid projects, the second one is sort of taking that community and campus scale microgrid and bringing it down to the building level. So like the Montgomery County Public Safety Headquarters that you see in the background there, you can sort of think of another term for this as a building-level microgrid.

Coming down from there, we're focused on providing dollars for the design of those advanced CHP systems. What we consider an advanced CHP is simply a CHP that integrates black start and islanding capability from the get-go.

And finally last, but most certainly not least, is our resiliency hub planning and design portion, which provides those dollars toward the design and planning of community resiliency hubs that provide residents with a safe and secure place to locate in the event of a grid outage event until proper emergency support services can arrive. And they use those funds to complete those five deliverables that you see before you there, which we have identified as those key documents needed to secure that organizational buy-in: your feasibility report, your preliminary engineering and designs, a 20-year pro forma financial model of the project, a greenhouse gas reduction report, and an implementation barriers report, so things like regulatory and statutory barriers to overcome and anything strategic from things like locating the project on the site, what have you. Next slide, please.

And I'm gonna quickly go through this slide, just because I know we're quickly coming to the end of the session. We've received a very robust response to our program in its inaugural year. You see that we got 25 unique project proposals across a wide array of sectors of our economy, which we were hoping for. We had initially selected 15 projects for a combined total of 1.15 million dollars, a caveat that with we're still in various stages of grant execution, so those final numbers could change a little bit. But the initial selection was what you see before you. Next slide, please.

So where does the CHP eCatalog factor into this entire solution strategy that we're going after? We like the CHP catalog for the following reasons: It has a functional and intuitive user interface, which allows every member of an energy project management team to engage themselves. It's easily learnable. The search features and the filters that you can apply can really customize exactly the solution that you're looking for. We like it also because these are pre-vetted DOE technical metrics, which eliminates a lot of that engineering and design cost that goes along with a custom stick-built system.

And this ease of use and ease of integration component that comes along with the packaged CHP units that the eCatalog showcases really pairs well with the holistic energy management goals of our rate base. Next slide, please.

So what are our long-term goals, all of these things considered? We have a large need for replicable, scalable, and cost-effective distributed energy resource system designs in Maryland for all of the reasons that I went through with you this afternoon. And there is an enormous potential for the eCatalog to serve as a nonbiased and accredited tool in this endeavor. We can point our applicants, we can point our grantees to this resource as they design their projects.

Being a unit of state government, we obviously cannot endorse any particular company. But in partnership with the DOE, who has pre-vetted these technologies from an industry-wide standpoint, we are permitted to use this tool, which will allow people to find solutions that they need for their business and their operations and whatever it is they might need a resilient solution for. And we've remained, like I said, we've remained a trusted engagement partner for a number of years now, providing advice and input on the eCatalog system design. So we have a great understanding of how it operates and where it applies the best when organizations are pursuing their strategies. Next slide, please.

And with that I will wrap up my presentation. And once we're done here, I will welcome the floor for questions. Thank you.

Bruce Hedman: Thanks a lot, Brandon. I appreciate that. Clifton, I'm – do we have any flexibility in timing, or is everything gonna go dark in about 30 seconds?

Clifton: *[Inaudible, cuts out]*

Female: The session won't end. I could say maybe take one or two questions.

Bruce Hedman: Okay, thank you. Clifton, would it be possible to put on the very last slide, because it has everyone's Email address.

Clifton: Oh. Sure. Sure.

Bruce Hedman: And then, there were a couple questions that had a high likeability. One, and Aaron I'll send this to you first, and Rich, maybe you can chime in. But what is a minimum requirement for CHP to be viable is the question, in terms of size, operating hours, what? Do you need a central heating system, things like that? Aaron could you take a quick shot at that, please?

Aaron Tasin: Sure. And I wish there was an absolute easy answer. CHP has always been a function of the price of gas versus the price of electricity and how much heat you can recover. And typically about 4500 hours a year run time is usually a good minimum. Usually we'll even see greater than 6000 hours is more really what gets you into the type of payback that excites a CFO or a business owner.

Richard Sweetser: Yeah, Bruce, I'm gonna add a bit to that. I mean, functionally we need coincident power and thermal use. Otherwise you have to get into thermal storage, and that adds more cost. So we're really looking at when you have coincident electric power and thermal use. And that thermal use as Aaron said earlier can be – it can be hot water, steam, chilled water. So that's the fundamentals. Obviously, they're outliers. We add ORCs and other things. But predominantly that's what we're really looking for. So those types of loads that are there with electric and thermal at the same time is really important.

Bruce Hedman: Great. Thank you. Another question I think was partly answered by Brandon in his talk. Are CHP engagement partners or DOE taking any steps to work with state and local governments on resilience in CHP? And again, Brandon talked about that.

But I want to point everyone to the Better Buildings Solution Center Website, because there was a CHP for resilience accelerator that ended about a year or two ago. And there are a number of tools on that Website still. There's a CHP for Resilience Guidebook. There's a CHP for Resilience a couple of Web-based and Excel-based screening tools where you could screen a number of facilities for resilience factors and value and for CHP fit. So

there's a whole bunch of good CHP and other DER for Resilience information on that accelerator site.

And maybe the last question we've got time for there, and Rich, I know you and I have talked quite a bit about this. But I'll point this to you. How do you address the criticism that CHP is based on a fossil fuel and the efforts in certain states and cities to do away with fossil fuels?

Richard Sweetser: All right, first I'm gonna start with natural gas. If you're going to generate electricity with natural gas, generally speaking, CHP is the most efficient way to do that. So as long as we're going to use a fossil fuel, natural gas-based CHP is going to be the best use of that fossil fuel, at least used least greenhouse gas emissions using fossil fuels, period. That's number one.

That being said, there is a growing use of biofuels, such as digester gas or landfill gas. Or – and that's quite common, we've been using that for many, many years. And you're gonna see a growing number of CHP systems in the eCatalog. Right now there are only five, and that's because we need to get more of them in. And there will be a lot more in the near future, 'cause it's quite common.

And also if you want to use a syngas you can actually use syngas to create a synthetic gas that can be used. And ultimately, and ultimately, there are companies such as Aaron's that are demonstrating the use of 100 percent hydrogen.

And there are two classes of hydrogen: blue hydrogen, that hydrogen that you get off of commercial processes; and what's called green hydrogen, which is generated by renewables where they can't use the electricity. Such as wind generates a lot more power at night when you don't need the power, and you can store that in batteries, or you can store that in hydrogen and create CHP systems using literally 100 percent hydrogen locally.

And I do know that the gas industry is looking at going upwards of 20 to 25 percent hydrogen content perhaps in the future through pipelines. So there's a whole host of solutions here.

Bruce Hedman: Great. I appreciate that. Clifton, I suspect we've come to the end of the session?

Clifton: I think so. *[Laughs]*

Bruce Hedman: Yeah, at this point, again, I apologize we ran over a little bit. I'd like to thank the panelists very much for taking the time to be with us today. It was a great bunch of presentations with good information and stuff. You've got everyone's contact information to ask additional questions to. I'd certainly like to thank all the attendees for listen, you know, hearing this and sending in some very good questions. And again, hopefully we can answer them on one-on-one.

Again, if you'd like to learn more about any of these resources and the, I think, 2800 solutions that are up on the Better Buildings Solution Center, go to the Website or feel free to contact me at the Email shown on the slide. And thank you, Clifton, for helping us out with this. So long, everyone.

[End of Audio]