Allison Kirby: All right. So, thank you all again. Hello, everyone, and welcome to the 2020 Better Buildings, Better Plants summit, a Virtual Leadership Symposium. Next slide, please.

Thank you all for being with us today, and we have a wonderful session planned and some fantastic speakers, who I'm going to introduce in just a few moments. But before we dive in, we just have a few housekeeping points we want to cover. Please note today's session will be recorded and archived on the Better Buildings Solution Center. We will follow up when today's recording and slides are made available.

Next, attendees you each have the option to share your video as well as unmute yourself. With that said, we ask that you keep yourself muted and video turned off when you are not speaking just to avoid any distractions. And then if you experience any audio or visual issues at any time throughout today's session, we are gonna be using the Zoom chat window located at the bottom of your Zoom panel. And that'll be designated specifically for technical issues. And Sarah will get to them as she can. Next slide, please.

So, if you all don't know me, this is my picture here. I am your moderator, Allison Kirby. And I am an ESG or environmental social governance program consultant at RE Tech Advisors, where I wear many different hats for many different projects, one of them being the Better Buildings Initiative.

In my role as a healthcare subject matter expert, I support my colleagues, Sarah Dieck, who is on the line as our session assistant, and then my other colleague Andrea Dukakis, who is your healthcare account manager, in managing and facilitating active relationships between the Better Buildings Program and our partnering healthcare organizations. I also oversee the Green Lease leader's program, engaging stakeholders, researching market trends, and developing resources to further the program's resources, bio success, excuse me. Next slide, please.

So this is our agenda for today. I'm gonna start with some more welcome and program updates, and then we will get into the exciting portion where we have Shanti Pless with the National Renewable Energy Labs talking about zero energy resources and then Travis English with Kaiser Permanente to talk about zero energy clinics.

And then from there we'll get our – we'll have our panelists do a debrief between the two of them. Shanti will go into some questions he has for Travis. And then we'll open it up to speaker Q&A. We're gonna be using our handy dandy Slido tool. If you haven't already gotten some experience with that in the opening plenary, you'll have plenty of time throughout the session. And then we're going to wrap things up with resources and closing. Next slide, please.

So first I want to thank our steering committee members, which you'll see listed here. These are our Better Buildings partners and affiliates that help us understand the challenges and the sector trends that are happening across the healthcare industry. And they help us focus different strategies that we can support our partners in furthering energy efficiency and sustainability throughout the sector. Next slide, please.

So, throughout the year our sector steering committee helps us understand those priorities and where we should provide our support where we can. So that includes engaging our partners in activities or producing solutions that address the top priorities across the industry. So right for this year we focused on energy efficiency and zero energy ready design for resilience planning. And then we also focused on engaging and creating a sustainable culture within a changing model of care. And then lastly, strategies for communication and obtaining high level buy-in from leadership. The next slide, please.

So, I want to call out one of our Better Buildings partners who we're recognizing this year. If you all had attended the opening plenary, you may have seen Cleveland Clinic Foundation's main pop-up for achieving their Better Buildings challenge goal this year. They reached 22 percent energy savings from a 2010 baseline.

And on the line, we actually have John Utech with Cleveland Clinic, who is the senior director of the office for a healthy environment. John, if you are on, please unmute yourself. You can share your video. And if you could, just share a few quick words, maybe some advice for others that are looking to achieve their energy efficiency goals. He might not be on yet, but let's see. All right. He might trying to be trying to join in. But we can revisit that a little bit later. Okay, so next slide we'll jump into the waste pilot.

So this waste reduction pilot was launched to address the 2.7 billion tons of industrial solid waste and more than 260 million tons of municipal solid waste the US generates annually. This is a new venture for the Better Buildings program, where we're working with partners to help them develop or refine goals, benchmarks, determine performance metrics, track performance, and validate results. There's over 30 partners that are a part of this pilot, and one of them is actually our healthcare partner, UW Health.

Mary Evers Statz is a trailblazer, a part of our sector that is one of the only healthcare partners that are a part of this waste reduction pilot. UW Health is another goal achiever that achieved their goal last year at 24 percent total energy reduction. And they've actually set an additional 10 percent goal on top of that to achieve a total 34 percent total energy reduction by 2027.

And I believe we have Mary on the line if she is available to unmute herself and maybe share a few words about her participation in the waste production pilot. Let me give her a few minutes. I know there's a challenge of trying to figure out how to unmute yourself and getting folks into here.

All right. Well, we can let folks – maybe I'll come back to Mary to talk a little bit about her participation in the pilot a little bit later. But we're gonna keep things moving. So next slide, please.

So if you haven't already, we're trying to make our sessions interactive by using the Slido tool. So please go to slido.com. This is where we're going to be having folks enter their questions for our panelists. And then also we have some polls that we'd like to launch to get some of your input on a number of different items that we're gonna be talking about today.

You can use Slido on your mobile device or by opening a new window in your Internet browser. And today's event code is #BBSummit. And then once you're in there, it'll prompt you to select which meetup you're in. And you, from there, you could select "Healthcare Meet-Up." So again, if you'd like to ask our panelists any questions instead of using the Zoom chat, which we're going to keep just for technical issues you may be having, just enter in your questions in the Slido tool.

You can submit them at any time throughout the presentation. But we are going to address them towards the end of our session during our designated time. So I'll give everyone a few minutes to open up Slido and select our session. We'll jump to the next slide while everyone's doing that.

So we also hope that you'll join the conversation on social media using the hashtag BBSummit2020 on either Twitter and/or LinkedIn and tag us at BetterBuildingsDOE or at BetterPlantsDOE.

So, with that let's jump into our first poll. So, our first poll today is, in one or two words, what energy projects are you most excited about or would like to complete over the next year? Let me give everyone a few minutes to type some items in. And as they come in, they'll pop up on the screen here for everyone to see. So as people enter their topics in, their answers in, this will formulate a word cloud. And anything that is double counted or is it a popular answer will become bigger and bigger. So it looks like we have a lot of variation in our answers.

And I know a lot of folks are putting things on hold as they address COVID and the pandemic and how are they preparing for future pandemics. But hopefully this is helping you to understand what you should prioritize related to energy efficiency and how you can recover. Interesting. So microgrid is the popular answer. Interesting. That'll be good for our panelists to keep in mind and just for us to understand what people are interested in. Cool.

With that, let's – we can jump into the next slide. Thank you all for your input there. Again, please use Slido for your questions. We will get to these towards the end of the session today. And so now I'm going to introduce our panelists. Next slide, please.

First up, we have Shanti Pless with the National Renewable Energy Lab. And then from there, we'll have Travis English with Kaiser Permanente. Thank you both again for joining us today. We have some exciting content planned to share with you all.

First up is Shanti Pless. Shanti joined the commercial building research group at NREL in 1999 with a focus on applied research and design processes for commercial building energy efficiency and building integrated renewable energy. This work has included facilitating numerous integrated design processes and energy modeling teams needed to realize cost effective zero energy commercial buildings. He is leading the development of the next round of advanced energy design guides and managing the whole building systems integration section of the group. He has written more than 50 journal articles, industry publication, guidebooks, and technical reports related to energy efficiency and zero energy buildings, which he's gonna go into a little bit more detail throughout his presentation.

To kick things off, we do have one more Slido poll, which will actually help Shanti with his presentation and where he should direct some of his talking points. So Sarah if we could jump into the first presentation slide. So what are some barriers to seeking electrification in health care? I'll just let you all answer.

And this is a similar type of question where it does the word cloud, so as folks enter in similar answers, they'll amplify and blow up. Interesting, cost. Yeah, cost is always a barrier, and I imagine even now more so as things are a little tight. We've got current infrastructure, utility costs. Hmm, education. Well hopefully with Shanti's resources, he can help provide some input on what's available and what can help guide you all as you're working through this transition.

With that, I think, let's jump over to Shanti Pless. I'll let you jump into your presentation. Go for it.

Shanti Pless: Thanks, Allison. Welcome all. Yep, Shanti Pless here at NREL. We're still at home, so you get to see my dining room background here. And but from the hills of Colorado hopefully I can introduce some of the concepts we see in zero energy buildings and emerging industry that is starting to grow pretty quickly here across the commercial building sector and get into some of the healthcare specific opportunities we see going forward and then kind of set up Travis to get into the details of Kaiser's recent efforts here. So that's kind of the goal here.

If you go to the next slide, and talk a little bit about for anyone that's kind of new to the net zero energy conversation, net zero energy, zero energy buildings, zero net energy buildings is also out there. And these are all kind of similar terms. A hundred percent renewable energy is being used a lot now for corporate renewable goals as well as city commitments to a hundred percent renewables at a building scale or at a community scale, perhaps, or even portfolio scale. These are different ways that we think about net zero energy.

And if you go to the next slide, in 2015 the Department of Energy put out a common definition for zero energy buildings to try and standardize a little bit across those different types of definitions. And so at a high level it's asking for projects to look at their measured energy use on a source energy basis and be clear about the boundary of what the building or the community or the portfolio is to be measured.

And if you go to the next slide there, the simple idea around balancing your consumption and production around renewable energy versus non-renewable energy that you use. And so it's a pretty simple idea. And so, but the details matter.

And if you go, continue to the next slide here, yeah, there might be some animation here. Sorry about that. Yeah. So, yeah. So, if you look back over the last, I guess, decade or so, a lot of the zero energy buildings that were out there were fairly small: small one or two story buildings, a lot of residential, but not necessarily a lot of the large-scale healthcare or urban buildings that majority of our commercial real estate represents, right? And so going forward, a lot of the work will be to figure out how to get the level of energy efficiency necessary to be – to enable things like taller, more urban buildings that have limited roof area for on-site generation, not just one building at a time.

We're seeing a lot of district or community-scale goals around zero energy, where a master-planned community, for example, has more opportunities for additional energy efficiency or district energy systems that can continue to reduce the load so that one large building can be offset by a neighboring smaller or warehouse buildings. And so those concepts of zero energy are more approachable for more buildings.

What I have over here to talk about today, higher load building types are now becoming approachable for zero energy, where historically a school or an office building doesn't have the air change requirements or temperature control or occupancy profile, so to say, on a full-scale. A healthcare facility might. And so we're starting to see the continued efficiency matching up with more and more cost-effective renewables that are out there.

As you saw in microgrid and needs going forward, you know, this idea of more resilient aligning the goals around energy and resiliency. They're not always aligned. Oftentimes, just grid-connected solar doesn't necessarily provide more resiliency to an organization as well as utility scale renewables don't necessarily do that as well. So opportunities to invest both in reaching zero energy but at the same time utilizing that to enhance resiliency is some of the research and opportunities going forward that in the next ten years we see.

And as the low-cost renewables are increased significantly, this idea of how we integrate them into a utility infrastructure was never really designed for lots of distributed renewable being back fed into a grid is a bigger and bigger issue going forward. And so thinking about how distributed renewables interact with the local utility, both economics and technically around interfacing with loads, load flexibility, how buildings can participate in becoming more grid friendly or grid interactive efficient buildings, as DOE and others are now coining that term. So lots of opportunity there to explore that.

And so in general we're also seeing that zero energy is scaling significantly. There's more of them in everywhere. And so if you go to the next slide, some of those reasons are here. You'll see there's over 500 commercial projects out there that are now targeting zero-energy. You see whole school districts committing their all their new schools and major renovation of their schools towards zero energy. We talked about zero energy districts, so you get a couple hundred buildings at a time all targeting this, helps to scale these ideas.

I think then the last two bullets here are really driving this industry to become more mature and kind of ubiquitous, if you will, on these 100 percent renewable commitments. That organization is like states or cities have made. You know, corporate commitments out there are really driving the zero-energy opportunity to support these 100 percent renewable commitments that are being made across the US. And as the costs and the – come down, the integration industry learns how to do this at a large scale. That's where these some of the stretch codes are coming in to be able to require the laggards to adopt these new strategies and technologies.

And so, you see that now in California with the current version of Title24 for three stories and less, residential and working towards commercial by 2030, as well as in states with home rule cities that make their own energy codes. Like it says here locally, like Boulder and Denver both implement their own energy codes. And so they look to the leaders in these stretch codes to try and come up with their own codes so that by 2030 they can expect all new construction and major renovations to be targeting these levels of performance.

So, in the last, you know, looking back ten years ago it was a handful of projects going forward. We are accelerating these ideas pretty quickly, I'd like to think. So next slide.

Just a quick snapshot where you see these 100 percent renewable commitments from cities popping up when you have mayors making these commitments it's up to all of us to *[laughs]* figure out how to do this cost effectively and create the resources and education and the tools, the modeling tools, and the technologies that can integrate to do this in a meaningful way. Go ahead to the next one.

And so with that comes certifications for if you're looking for third-party verification of your energy performance around zero energy. A handful of these that are out there, whether they're the USGBC's new LEED-0 outcome base code called LEED-0. They have one for energy as well as for carbon and water and waste, I believe.

The Living Building Challenge has been around for a while now, one of the first offer of zero energy certification. A couple different ways to go about that there.

The folks from Architecture 2030 are proposing their outcome base code called the Zero Code, which are being considered for stretch codes across the US. I've got a couple slides coming up here on some of the details what we're learning from as it relates to healthcare there.

And then, you know, just standardized definitions with the DOE Zero Energy Building standard definition, as well as when you start putting this into stretch codes it creates a standard implementation and definition. I will say ASHRAE is also thinking about it and in the early stages of coming up with a standard for zero energy as well. So, lots of industry momentum moving this direction in the next ten years where I think they'll have a clear approach here as we standardize all these certifications and efforts. Next slide, please.

So, this is what the LEED-0 Website looks like. I just had the experience of going through it and really studying this up, because our own buildings at NREL we have offices and labs and such and have been operating.

And so if you'll go to the next slide there, this is what your plaque looks like – oh sorry. This is some of the details I felt like this group should probably think a little bit about in terms of high load buildings. If you say a large hospital, and you can't get to zero energy on site with your own renewables, the approach here, this hierarchy that they provide – and other provide something similar

– around where your renewables are sourced from is something that it makes programs like this with offsite renewable accounting.

If you're a portfolio scale approach, whether you have it onsite or offsite, it enables the large organizations to think about these goals now. And so where you're first kind of trying to implement all of opportunities for on site and resiliency, and then you're going to your local community, your local generation is the second goal they want you to figure out. And then you're talking about kind of virtual power purchase agreements where you own the renewables but they're not part of your building proper. And so it's as a portfolio kind of accounting game at that point.

And then there's offsets that – certificates – that you can kind of buy your way out that others are starting to – once you do those, other strategies have become a viable effort to try and zero out your energies. And so the USGBC is recently released this structure for how to do this for higher load buildings. If you'll go to the next slide.

Yeah, so there you go. That's once you take all your measured data, align up, and do the calculations per their calculation guides, you get a plaque like this. This is our own building at NREL here. We went through that process just a couple months ago before we were all quarantined at home and so got a verified zero energy performance from USGBC. So it's cool to see the national rating program starting to offer these types of recognition opportunities. Go to the next slide.

Similarly, the zero code that's out there is asking for something similar around maximizing your efficiency first. But then – and then going to your – what you can do on site in high load buildings or in taller urban environments it's fairly limited. And then having a robust mechanism for accounting for offsite is becoming the approach that you'll see over and over again whether it's architecture 2030 or USGBC and even IFLI and their zero code – or their zero-energy certification – offers a similar program. Mm-kay go ahead to the next one.

For those of you getting the details of how these work, this is out of the zero code technical support document that they offer up in terms of how you do the waiting for how much of each class of renewable you need to do your calculation. I thought this was important to kind of show that they allow on-site renewables through community sale of class 1 to direct access and green retail tariffs as a class 2, to unbundled RECs as a class 3. But you need different amounts of them to offset your energy use.

And so there's lots of details how they came up with these multipliers. But those are out there being proposed now. And so it's something to think about in terms of balancing efficiency, load flexibility, with renewables to enable zero energy concepts for others to approach. So, go ahead to the next one.

So, a few thoughts here. And you'll see this, I think, probably throughout the summit. But part of the work that we do in support of this industry in the Department of Energy and BTO and specifically in our group here at NREL is focused on industry design guides for when a new handful of projects really prove out how to do this cost effectively. And we can do the modeling to show it can be done across the United States and in different climate zones.

It's an opportunity to document those strategies and put 'em into industry's supported sponsored design guides, if you will. And so the professional societies have been supporting the development of what were called advanced energy design guides, kind of beyond code efficiency recommendations for over a decade now. In the last few years they've been focused on zero energy design guides. So the two that are currently published, the Small or Medium Office Design Guide as well as the K-12 schools. And we'll have a multifamily design guide coming out for zero energy in the next few months here. Look for that.

And so you kind of be, you know, stretch codes if you will, industry relevant strategies, and if you go to the next slide there, those are the current zero energy ones. But there was a 50 percent one for large hospitals I was the chair of way back when. I think this is probably 5-plus years old now. But it's always good to put in front to remind people that this is a 50 percent savings over code at the time, 2004, for large-scale hospitals, right? And that has been out there and has a range of standard common space types that are covered in terms of air changes and standard occupancy schedules and such that all drive towards a set of recommendations.

On the next slide, and that, you know, across the different strategies that influence how a hospital uses energy, and so from envelope through wedding, and even plug loads and high processed load spaces that are out there, you know, there's a range of strategies that are still relevant today, especially in healthcare.

And the next slide on the mechanical system where reheat is often almost half the load in a large hospital, there's a handful of strategies for aggressive reduction in reheat by decoupling your space conditioning loads from your ventilation air change loads for pressurization requirements that are out there. We'll hear from Travis and Kaiser and how they are implementing strategies like this here in a minute.

But so range of efficiency strategies for sure are available to do that. So, I just wanted to make sure that's in front of everyone. It's the top of everyone's mind that has an opportunity to think about high efficiency. And I think you've probably talked a lot about this in the healthcare group here. But it's a resource that's out there. You can still download these for free on ASHRAE's Website. ASHRAE@org/aedg. All right. Head to the next slide.

So we talked a little bit about going forward where the current crop of high performance best in class of zero energy buildings are. This is a retrofit of an early 90s office building in Washington, DC near Dupont circle, American Geophysics Union. It's their professional society of geologists and planetary scientists. And so this is unique in that it's a six-story office building that's being renovated to reach zero energy.

You can see a large-scale PV canopy is the only generation opportunity they have. So to get there they have to be, you know, implement significant efficiency strategies for an office building, in this case, to be able to kind of move the urban zero-energy opportunities forward. And so things like wastewater heat recovery from the sewer that runs in the street, to full electrochromic glass to manage solar heat gain and glare, to a radiant cooling office building in Washington, DC, of all place, right?

And so we're starting to see these technologies be implemented and the industry starting to figure out how to do this cost effectively and so that you can do things like radiant cooling in hot, humid climates like in Washington, DC to be able to get down to an energy's intensity below 20 kBtu per square foot per year, which is pretty good for an office building if – for sure.

The next one is another office building in the same area. This is an United Therapeutics office building. And again, a kind of a, I think, this is a seven or eight story office building with significant kind of urban constraints in terms of on-site generation. And to get there they had to figure out how to get ground source heat pump wells drilled underneath the building.

So all their heat rejection equipment is below the building in ground source heat pump systems and had to actually go through some unique implementations of rules around wells, drilling in under buildings in Maryland to make this happen. But they were able to get through that and are targeting zero energy.

And again, another showcase. This isn't for everyone. Not everyone has the financial resources like United Therapeutics does to do this. But when you do, technically it's being done. It's our job is to figure out how to do this cost effectively so it's approachable for more and more projects going forward. But important projects like this because it's proving it can be done. And then going forward it's how do we get the learning curve and the costs to the point where this is approachable for more and more projects? So pretty important high-profile showcase project to kind of go, you know, to fit into an urban environment and still reach zero energy. All right, next one.

And so when you start doing that, projects like this are starting to showcase a way to architecturally integrate active generation components into your façade. And to fill up your roof you have a south-facing, unshaded façade, for example, or a southeast or a southwest. There are opportunities to start to think about active generation as rain screen panel. And so this is an office building here locally in Colorado that has done that.

And you definitely don't get optimal output, but you do get winter peaking output or winter or summer afternoon peaking output, which is becoming more and more valuable as everyone has solar, you know, peaking in the middle of the day in the summer. This is an opportunity to start to maximize active collection area. And you're still getting a meaningful amount of output. It's not optimal, right, you know, maybe say 70 percent of an optimal oriented solar panel. But you are getting some meaningful output.

I think architecturally it looks like solar panels. There are emerging technologies coming from Europe now that allow you to have a rain screen metal panel that does not look like a solar panel that is starting to be thought about for applications like this. So, having strategies like this will allow us to think about taller buildings in more urban environments starting – or higher load buildings that need more of their surface area to be active generation components to get there. All right, the next one.

And this is another good local example here in Colorado. This is a community scale district. This is the water utility here in Denver that has redeveloped their whole campus, and this is their office building. It's at zero energy. But it's also, you know, they have a lot of other buildings on their campus that are using a district cooling system that's pretty innovative. But they're able to use the city drinking water as a cooling source for a district cooling system across this campus.

Right, so when you do one building at a time, you don't necessarily have that opportunity. But when you are doing it at a campus or a community scale, these types of district energy approaches become more viable so that you can get more efficiency kind of at a community scale. So good example of that here. And next slide.

There's lots of other districts out there that are also thinking about this. This building's important in Massachusetts, in that it's a teaching laboratory. So it's starting to see higher load buildings, and I'll say 40 to 50 to 60 kBtu per square foot per year, but still able to reach the zero energy but requires not just solar on the roof, right? This is their full _____ covered in a canopy system to reach zero energy for a laboratory, which is significantly more energy use than some of the office buildings we've been talking about or schools. But next slide.

I can run through these projects pretty quick here. And this is an important project in that it'll be, once completed – it's under construction now – the largest, most single high load laboratory building to reach zero energy at 380,00 square foot and almost 50 thousand kBtu per square foot per year, which is great for a laboratory.

They're doing things like vehicle testing, and they've got cold sub rooms to put large vehicles in to do emissions testing at -40, right? So significant process loads to do that and are still as a state-owned facility with part of the state executive order for zero energy for state owned facilities for new facilities. It's trying to be an example of that.

Also doing – and in California where everyone has solar, it seems like, there's the midday value of solar is pretty minimal in being off peak at this point. So they either have to start thinking about integrative demand management to minimize your afternoon loads as well as energy storage to maximize your generation in the later afternoon when it's higher value in southern California. So an important project to continue to follow, proving that it's being –

zero energy is being thought about and done at a larger, more load-intensive scale. All right. So if we go to the next slide here.

Just a quick resource. I always put this one out there, in that it's, you know, in our own zero energy buildings and a lot of the work we do it's always – and we saw cost always being a concern, right? Cost control strategies for zero energy is always critical.

And one thing we learned in building our own zero energy office building at NREL is this idea that I know you can – when you are able to prefab and offsite construct major components of your building, whether it's your radiant cooling system you see in the upper right there, or your precast wall panels with the windows already installed on the façade, you're able to get more energy efficiency integrated more cost effectively. And that was just a handful of strategies.

And so on my research at NREL, I've been focusing now on how far can we take and go with this strategy. This is just wall panels or a mechanical radiant tubing system we've offsite prefabricated. What if we could prefabricate major program, things like full hotel rooms, or full apartments, or full exam rooms, and do all that in a way that allows us to integrate more energy efficiency technologies but in an offsite constructed solution?

And so that's become a key efficiency research opportunity for us as well as the Department of Energy. They've got a new focus area called Advanced Building Construction Research Program where they're – we're thinking about the process of installing efficiency using offsite panelization or prefabrication, or to streamline processes in general to get more efficient and more cost effective, knowing that the productivity in our construction industry is still pretty flat, right? So if we can increase productivity using strategies like this, we think we can get more energy efficient and cost effectively integrated.

So, something going forward as a trend that we're looking to understand further and where that applies to the healthcare sector is something Travis really could talk about as we go in terms of, if you go to the next slide, you know. Yeah, so here's some of those, the industry reports that are out there about how off-site construction can reduce project construction timelines by 40 to 50 percent. Pretty significant, right? So when you save that much construction time, the up-front planning and prefabrication ideally allows for better integration of systems. The next slide there.

So yeah, this is our ongoing work around how to do this, right? And so we're seeing faster build, you know, compression of timelines for sure, in that for certain programs _____ to maximize up to 95 percent of construction happening in a factory off site. And it's a small percentage of the total overall effort in construction recently, mostly in multifamily and hotels.

But the hotel sector, hospitality, where most of their program is modularizable means they can get better quality. Can be cheaper to build if you can monetize the timeline savings. And you're getting more investment from others outside of the construction industry recognizing that productivity has been a significant barrier looking to be disrupted.

Our challenge, though, is how do we make that – this kind of emerging trend – result in more efficient buildings, right? So it may or may not. We're, you know, and we're trying to understand that now and then use industrial engineering, kind of lean construction practices but applied to a factory process to get more efficiency integrated. So that's some of our ongoing work. So for the next slide.

And there's a handful of healthcare specific modular companies out there. This is one that we've talked to and heard about where they are doing out of their factory in Alabama, I believe, are doing a smaller scale clinics and ER facilities, right? We're at, say, maybe ten of these modules that they're able to design and bolt together and streamline the speed of construction. It may or may not be more efficient, I think. So something to think about, though, is when you start to build your whole program off site, what are those opportunities. The next slide.

And, you know, this has also been kind of some of my inspiration is hearing from this company here when they did their first solar powered mobile clinic, right, primarily because of speed of delivery, but also because of having generators run outside attached to this mobile clinic. You know, and the sound and outdoor air quality issues, and the vibration and the power quality that resulted in, they invested in a battery-based solar kind of remote power system for a mobile clinic.

And so, and Clemson was the first kind of customer to willing to do that. But now going forward that's kind of standard for them for speed of delivery and as well as outdoor air quality issues that it's become standard, right? So something to think about in terms of a healthcare specific application. Let's go to the next slide.

You know, going forward, how do we think about these technologies and strategies for higher load critical care facilities, right, that have a need of speed of delivery and can be modularized, right, and if there's value in that in thinking through? I think initially these are being thought about in more remote locations that have – that need a community remote healthcare but aren't building permanent facilities where you can prefab these and get the level of efficiency necessary to self-power them is – I don't think it's been done just yet, but it's something to think about going forward on the research side.

Put these, you know, energies or energy pieces together, healthcare needs together, as well as offsite, the benefits of offsite construction all together in a solar powered permanent modular healthcare facility. So, just wanted to throw that out there. Something maybe to think about going forward if it's possible to be done, what it would take to actually do this for the group to think about as we get into our question and answer session here. So with that, do I have – does that – is that the last slide?

Allison Kirby: Yep. I think that's the last slide. I think we'll leave the Q&A portion to afterwards.

Shanti Pless: Yep.

Allison Kirby: So, thank you Shanti.

Shanti Pless: Sure.

Allison Kirby: That was great. Really great resources there, and hopefully that answered some of your questions. I know you guys were looking for educational resources. And so before we jump into Travis's portion of the presentation, I just want to remind folks that you can enter in your questions into Slido from the Q&A portion. So just a friendly reminder, so as you have those questions in your mind fresh out of Shanti's presentation, make sure you get those in there and I'll address them as we get into that portion of the presentation.

And with that, I'm going to introduce our next panelist, Travis English. He is the national director of engineering and chief design engineer for Kaiser Permanente's Facility, Strategy, Planning, and Design Group. Travis is a PE with a BS in mechanical engineering from California State Polytechnic University at Pomona and an MBA in management from California State University Fullerton. He has 20-plus years of experience in design and construction.

And with Kaiser Permanente, Travis emphasizes the value-based and outcomes-based approach to MEP systems to meet the challenge of providing world class care environments that meet the ends of responsible, sustainable, and affordable care.

So, similarly to our last presentation, we're gonna kick things off with another Slido poll. So if you haven't already, please go to Slido.com. Enter in #BBSummit. Select "Healthcare Meet-Up." And then there you'll be able to see our next poll, which is where do you see the biggest opportunities in healthcare for net zero or zero energy adoption. This could be certain facility types, it could be certain systems, best practices, et cetera. We'll just give folks a few seconds to enter in their answers.

Mm-hmm. We have medical office buildings, outpatient facilities, lots of clinics. Blatantly obvious is medical office buildings, yep.

Travis English: These guys cheated. They read the presentation in –

Allison Kirby: Yeah *[laughs]* I think so. *[Laughs]* All right, Travis, if you want to jump into your presentation, I'll pass it off to you.

Travis English: *[Laughs]* Sure.

Allison Kirby: Cool.

Travis English: Yeah, hi. I'm Travis. I work for Kaiser. And I think maybe the audience gets this, that in healthcare design circles this concept of net zero seems often crazy and unattainable because hospital energy is really high. Our national average EUI, energy use index is over 200 kBtu per square foot year. So a lot of architects and engineers, and to a certain extent owners, have just kind of very little hope that net zero is *[laughs]* even a viable goal in the healthcare sector.

I believe this building that I'm talking about today is the first demonstrated net zero healthcare building in the United States. I've made that claim before in public already. And I'll say the same thing I said last time: if anyone listening thinks that claim is incorrect, then please let me know and I'll stop saying it. And just to include the nuance of this is a demonstrated net zero building, and that's site energy. There have been some projects with a publicly stated goal to be net zero. And there have been a few who said that their design was net zero.

I'm gonna spend a bit of time talking about the energy performance gap. And what I've learned about building energy is that design intent and reality often don't match. This, for us, was the third building that we wanted to be our first net zero building *[laughs]*. It's the first building that actually kind of got there.

It's located in Santa Rosa, California, 87,000 square feet, some key statistics up on the board. This is registered, by the way, with the living building net zero system. So go ahead and hit the next slide.

So, if you're familiar with healthcare design, you probably know that we have this ASHRAE standard called ASHRAE standard 170. It has this table full of air change rates. All the exam rooms need to be six air changes, X-ray rooms need to be six air changes, et cetera, et cetera. We didn't use this table on the project. So if you use this table it has a really big impact on HVAC energy. Similar to a lab when you implement high minimum ventilation standards it really drives up your heating and cooling energy on an annual basis.

What ASHRAE doesn't always advertise is that in clinics, your doctor's office, or this building, which is – your doctor's office, your primary care doctor's office is probably not in a hospital, I'm guessing – these rules are not written into the codes. There are some folks who would like to see them written into the codes *[laughs]* but right now they're not anywhere in the country that I'm aware of. So that makes this table more of a voluntary adoption for healthcare organizations. And we do not volunteer to adopt this. Go ahead and hit the next slide.

And that's probably, that is worthy of criticism. You could criticize us for that. But another thing that ASHRAE doesn't always advertise on the front page is that they've actually looked at the research behind those air change rules and found it to be quite poor. This is a study that came out last year on ASHRAE letterhead, and when you read to the end it actually says that 75 percent of our healthcare ventilation requirements and about 95 percent of those air change requirements have no evidence basis, there's no clinical basis, there's no rational basis. So there's not a very strong case for voluntary adoption of a very energy intense standard.

This is one of the keys moving forward in healthcare. We need to spend energy wisely, which means at a minimum spending energy on either evidence-based – evidence-based is usually impossible – so either evidence-based or performance-based prescriptions. I'm gonna come back to this at the end. A lot of people have a lot of belief *[laughs]* about air and health, much of which is kind of fear and myth and superstition, tradition, folklore, whatever you want to call it. And sadly, healthcare ventilation is one of the most nonscientific aspects of building engineering.

We do have about five rooms in hospitals where air quality and air movement is really important and clinically important. But then we have our standard has this air change table with literally a hundred spaces. And all these really non evidence-based prescriptions of four air changes per hour or six air changes per hour all over the place. Those numbers are really quite meaningless in terms of evidence. You might as well be hanging garlic around the building to ward off vampires.

So this is a long, long way of saying that Kaiser Permanente has elected not to follow the air change rules in our clinics in our medical office buildings. We do not voluntarily adopt ASHRAE Standard 170 anywhere that we're not required to by code. And that is fundamental to this project. The building that we're talking about is a clinic. It's a big clinic. It has variable volume systems and a return plenum. If we were following the air change rules, the energy performance that we're talking about would just flat out not be possible.

So let's hit the next slide, 'cause I do want to show you a couple of years' worth of buildings leading up to this building. *[Laughs]* Most of our new construction in the last eight years has been these clinic facilities. And starting in 2011 we've had a pretty aggressive energy program around those. We do energy models for every building, and we have an energy target for those outpatient clinics. Our energy target is 50 EUI. That's the design energy target.

And then what we do is we measure the result of every building, and we compare it to the energy model. So you could kind of see here this dropping curve. The buildings that we've opened from 2015 to 2017 and on, compared to the buildings that we were opening in kind of 2012 and prior, we have seen a full 50 percent reduction in energy signature.

On the other hand, our energy target was 50 EUI. That's what our energy models showed. They actually pretty consistently show lower than that. But the actual consumption comes in higher, significantly higher, and consistently higher. There's a name for this. It's called the energy performance gap. The energy performance gap is the gap between what our calculations say is gonna happen with energy and what really happens with energy. And in most of our designs in our experience, that energy performance gap is somewhere between 50 percent to 100 percent. Pretty significant.

So go ahead and hit the next slide, and that takes us back to this Santa Rosa Medical Office Building. So now, since I told you we're a net zero building, let me give you the bad news. When we say zero, we mean five. *[Laughs]* And I'm told that once a building gets below ten EUI, then you claim it as a net zero building. And so we're going by that rule.

First patient was May of 2018. We started the M&V period in September. So we have the full year. The five EUI is a September to September number. This building consumed 36.8 EUI. And in the same period onsite solar production was 31.8. So net consumption was five. We call that net zero. Go ahead and hit the next slide. I think these next couple slides are relatively quick.

This is the building exterior. It's a modular cladding system that you can see here. Go ahead and hit the next one.

And then we did incorporate these electrochromic windows. I'm not gonna say the brand name here, but these are the windows that darken and lighten, you know, like the opening seed from Blade Runner. But they do it on a circadian rhythm day to day.

At this point let me mention cost and budget. The budgets that we carried for these buildings, our medical office buildings, do not have energy dollars at all. And we look at energy models as plus or minus 15 to 20 percent margin of error. So based on that, you don't often see a business case where we budget change for energy features.

Now I'm not gonna tell you that this building had a particularly low budget or even a relatively low budget, but the question often comes up, "How much extra money did you spend for the energy features?" And the answer to that is very clean, zero dollars and zero cents. There was never a business case to approve additional budget for this project based on energy features. Next slide, please.

In fact, the primary HVAC design strategy of this is this all electric system. We have a series of heat pumps. So there's no chillers, and most importantly, no boilers. I'll talk about that in a minute. *[Laughs]* And there's no gas line. On this site, the fact that we were able to eliminate the natural gas and the piped heating system was a million-dollar savings to the project. And on their budget, they didn't give the million dollars back. They spent it other places. *[Laughs]* But the HVAC system itself was a savings. So for HVAC we have this north unit, south unit, east unit, west unit, and then a central unit. Go ahead and hit the next slide.

In this space we had a combination of traditional VAV zones and then thermal diffuser zones. But even the traditional VAV zones, the heating is electric. So it is an all-electric building. All right hit the next slide.

So now I'm gonna do a little bit of a diversion here and talk about another building *[laughs]* just to talk about natural gas. Because natural gas is a big recurring theme that we've seen in this energy performance gap conversation. I'm not giving you the name of this building to protect the guilty, but on paper this is a heating system that's 95 percent efficient, right? In the design energy model, this heating system is 95 percent efficient.

And by the way, I'm inclined to believe the manufacturers. I think these boilers are built for and tested for and validated at 95 percent efficiency. But when we put them into buildings, we tend to oversize them, we tend to connect them to pumping systems with a bunch of zone controls that introduce a whole lot of inefficiency.

This is a study that we did on another building for the first winter that it had. This is the coldest months of the year. And the heating system here is operating at like a 30 percent efficiency, not 95 percent, *[laughs]* 30 percent efficiency. Now, there's some corrections that we can do within that thing and some other factors. This system may operate up to about 50 percent efficiency.

But the point is it's way off of the energy model, right? It's not 95 percent at all. It's not even 80 percent. It's down sub-50 percent efficiency. And this is not a unique or even an extreme example. We've been really digging into this energy performance over a series of buildings. And those natural gas heating systems are a recurring theme.

I think this is another key moving forward in healthcare. I was a – before I came to Kaiser – I was a design engineer for a decade and some change. So I did design on hundreds of buildings, right, with the standard tools, TRACE 700 or DOE2, EnergyPlus, you know, hundreds of buildings. Never once in my design career did I collect the data to look at the heating load in the coldest week of the winter. Never once in my design career did I collect the load to look at the cooling load in the hottest month of summer. Never once did I collect data to validate boiler plant efficiency or cooling plant efficiency, right? I designed a ton of buildings, and I never did that validation.

And when I say it that way, it makes me sound like I'm a bad engineer, which I probably am. But that's very, very normal, right? We – nobody does validation. It is super rare. Even those of us who have done it have done it on one building or two buildings, you know? It is extremely rare.

Another big myth here, by the way, when you get into validation, is the myth of plug loads, particularly in healthcare. We have a lot of design engineers that in the energy models assume these sort of massive recurring plug loads over the course of the day. Which, once you get into data, it just never comes true.

The good news here – and I know this is a bit of a rant – the good news here is that the tools are there. Database commissioning is now cheap, it's market ready. We're demanding it on every project in the last two years.

Of course, there's bad news *[laughs]* that comes with that. I've said that database commissioning is very much like getting drunk and super depressed and then looking at yourself in the mirror naked, because it highlights all kinds of aspects of system performance that are very uncomfortable, right? Many of the design assumptions that we make are either wrong or they're just misguided. So go ahead and hit the next slide.

Which now brings us back to Santa Rosa with its all electric design. This is something that went really, really right here. The energy performance gap in this building was only seven percent, which is really, really low if you've ever dealt with energy models versus actual consumption. I mentioned before, we assume that the energy model is only 15 or 20 percent efficient, right, in new construction as a rule. So this energy performance gap of seven, less than ten, is really kind of standout.

Actually, you can see that the energy performance gap of the building consumption came out less than the energy performance gap of the PV. The PV systems had more error in it than the building did. So I think there's one more slide, right? Oh yeah, just this as a close.

So right at the end here, let me tell you, this Santa Rosa Medical Office Building was a son of a bitch to commission. We had three types of temperature control systems. We had some real issues with HVAC units switching from heating to cooling. It took us a full year to close out all the commissioning issues in the building.

That's not to say that we wouldn't do it again, but we definitely had some lessons learned *[laughs]*. Our design and our control scheme was probably over complicated to a large degree, but the energy performance came in great. It is a real net zero building with the data to prove it. And we have a host of clinics in design and construction right now. So I hope to announce our second and third net zero buildings soon.

But before we move into discussion, I'll sum up with kind of the two points that I hope I've highlighted. And let me reiterate, first off, we have to make validation a rule, not an exception. That's gotta be the new standard, right?

Imagine if you had 10,000 data points a day that were coming in from cancer patients. You hook them up to biometrics, and you monitor to a thousand points on 15-minute intervals. If that data set existed, we would be insane not to look at it, not to mine it for every possible conclusion that we could come and learn from it, and learn, and learn, and learn from it.

In a less dramatic way, that's exactly what happens with our building systems, our energy building systems. Most of the buildings that we've built in the last ten years have way more than a thousand points of data. So 10,000, 100,000 points of data a day, is easy. And yet, building, after building, after building, after building, we ignore that data. And we instead look at our tools like Trace 700 or Energy Plus or whatever.

If I've learned anything in the last three years, is that the design tools that I grew up with are frequently wrong and can produce outputs that are radically different than what happens in reality. So the correct thing to do, I believe, is to look at the real data that comes out of our buildings on a day-to-day basis. It's the biggest learning opportunity that there is.

The second thing that we have to do is stop hanging garlic. We've gotta move to evidence-based ventilation measures. So many human beings have weird superstitions about air *[laughs]*. My great grandmother was a German immigrant from World War I, and she believed that if you slept with the windows open, you would get sick, and you'd catch a cold. Unfortunately, she moved to Tucson, Arizona. So as a kid when we went to granny's house in Tucson in the summer, it was terrible. Because the only time it got below 90 degrees was at night, and she wouldn't let you open the windows, because she was superstitious and thought that you'd catch a cold.

That sounds crazy, and I can laugh at granny now. But we do a lot of weird things around here. Just this month we had an article in the ASHRAE journal about COVID-19. And one of the recommendations in there was to run your HVAC systems 24-7. And unfortunately the CDC picked that recommendation up out of the ASHRAE journal and plopped it onto the CDC Website. So it looked like they were enforcing it, right, or they were endorsing it. Hey, building owners should consider running systems 24-7 on account of COVID-19.

And I'm sure that was well-intentioned advice, *[laughs]* but look at the evidence. It's the hypothesis is that running HVAC systems at midnight will prevent the spread of COVID-19 at 10:00 in the morning, right? The exhibit A of the evidence is nothing. And exhibit B is nothing. And the first witness for the prosecution is nobody, right? There's nobody. There's not a shred of evidence that indicates that running building systems at night are gonna do any good. So you literally might as well hang garlic on the door frames to ward off vampires.

And our industry is unfortunately shot through with this unscientific thinking around ventilation from air purification salesmen at the Sharper Image, all the way up to the highest ASHRAE committee. We repeat all kinds of things that really deserve to be questioned, right?

And healthcare ventilation is the absolute worst. I've heard people say, you know, just very matter-of-factly, we need to have more air changes in a cancer center because – and then you ask. It's like, well because why? Cancer doesn't have anything to do with the air. "Well, the cancer patient might get something from the air during infusion." They might also get bit by a vampire. Those two risks have exactly the same level of evidence.

So, in the long run, we need to go to either evidence-based or performance-based ventilation standards. And then we need to – you cannot manage that which you don't measure. If you want to get into the air quality business, we better start measuring air quality. And then we need to measure our energy against our designs to spend energy wisely and get the results we want. That's all I've got in terms of prepared. *[Laughs]*

Allison Kirby: Thank you very much, Travis. You have some really hilarious analogies that I was laughing at on mute. So, *[laughs]* I imagine others were doing the same. *[Laughs]* But, thank you. Really great presentation. And we are going to jump. And a reminder that everyone if you have your questions, please ask them into the Slido tool under the Q and A portion and we'll get to those in just a minute. But first, we want to listen in on our speakers.

I know Shanti, you had a few questions that you wanted to ask Travis. So we could start there. And then we are going to jump in after that into some more Slido questions, and then I'll, and then after that open it up to address all your questions. So you guys have some time to enter in all your questions. But with that, I'll pass back to Shanti.

Shanti Pless: Yeah. Thanks, John. This is just a handful of questions here to get started. You talked about electrification and getting rid of, in your system efficiency for your natural gas plant. What are the other challenges you have going into all electric, not running the gas line to buildings that kind of defy normal design, right? If you have gas in the street, but you're not having gas into the building, what other challenges do you see going forward in trying to electrify more health care facilities?

Travis English: The biggest challenge that I'm up against right now is just outright equipment availability. We do have a lot of heat systems in hospitals – medical office buildings, as well, but hospitals tend to have these massive two-million-BTU boilers, or three-million-BTU – bank of three three-million-BTU boilers. And I can show you data that those should be downsized by about 60 percent.

But even at that level, we just flat-out don't have the availability. Right? Whereas a heat pump water heating system or steam generation system, electric steam generation system that can hit these massive sizes that we need to get. We are looking at some in the next wave of medical office buildings. We have found – I think we have found – some heat pump water heating systems that will be able to do on those buildings.

And then but that is a big challenge. There's not a ton of products available on the market internationally. The Germans are a couple of years ahead of us, as I'm sure you know. So they have some stuff. Some of that technology is creeping over into the US market, but it's not moving super fast.

Shanti Pless: Cool. And you talk about 50,000 BTUs per square foot per year being your standard. How do you communicate that standard to design construction teams?

Travis English: Yeah.

Shanti Pless: Do you put that in design build contracts? And do you make it a performance requirement? And then, do you have incentives if they help you meet it? Or whose requirement is it? Right? You talked about database space commissioning that, I imagine Kaiser went through as kind of the first year of operations learning how to operate it. But how much of that can be put onto a shared risk with your design build teams to help new construction meet those design requirements?

Travis English: Yeah. I think where you're going, just because I'm familiar with your guys' building. And we talked a lot about performance-based contracts, where you have the design engineer have some skin in the game in terms of that first year of operations. But we haven't gone down that road contractually. With our ANE contracts work is that we state the performance targets, so it's like you have to hit 50 EUI. So before we fund your project, you've got to show me an energy model that shows that you're at 50 EUI. And if the energy model has some BS in it, we're going to catch it before you go in construction. But then we don't give the design engineer essentially any skin in the game that first year building it.

Shanti Pless: Or even the controls contractor.

Travis English: No. Yeah. You're right.

Shanti Pless: Cool. Yeah. And then, yeah, so the ASHRAE, the interchange requirements, I think, is beyond my kind of insight in terms of what's evidence-based versus, and what do you suggest in terms of what's needed on a national scale for coming up with evidence-based ventilation? That sounds like a significant industry-wide lift that – is anyone working on that? Is that going to happen at some point?

Travis English: No.

Shanti Pless: Or is that just a wish that you'd like to see in –

Travis English: I try to talk about performance-based ventilation. Because the evidence – think about just the very simple thing. If you go to a hotel in China, then you're going to have a particle counter on your wall that tells you what the particle count is within the room. There's no – internationally, there's no standard for what the safe level of particles in a room is versus the not safe level of particles.

I mean, there's some very obvious, if you're way the hell up here, then that's a problem. But it's very difficult to – nobody actually publishes it. ASHRAE. Nobody publishes a safe level of indoor particles. But just the fact that they're measuring it, I think measurement will come prior to standardization. Right? You start to measure it, you start to look at it, you start to get a feel for where you're actually running, where you're looking in the building, and then start to manage, too, what you're measuring. And then, in time, that will lead to standardization.

If you asked ASHRAE right now: What's the level of particles that's safe in a patient room? Then their heads would just explode. They're 15 years away from being able to nail down that number, right? But we do – I think we can very effectively and very expediently, the cost of those sensors is quite low. And so to run a program where you come into the building twice a year, and measure particle counts, and just compare them to kind of the known data from the last year, or the last building, or what's going on outside, we could start to do that stuff really quickly. Right?

Shanti Pless: You've had some success with displacement ventilation, right? Is that helping it start?

Travis English: Yeah. A little over advertised. We have one. *[Laughs]* We have one building that has some displacement ventilation. Kaiser Permanente participated in a lot of the research that got displacement ventilation in the code. I know some of the people on the call have more experience with actually deploying displacement ventilation in the new designs than we do. We haven't really laid any of our design eggs in that basket, since – we've done more chilled beans in the new design and construction portfolio than displacement.

Shanti Pless: Cool. Those were some of the questions I wanted to jump in there. I haven't seen the list, the greater list. So I imagine – hope I didn't ask some of the questions others were asking.

Allison Kirby: Yeah. Yeah. And actually, I know, Sarah, we have our poll questions. But I think I'd like to jump to our audience questions first, and then maybe we can run through the poll questions. Sorry to jump around on you here. But, I think just starting down the line, first question is for you, Shanti. How are property insurance companies responding to large arrays of batteries for microgrids on hospital sites? Are they considering them fire hazards?

Shanti Pless: Oof. Yeah. Where you put your battery is important. And so we've been putting batteries in buildings for data centers for a long time, for UPSs. And so I think a lot of the UPS data center battery kind of design strategies for fire mitigation is, in fact, those are being considered for microgrids, as well. But there's also opportunities in the microgrids I've seen where these are container-based, and they're outside and not in the building, per se, and they're used as kind of electrical and HVAC and fire protection costs for the building to host the battery in the building.

So, that's how I see. It's been more about fire department approval of where you put these, rather than property insurance companies. I imagine as this becomes more standardized, that will be represented in the risks associated with this when more data comes out on that. I will say in multifamily, at least, I've seen a battery, UPS batteries for apartments, put in the apartment directly because they're small batteries, and not have large arrays of batteries, but lots of small arrays of batteries distributed. So, it's a little bit different approach, but that's a primary reason why they're doing that.

And so it's also because of the metering systems in the same apartment building is by apartment. So you're able to put the battery on the customer side of the meter. It's also driving some of that. So, somewhat of an indirect question. I think it's an emerging industry, for sure. There isn't a lot of microgrids with batteries in hospitals just yet for, yeah, that's out there. So I think that in the projects that are coming online that are providing some model backup power at a large scale are just starting to make it into projects.

Allison Kirby: Great. The next question we have is, Travis, for you, Travis. How did you convince your infectious control team to accept lower air change?

Travis English: Yeah. There's going to be five questions on infection control air. So, but let me tell you this. And I've said this 100 times. I would much rather present to an audience of infection control professionals than an audience of HVAC engineers. I can – we had this presentation where we talk about catheter infections, right, one of the biggest types of infections in hospitals – catheter infections. Or blood stream infections from the needle.

I'll stand up in front of an audience of infection control practitioners any day of the week and say, "Hey, listen. The room air change rate has absolutely nothing to do with catheter infection rates or with blood stream infection rates." And they'll all nod their heads. You won't get a single objection. If you say that in a room of HVAC engineers, carry a shield, prepare to be shot, know where the exits are from the building. Because you will be run out of the building.

So, I haven't had really an issue with infection control. For the medical office buildings, it was quite simply that we have a 30-year history of building buildings. And most of the buildings that we've built over the last 30 years never followed any air change rates. We built commercial buildings, right? We're leasing them from landlords. And so we've got return plenums, and VAB systems all over the place.

And there's no difference in the quality. *[Laughs]* You ask a doctor or a patient or an infection control specialist, you know, "Which ones of your buildings have six air changes, and which ones are sitting at 0.15 CFM a foot minimum?" There's no difference, right? And so on the medical office building side, we made that a national standard about – I think it was like 2011, 2012. And never got a minute of resistance on that.

Allison Kirby: Okay. Thank you for that. Moving down the line. Can you expand upon the plug load myth you talked about?

Travis English: Yeah. And I think Shanti has been involved in some of this work. And I know some of the consultants on the phone have been involved in some of this work. When I started here, we had a lot of design engineers in both the clinic buildings and the hospital that would lay in design assumptions around two watts a square foot, or three watts a square foot. We'd see numbers like that. In a patient room, they'd say two watts a square foot.

So at this point, we published some papers about actual measured loads in surgery centers, and throughout the medical office building. And I know we worked with Shanti's group to publish some stuff in hospitals. Heather Burpee and the group in Washington have also published some good studies. So that's what we tell design engineers now. Do not look at the list of equipment and add up all the name plates and take a diversity factor that you made. Go look at the published studies, and make sure that your models match those published studies.

But to get straight to the bottom line, in medical office buildings, we don't see plug loads. The average winds up at about a half a watt per square foot. And then in the surgery centers, you will get up to a watt per square foot. But then, over the course of the day, you'll go down below that. Plug loads in patient rooms are ridiculously low. It's basically a TV in the room, and then kind of you might have some equipment running at the headboard in there. But the plug load in the patient room is less than the plug load in my living room on a square foot basis. Yeah.

Allison Kirby: All right. Thank you. And then the next question, again, Travis, level of what size particles?

Travis English: So, any measurement beats no measurement. The United States is actually pretty far behind the rest of the developed world. To start off here, we don't have a particle standard for operating rooms. Let me repeat that. The area where we perform surgery on human beings, we do not have a particle measurement base standard. *[laughs]* Germany does. The UK does. Italy does. France does. And everybody else does. The United States doesn't have one.

And so you would think that at least in an operating room, you'd be measuring particles and most of the international – they either measure the half micron particles, or they go against NISA standard, or something like that. In a common spaces in a building, you want some general particle measurement, really just to confirm that your filter systems are working.

The experiment that we did in patient rooms, we used PM1+ sensors, which were cheap and we could deploy 70 of them throughout the building. And then you compare it to the outside air. And what we found was that even at one and a half air changes, or one air changes, your indoor particle counts are ten percent of your outdoor particle counts, or less. It's very, very clean inside the hospital building when you're downstream of those filters.

Allison Kirby: All right. Next question. What kind of an energy efficiency approach in health care designs responding to the future airborne disease, such as COVID-19?

Travis English: Well, I was hoping you wouldn't say COVID-19. *[Laughs]*

Allison Kirby: *[Laughs]*

Travis English: COVID-19 is not an airborne disease. So let's be very clear here that COVID-19 is primarily droplet-based precautions. So if you and I are in the same room and we're sharing air, then the air in that room is contaminated. You should consider it dangerous and wear your mask, et cetera. COVID-19 does not move from one room out into the hallway and then infect people in the next room via the air.

There are diseases that do that. Tuberculosis does that. The measles does that. Those are significantly more dangerous *[laughs]* than COVID-19. COVID-19 is, I think, the base of the logarithm number, RNOT is like a 1.5 or a 2.0 – a bona fide airborne disease has an RNOT of 10 or 15, right? Radically more infectious. Measles is radically more infectious than COVID-19. And airborne diseases are legitimately frightening.

So that being said, if you actually want to use HVAC in some way to look at COVID-19, focus on the room and the room only. Right? Like what are you going to do within this room? Can you put HEPA filters within this room? Great. That will clean the air. Can you put UV somewhere in this room? Great. That will disinfect the air.

But anything that you're reading about going back to the system and putting filters at the system, COVID-19 can't move 50 feet down a duct and get to the air handling unit. Or at least there's absolutely no evidence that it ever has, right? 100 percent outside air, those sorts of things have – they're not really even rational. So, let alone evidence-based. And so we're not taking a bunch of precautions like that. We're not rethinking the design of our hospitals to start implementing precautions like that. We're not doing that.

If a measles 2.0 actually hit, by the way, just to clue you in on some emergency management plans – if a measles 2.0 hit, and we actually had a bona fide airborne new disease that hit our population, stay out of all buildings. Put those people in tents, and ventilate the tents with once-through air. Do not let them enter buildings. Because once they're in the buildings, you infect the whole damn building. So it's a very different emergency management problem.

Allison Kirby: All right. Let's do one more question, and then I want to jump back into Slido for one of our last polls. And so this next question, again, Travis. Someone mentioned strategic energy management as an upcoming project. How does Kaiser evaluate SEM for existing properties facilities?

Travis English: We actually have our national energy manager on the call here. Our energy management program is probably less sophisticated than you would think. *[laughs]* But it's sophisticated enough. We do track the energy bills for every building in the system. I think we have 2,000 buildings in the system. And so we have EUI numbers. We use EUI for that.

And then in terms of our strategic energy management, there's kind of two aspects to that. One is that we are deploying a continuous commissioning solution to try to help us identify measures as we go in those individual buildings. And then the other part if the capital plan, which is where I get involved. Anytime you're spending more than a certain amount of money, then you gotta go through our standards in order to get approval.

And so we look at those energy measures. If you're going to change out an air handler project, then no, you're not allowed to put it in a replacing kind constant volume system with terminal reheat. Nope. Sorry. Can't do that. IF you're going to spend the money, then you're going to spend the money on energy smart solutions that you've got. But those are really the components, basic blocking and tackling, I would say.

Allison Kirby: All right. Well, thank you, both. That concludes our open Q and A section. We're going to jump to Slido again, and launch one last poll, which we think is pretty important. I don't know if those of you who were on the opening plenary, we really like to use our meet-ups to get some valuable input from you all while we have a really collective diverse group of folks from the health care sector, and probably some other sectors on the phone. So this question we're really hoping to gather input from is how is your organization shifting priorities after COVID-19? So I'll give you some time to enter in your answers here.

Going back to our steering committee and what the Better Buildings initiative does related to just health care sector, what we do each year is try to identify their top priorities that are impacting the industry, and understand whether we need to develop some solutions, case studies, some peer exchange opportunities, presentations, and so forth. And trying to figure out how we could best facilitate those conversations to help you all understand what strategies and solutions exist out there to help you overcome some of these barriers to energy efficiency and sustainability.

Looks like we got a number of responses coming in here. We have remote monitoring, telehealth is becoming a huge shift. Resilience. Yeah. Virtual visits is big. Flexibility. And cost savings. Data analytics, research. Great. We're going to keep this open until the end of our session. So feel free to keep typing away and entering in your answers here. Again, we find this information really valuable.

But, as you do that, I'm going to jump into the last couple slides here. So, we have created this health care resources page that is a page that highlights our solutions and resources for the health care organizations related to our health care sector priorities that we set for the year. So this is related to our top-three priorities that we addressed in the beginning of the presentation.

And this includes, like you'll see we have a Kaiser Permanente's California First Medical Center microgrid implementation model. We have a number of solutions at a glance, different types of case studies that are from our Better Buildings partners, and then also some of our affiliate resources that we've linked to. So this is a great resource you call can check out, and we encourage you to do so. Next slide, please.

And then we have some other resources. We have our Healthcare Sector Page, which is on the Better Buildings Solution Center. This is the link to all of our Better Buildings partner solutions different resources outside of the health care sector. We have links to webinars, and so forth. It's a great hub for everything that is high care related.

And then, like I said, we have some case studies from our Better Buildings partners, which you'll see a number of different types of case studies that we've recently published in the past year. And this presentation we will be sharing with you all. It will be made available so you'll have direct access to these links. Otherwise, you can find everything on the Better Buildings Solution Center. Next slide, please.

So these are some of our webinar sessions throughout the summit that you can check out that feature some of our health care partners. Stump the Chumps: How to Optimize Critical Facilities. We have one of our Better Buildings challenge partners, Daniel Mastin with New York-Presbyterian Health. And then on Thursday, The Path Forward: Perspective on Prioritizing Energy

Efficiency; which is our closing plenary. We have Jon Utech with Cleveland Clinic. Next slide.

So this is our Better Buildings webinar series. We'd like to invite you to attend a real diverse array of our webinar sessions. Partners will discuss some of the most pressing topics you're facing and sharing best practices and innovative new ways to approach the sustainability and energy performance. To register, you can go to the Better Buildings Solution Center and click on 2019-2020 Webinar Series. And with that, we'll jump to the last slide, final slide here.

I'd like to thank our panelists very much for taking the time to be with us today. If you'd like to learn more about the resources discussed, please check out the Better Buildings Solution Center, again, and feel free to contact me at my e-mail shown. We also have our panelists' e-mails here. And again, thank you all for being a part of the Better Buildings Summit, and we hope you enjoy the rest of the week.

[End of Audio]