Rachel Shepherd: Well hello and welcome everyone to the 2020-2021 Better Buildings Webinar Series. You are in the right place if you're interested in hearing about a series of best practices on Better Buildings Challenge and Alliance partners and other organizations working to improve energy efficiency in buildings. Next slide please. So today we'll be talking about Smart Tools for Smart Labs, sorry I missed that part before, but my name is Rachel Shepherd and I'll be the moderator today. I led the Better Buildings Smart Lab Accelerator from 2017 to 2020 and will be sharing a lot of information that came out of that accelerator. Next slide please.

So we have a great lineup of speakers today. After some introductions and a few polls you'll be receiving a live demo of the Smart Labs Toolkit, which was an outcome of the Better Buildings Smart Lab Accelerator, and then we'll be hearing from the University of Colorado Boulder, which is a Better Buildings Challenge and Smart Lab partner and we'll hear about their innovative ways about how they've improved their lab's program as well as their buildings. And then lastly we'll wrap it up with a few questions and some closing remarks. Next slide please.

So we're excited today to announce that we'll be using an interactive platform called Slido for Q&A. If you've attended our webinars in the past you should be familiar with this platform but if you're not it's pretty easy. So I ask you right now if you could please go to www.slido.com you can either use your mobile device or you can open up a new window, a new internet browser window on your computer, and then you're going to type in the event code #DOE. So if you have – if you would like to ask a question to the panelists please submit your questions throughout this presentation in the Slido format and then we'll be answering the questions at the end of the session. You will be able to like or promote questions in Slido so we encourage you to do that too if somebody else asks a question that you're interested in.

So I'm going to give 1 more moment now for everybody to go to Slido, www.slido.com with the #DOE because we're going to have a poll question coming up in our next slide. So 1 more moment I'll wait and then we'll go to the poll question. All right, let's go to the next slide. So we're going to kick things – we're going to start things off with a few poll questions so we can learn more about you, our audience. So again please join us and we're going to respond to the poll, which is where are you calling in from? So please enter in there where you're calling in from, what state or city. Great, we see a lot of Colorado, that's awesome because we've got a lot of Colorado representation on this call here as well as

North Carolina and Chicago; that's great. Atlanta is holding us down here, awesome, New Mexico, Maryland, New Jersey, we're all over the place. Is there some west coast representation? Toronto, that's awesome, awesome. North Carolina again, Boston, that's great. All right, I see Oregon out there, awesome.

All right, well make sure to please keep Slido up either on your phone or computer because we'll be asking more questions in a moment. So let's go to the next slide and we'll talk about kind of the framework here – oh, sorry. So the next question is what is your position within your institution? What is the position here that brought you to learning about Smart Labs? We've got industrial hygienist and EH&S staff, other, which is currently the top one, energy auditing professional, executive leader, industrial hygienist, lab or facilities manager, researcher, architect and engineer. All right, we've got other as the highest one so that means that we need to work on our categories a little bit, but the second one is energy auditing professional, which will be great for this discussion as well as architect and engineer and executive leader.

All right, well thank you guys for submitting that and let's move onto the next one. Okay, so we'd love to hear from you why are you interested in this webinar today? Why have you joined it? Is it to learn more about safety and indoor environmental health, is it for energy and cost savings, resilience strategies? I know a lot of our critical loads in our campuses are related to laboratory and laboratory emissions, institution-wide sustainability goals, tools that will help with laboratories. It looks like energy and cost savings is way high up there, which is great because we'll be talking about that today; that's our main mission here, but also sustainability and institution-wide sustainability programs. I think laboratories play a key role in that so that's great that that's another goal kind of coming in second here as well as some of the tools that could help you with your sustainability programs, which energy and cost savings could help with. All right, well thanks again for participating in the poll and please make sure that you keep Slido up for polls that we have later in the webinar.

All right, so I'm going give some context for the webinar today that will help you understand kind of particularly the Smart Labs Toolkit as well as CU Boulder and a lot of the success and progress that they are making towards – with their lab program and buildings I'm excited to announce the results of the Better Buildings Smart Lab Accelerator. For 3 years now 17 lab partners across 9 million square feet of lab buildings have worked to develop standardized approaches for overcoming barriers in energy

efficiencies in labs. I think when we first embarked on this journey to do a deep dive into labs we knew there was a lot of opportunity but we didn't really know what to expect coming out of this and so we were pleasantly surprised with all the results and the progress that our partners have made as well as the Smart Toolkit that came out of it.

So partners saved about 103 billion BTUs altogether and realized an average portfolio improvement of 11 percent. The Accelerator's goal was to kick off or accelerate partners' progress towards a 20 percent reduction over 10 years and partners are currently on track to surpass that goal, which is really exciting. And so I think the million dollar question out here is how did they do it? How did they get all the energy savings and improvements? And the answer is that there's a lot of different ways that they did it, there's no silver bullet, but the Smart Labs Toolkit is kind of a hub of information that was developed by experts, industry leaders such as University of California Irvine, and our partners to help other organizations and stakeholders work together to improve their laboratories. Next slide please.

So we have a great list of speakers today. I will introduce them when they come up but we have 2 staff members from the National Renewable Energy Labs, Rachel Romero and Amanda Kirkeby so they'll be speaking first and then we'll hear from University of Colorado Boulder from Shannon Horn and Kathy Ramirez-Aguilar. Next slide please.

All right, so I think we have another poll coming so if you could please go to www.slido.com if you haven't already and do #DOE and we'll pull up our next poll. So the question is what types of tools would you find helpful in implementing a Smart Labs program? And I know we haven't introduced what a Smart Labs program is for those who may not be familiar with it but it's definitely improving the efficiency and safety in your lab so what are some tools that will help you with the efficiency and safety in your labs? So I see the highest one right now is guides on outlining best practices and that certainly – we have some of that and would love to build on that more with input from all of you out there working on laboratories. Worksheets and calculators to guide facility assessments, that's coming in second and that would be I can imagine very helpful, especially for energy auditors and other folks looking for opportunities in labs to improve safety or to improve energy efficiency and maintain our improved safety. I see partner case studies, about 50 percent of folks that makes a lot of sense to, as well as training and videos. So I'll give 1 more moment

for everyone to put in their input if they haven't already done so but this is really helpful for us in determining what's next for us to work on that will be helpful for you all. All right, we can go to the next slide.

All right, so it's my pleasure to introduce our 2 speakers today. Our first speaker will be Rachel Romero. She is an Energy Engineer and Project Leader at the National Renewable Energy Laboratories in the Integrated Application Center. Rachel helps lead the Smart Labs program in DOE, helps lab owners and operators plan and cost effectively achieve safe and efficient and sustainable laboratories. Rachel has a Master's in Building Science from the University of Colorado Boulder and then we'll also be hearing from Amanda Kirkeby, who's an Energy Engineer in the Integrated Application Center. She supports the development of resources for high performance laboratories and other building systems-related initiatives across labs. She also supports the Department of Energy's Solar Decathlon Design Challenge. So I welcome you Rachel and Amanda and take it away.

Rachel Romero: Thanks Rachel, glad to be here. So Amanda and I will be sharing the Smart Labs Toolkit with you today. So we're going to talk a little bit about why Smart Labs first and then talk about the process for Smart Labs and then Amanda is going to give you some information about the tools available. It was great to see that poll and hear what tools you're interested in because we do have a lot of those and we hope to continue putting together helpful resources for you. All right, with that we'll go to the next slide and we'll talk about why Smart Labs.

So Smart Labs are really looking at energy efficiency and safety in laboratories and so a lot of you were interested in energy and cost savings. There's definitely a huge piece of that when you're looking at Smart Labs. Also you know sustainability is a part of this so you were looking at the programs that are a part of this. We've also got resilience and managing change in labs. Labs are constantly changing their programming and the chemicals and the components that are in laboratories. We'll be hearing about that from our partners at CU today. So can all of this be achieved at once? You know a lot of people say that energy efficiency and safety are kind of at odds with each other, but you can manage all of this and try to fit them together. Even though it's challenging it can be done so we're going to talk a little about some tools and resources on the next slide.

So a Smart Labs program really enables world class science

through safe and efficient high-performance labs so we're looking at the design and the operation of them. So that is completed through dynamic ventilation, so really understanding the needs of the space and then fitting the ventilation to those needs, engaging researchers, which you'll hear a bit about today as well, and how to bring the scientists into the discussion. Stakeholder involvement is really important as well and then continuing to maintain and operate the lab space. Through all of this we talked about how safety can be optimized, you can reduce costs, and you can really maintain high-performance labs. So in the next slide we're going to go through the Smart Labs process.

This has been put together through a lot of partners and work together, but the process, you'll start with plans and putting together a team, looking at what your facilities need, and really understanding where you want to take the laboratory facilities. From there we'll follow the gray path to assess. This is where you really dive deep into how the buildings are functioning and how – where can you make improvements, how can you make improvements, what's happening in the building, what are your plug loads, what are the ventilation loads, and that's where you assess your facilities. From there we move into optimize, so really making changes whether they be small or up to full renovations or retrofits to improve and optimize your facilities and how they're functioning. And from there we move up the gray path to manage and that's where you maintain operations and then when change comes around you understand what the changes are and if you need to you go back to assess, which is why we have this circular part of this process. From there we've created the Smart Labs Toolkit and the link is below at smartlabs.i2sl.org and on the next slide we'll tell you a little bit about what is in the Toolkit.

In the Toolkit you will find step-by-step guidance to work through this process, so the plan, assess, optimize, manage process. You'll find tools and Amanda is going to demo a couple of those here shortly, tools to help calculate, Word documents to help write up your plan, templates as well as training videos to help explain Smart Labs to others, whether that be staff, researchers, management, videos across the board covering all the components of Smart Labs. There's additional resources that we link to that are outside the site but are valuable and then we also have partner case studies. There's about 15 partner case studies of partners that have actually implemented Smart Labs and been successful in a portion of that. And so all of that is altogether on the Smart Labs Toolkit. So on the next slide we will take you over to the Smart Labs Toolkit for a live demo with Amanda.

Amanda Kirkeby: Great, thanks Rachel, great introduction to the Smart Labs process and now how to actually achieve those cost savings and energy savings and what the Smart Labs Toolkit holds for resources. So when you first go to the Smart Labs Toolkit site you'll first see this navigation bar on the left-hand side here that goes through an introduction in Smart Labs as well as the 4-phase process that Rachel was describing earlier. We also include a page that is dedicated to new construction and how to incorporate Smart Labs principles into new construction projects at your institution. We also include a working with scientists page including training and our partners at CU Boulder are going to describe a little more of what is on that page later on in this webinar, and then we include a link to the resources and contributors and all the links and attachments that are included throughout so you can find them all in 1 place as well. Also on this front landing page you'll notice this 3D model of a laboratory and we include components that are key to a Smart Lab so including your standard operating procedures or your variable air volume exhaust flow and you can click through and roll around and explore different components of what is included in a Smart Lab.

We'll take a look at the first phase of the Smart Labs process. So each of the pages throughout the Smart Labs Toolkit includes guidance and walks the organization through, walks you through what steps are a good process for achieving Smart Labs at your institution. So when you first come to each of these pages there's links to the steps that are the main components of each of the phases so for plan it would be building a team, developing your plan, and then at the end of each is a deliverable, which we include templates, so for a plan it would be developing the Smart Labs Roadmap and this outlines what your organization is going to do, your prioritized buildings, your timeline, and outlines the goals of your projects along the way so you can keep track of progress and keep things moving in the right direction.

With that we'll go to the next page at the bottom. It leads you right into the next phase of the Smart Labs process, which would be assess, and on this page it really is the heart of the Toolkit. We include a lot of tools throughout here, which I'll dive into the main tool, which is the Lab Ventilation Risk Assessment Tool. Ventilation really drives energy use and cost in laboratories and so really emphasizing how to get ventilation to where it needs to be to provide the right airflow at the right time in the right place at your labs to not only achieve safety and provide a safe working environment for your researchers but also reduce cost savings by

only supplying the air you need based on occupancy and demand base control.

So with that I'll look at the section on performing the Laboratory Ventilation Risk Assessment and this process is an in-depth assessment, you really dive into the ventilation systems of your first building that you prioritized in that planning phase with your team, and there's 2 main tools here, the Lab Ventilation Risk Assessment User Guide, which guides you through that process, as well as this Risk Assessment Tool, which we'll take a look at and once you go into this tool it may seem a little overwhelming at first but we've provided instructions and in tandem with the User Guide it describes the process in an easy-to-follow way for your facility managers to go through and manage or assess the ventilation risk in each of the labs.

And so what that process looks like is first looking at your exposure control devices so that would be your fume hoods or your biosafety cabinets and what have you and what kinds of chemicals are you using in your labs, what kind of exposures are your researchers potentially having in the course of their research activities, and so there's a few different categories of risk that you can – or characteristics of these hazards that you can assign ratings to. So 1 would be what's the actual chemical itself so say it's water, that's a pretty low risk or low hazard to your research, so that would be a 0 on the scale of 0 to 4, but you get into something like tetroxide or some of the more dangerous chemicals that you really don't want to have any researcher exposed to and that would be a hazard rating of 4.

And so each of these characteristics, we have quantity so how much of that chemical is being used as well as how it's being generated and how much of it is being generated, and all of these characteristics, even down to the housekeeping of the lab, so whether your researchers are maybe using their fume hoods for storage cabinets, which is not an advisable practice and we include guidance and outreach to encourage your researchers to use their fume hoods properly and use safety cabinets and other storage devices, but through all these characteristics you can calculate what the risks of those labs are. So those outline what those characteristics are and how you assign ratings on that 0 to 4 scale.

And then coming to the actual survey part of this risk assessment, so you go in and you survey your lab space and this is on a room-by-room basis and first you enter your survey information here so it's room number, what kind of lab it is, all that sort of information

you can capture here, and then you can also enter your information for your specific exposure control devices so say it's a traditional fume hood or there's other options in here. You have a biosafety cabinet or a snorkel, you can choose those options throughout.

And so you can list all your exposure control devices that are used in your lab when you go through and fill out this information and then over here on the right side you would go through and fill out all this. You would fill out as well what types of hazards that are being used for those specific fume hoods, let's say your fume hood is being used for bio – well usually chemical and then you can go through and enter what type of hazard using these criteria as a guide just to list out. And at the very right part of this, oops, went a little too far there, but we have you can enter ratings based on use criteria or the chemicals and hazards and how they're being generated and all those factors and characteristics of the hazards into these boxes over here and then this automatically generates what your risk score would be for that particular hazard in that particular exposure control device.

Once you have that then you are able to get a list of how many devices you have in the lab as well as what risk is associated with each device and the researchers' activities that might be associated with that and with this risk calculation you combine that with a survey of the lab environment space, so all these it walks you through the steps and kind of describes what each entry looks like as well as what's included in the drop-downs over here. And then once you survey your exposure control devices in the lab we also move to a broader lab environment survey, which is included in this tab. So this kind of takes a broader look at what activities are going on in the lab and you can go through and fill out hazard types as well. This is for the whole lab environment itself and there's similar criteria included in the tab below here that help you fill out this process.

Once you get a calculated score for both your exposure control devices, fume hoods, and all those types of devices as well as the broader lab environment you can use these risk scores, which basically categorize how risky or hazardous the activities that are being performed in that lab are and you can use those to input into our air change rate calculator, which helps you calculate what air change rates you need to provide a safe environment for those specific research activities. So it really provides a systematic process for identifying those rates so that you're not providing more air than you need to and spending more energy and more money to run those ventilation systems at higher interchange rates

than they need to be running.

So through this again the air change rate calculator and all these are linked in the Toolkit in an order that's easy to find, but these you can go in and those risk levels that we just identified through the LVRA or Lab Ventilation Risk Assessment Tool you can enter in here as well as basic category or basic metrics of the lab room such as area, height so you can get a volume, and with those you can enter in some specific information that you should have documented or if you don't have documented it's a useful thing to identify now in this process. You can go through and you enter your supply ventilation, supply information, and then your exhaust information and from those metrics you can calculate what the occupied and unoccupied air change rates should be and all this is described in detail down below through this infographic to how each of these are calculated as well as their sources so you see ASHRAE classification, laboratory ventilation design levels as a large part of that so it's ASHRAE 62.1 and it ends in 39.5, so there's resources which are in there – well some of them and so you'll have to download but those are also linked throughout the Toolkit to help you learn more about why those rates are designated as such. And so with that you now have a strategic way to assign air change rates in your lab and save energy by providing smart ventilation.

The other tool in that assess section that I want to point out is the dilution calculator so this is useful for going into really how the certain chemicals are diluted in the lab space so you can go through and it gives you how it dilutes over time for any number of chemicals. I won't go into too much detail here, just want to point you in that direction. And with that I'll go back to the Toolkit here and go over some of the other tools that are included beyond just the assess page.

There's also – we include – 1 of the things in that poll earlier was focus on resilience as well so we include resources linked here such as the National Renewable Energy Labs Resilience Roadmap as well as the Technical Resilience Navigator and more resources to help you guide your institution in a resilience assessment and make sure you'd doing what you need to be to be prepared for natural disasters and unforeseen events. With that another tool that I want to point you to, which is in the – we'll go back to the main navigation page here – the optimize phase, which is again on our navigation bar on the side here. On the optimize phase you go into different funding opportunities so this outlines a bunch of different resources and tools to help you guys through actually

implementing improvements that came up through that assessment of your laboratory systems. So we have some toolkits and financial navigators linked throughout this section as well. And 1 of the other main resources in this optimize phase is HVAC Resource Map, which is another tool to use in identifying how to make your systems more energy efficient throughout your laboratories and this is an interactive user interface where you can go in and find okay, I want to learn more about variable air volume, how that works, or maybe laboratory ventilation effectiveness and we go through and it provides more resources and in-depth guidance on how to achieve energy efficiency in each of those specific components of your ventilation system.

So there's a lot to cover there. I'll take it back to the main – this is on the resource page so resources before we go to that attachment section. But resources, there's a lot to explore here so I encourage you to go through to fish out again to the contributors for the Toolkit, which are through the Federal Energy Management Programs as well as some of our partners including 3 Flow and My Green Lab. It wouldn't have been possible and also the Smart Labs Accelerator partners that both Rachel's on this webinar have pointed to earlier we include. That was another big resource that seemed popular in that poll earlier so I wanted to point you to there's a list of all the case studies and these are linked throughout the Toolkit in areas that they're applicable to but they're also included in this resources page at the very end so you can learn more about how each of the partners came up with innovative strategies to achieve energy efficiency and safety in their labs so driving energy savings through occupant engagement, a variety of different topics from technical to more user engagement.

And with that there's also all the tools that we went over throughout this Toolkit are linked in this attachments page on the resources at the very end so if you're looking for a tool in particular you can come through and look for so here's the HVAC Resource Map, there's best practices and guides linked throughout as well as research papers, trainings, conferences, and these are all organized by the phases of that Smart Labs process that Rachel described earlier. And with that I'll pass it back to Rachel to wrap things up and that ends the tour of the Toolkit.

Rachel Romero: Great. Thank you Amanda. So that was a very brief tour of the Toolkit. As Amanda showed you there's a lot of content there so I'd encourage you to visit the Toolkit itself. She just did a very high-level of that, which was great, but there is more so check it out at smartlabs.i2sl.org. Take a look at that, feel free to email, there's an

email at the bottom if you have any questions as well as our emails will be linked at the end of this, but use them, let us know if you have questions, and so that was pretty brief but we will pass it over and back to Rachel. Thank you.

Rachel Shepherd: Great. Thank you Rachel and thanks Amanda. That was a great, quick tour. I want to quickly mention that you probably have noted that the link to the Smart Labs Toolkit is not a DOE link but i2sl.org and so I want to give a special shout-out to the International Institute for Sustainable Labs, I2SL, who have partnered with us or partnered with us to produce that toolkit. They are a non-profit organization that works with many different organizations, universities, federal agencies, commercial sectors to improve the sustainability in laboratories and the Smart Labs Toolkit is a great kind of starting point. It's a lot of information but I promise that you'll get something out of it if not a lot out of it if you go through it. So thank you again Rachel and Amanda for walking through it and I encourage everybody to go check out the Toolkit.

So before we go into our CU Boulder presentation and our speakers I wanted to introduce another poll to everyone so please make sure that you're going to www.slido.com #DOE and the question is what types of engagement programs have you implemented within your organization, so that could be things like shared equipment programs, risk management, other, green labs programs, recycling or waste management. I see green labs and recycling and waste management might be at the top there so that's great and that's – that certainly relates to energy efficiency, what we're talking about today. It's a really good pairing or kind of complementary program when you're focusing on recycling and waste management. Awesome, risk management as well, that's a really important program to be focused on, especially with your facilities and energy folks partnering with your EH&S folks; that's great. And I see some folks on there have shared equipment programs so I'm really looking forward to introducing our next speakers at CU Boulder that will talk about a lot of their different programs that they have that they've implemented and the success that they've had.

So thank you for inputting your input into slido.com and we're going to introduce our next speakers. Awesome, so while we pull up their pictures we're going to hear from 2 speakers from CU Boulder today, Shannon Horn, who's a professional engineer and lead AT with a Bachelor's of Science degree from Colorado State University and a Master's in Engineering Management from CU

Boulder. Shannon is the Principle Campus Mechanical Engineer for CU Boulder where she holds a diverse set of responsibilities from being commissioning agent to AHJ to supporting energy conservation projects and initiatives across campus. And then we'll also hear from Kathy Ramirez-Aguilar who has created and managed the CU Green Labs program at the University of Colorado Boulder for more than 10 years. The CU Green Labs program works with advanced sustainability – works to advance sustainability in laboratory research for CU Boulder and the greater – both in the campus and the greater community to maximize positive impact of research investment for people and the planet while minimizing the negative effects resulting from significant resource use and waste generation, which is a great transition from some of our poll results that we just got. So I'm going to turn it over to you all to present on your great CU Boulder program and I encourage everybody to enter in their questions into Slido. Shannon, take it away.

Shannon Horn: Thanks. Thank you Rachel for inviting us. Thanks to Better Buildings as well. I thought we would dive right in and give a little bit of background about the program at CU Boulder. We have approximately 2.7 million square feet of laboratory space in our major lab buildings and this is about 22 percent of our total campus square footage and as we see historically across the country as well it's about 43 percent of the total annual energy consumption of the entire campus.

So all labs were built in different eras with different philosophies of safety design, science, and functionality. So our program actually started off as a lab air change rate program and we identified pretty early on that we could see anywhere from 18 to 40 percent potential energy savings. And while we started out there we quickly realized that there was more opportunity to expand the program and leverage its full potential, which it's exciting to see where it's gone, specifically with the Department of Energy and the toolkit that was created. Next slide.

So I'm going to talk a little bit like I think Rachel and Amanda had just suggested there's no silver bullet, but I'm going to share specifically what's worked for us at CU Boulder. And for us creating a core team of our environmental health and safety, our industrial hygienists, our sustainability and green labs, our operations, and our energy and engineering teams as the primary pillars to the program and then you'll see like a big blue circle around it and that's basically the rest of the campus feeding into these pillars to basically develop the program and move it forward.

Next slide.

So 1 of the reasons that for us why we needed these 4 pillars is because a lot of us have a little bit of overlap, specifically in safety, risk, and culture and you'll see through every single one of these groups and with that we bring a different perspective. So while we can engineer everything from a technical perspective we learned very early that embedding the process into the culture of the university through current workflow management programs was essential. And you'll see on the slide where we would propose and research and study different initiatives, we would validate our assumptions, establish our standards, and then develop baseline programs from these 4 groups. And this was important because if we had additional job responsibilities we could see the programming fizzling away and having a financial interconnectivity with current workflows was important for us at the campus. Next slide.

So I thought what we'd do is touch on some baseline programs. These aren't the only programs we have but they tend to be the core ones that we have. So we have a Chemical Inventory Ventilation Risk Management Assessment pie that feeds also into our Lab Utilization Program, also our Preventative and Deferred Maintenance Program, our Continuous Commissioning Program, and New Construction, Remodels, and Procurement. And we felt it was important to really show how they're all really interconnected and interdependent and thus the other reason to have that team together so that we could continuously improve and kind of release the potential opportunity of the program.

Today we're just going to – we probably could talk about an hour on each 1 of these programs but clearly we don't have that, but I'm going to emphasize a couple of examples of where we've had great success with that and also how to have that conversation within your organization to really maximize the potential. The 2 parts that you can always look up for resources later are the Lab Utilization Program and the New Construction and Remodels in particular regarding procurement. Kathy and I with a couple of others did a whole presentation on that but I'd encourage and would love further collaboration with other institutions if you'd like to get in touch with us. Next slide.

So I thought we'd dive into a little bit of some of the examples from those baseline programs. Here we show service calls and preventative maintenance and the correlation between the 2. While we know of a direct relationship between service calls and energy

and the reason I put specifically service calls on here is because oftentimes it's a hard sell internally in an organization for people to realize the energy savings and oftentimes they're more concerned about what's impacting their daily life. So that's 1 of the reasons I wanted to demonstrate this slide. As you can see the yellow is the preventative maintenance hours and then also the blue and gray lines are specifically the service hours that are in response to that preventative maintenance and as you can see as we decreased preventative maintenance the calls correspondingly went up and as we increased preventative maintenance our calls correspondingly went down and this also has a direct correlation to energy flow. Next slide.

There we go. This one's the Continuous Commissioning Program. I can't speak highly enough about this one. Again we are also correlating this to service hours and which has a direct correlation to energy. As you'll see to the right of the yellow line it indicates the number of service calls when you actually have a really good commissioned building and typically commissioning gets you through the first 5 years when you first commission a building and then the next 5 years you typically need to recommission it. We have a pretty robust program right now as you can see from this graph for the first 10 years and then after that what you're seeing is where we catch up with our financial cashflows. So everything to the left of the yellow line you'll see where the service calls start to go up and increase and correspondingly that's also where we're trying to solicit more financial input at that phase 10 years plus. You'll also start to see also where that gets into the different maintenance items for most institutions and as you can see the service hours stay lower and again we're seeing that direct correlation with energy. Next slide.

And another example we wanted to focus on is a little bit of the air change rate risk assessment and how each team member is contributing to this. We also wanted to demonstrate that this can contribute to a resiliency program. Our Air Change Rate Management Program was really essentially for us during COVID actually. As we know a lot of the aerosol is 1 of the contributing – what they do call them, R0 or the transmission paths of the virus, so for us to be able to report to our upline, our program, it's shown to be more valuable not only in the labs but beyond for resiliency and response. So here we've just given a quick example of how we wanted to explore a potential of 2 air changes per hour for an unoccupied period, time that with a chemical inventory continuous commissioning program, the new technology potentials, safety awareness, sustainability, and energy focus culture and how we

communicate that and how we actually execute it and I think Amanda did a really good job on the toolkit, all the factors specifically going into ventilation that need to be considered. It's important but also that everybody's at the table understanding what goes in there and I think that's the partnership that we keep wanting to emphasize that changes the culture. Next slide.

So tied with that first slide we're on track for a 20 percent energy reduction and energy consumption over the next 10 years, we're about 5 years in, and we don't – we currently are not seeing an impact to us even though we're seeing financial impacts on other fronts with higher education mainly because we have embedded the processes in our workflows so again it's not like an extra activity tagged on top. So if that's 1 message I could get across is trying to embed it in your culture and your workflow processes the further the program can go. Next slide. And this one I'm going to turn over along with the theme of culture to my friend Kathy. No matter how great your technical solutions can be it's always important to have 2 hands clapping and address how the user is actually using the spaces.

K. Ramirez-Aguilar: Yeah, thanks Shannon. Thanks. Yeah, I'm really excited that the Smart Labs Toolkit includes a section on working with scientists, which is the area where my work is focused at the University of Colorado Boulder. Scientists obviously play an important part in the lab sustainability movement through the decisions they're making and the practices that they're choosing and I'm seeing that scientists are increasingly interested in doing their part to reduce the environmental footprint of their research. So in the next slides I have picked out 3 topic areas from this section of the Toolkit to highlight, which are certainly areas of great interest to the CU Green Labs Program that I manage at the University of Colorado Boulder. Next slide.

Yeah, so the first item that I wanted to highlight was the International Laboratory Freezer Challenge and there's a link to the challenge here on the slide, but I was lucky enough many years ago to be working closely with Allen Doyle at the University of California Davis that had this idea of creating a freezer contest. So we created it together and the first version of the freezer challenge was about a decade ago and I'm of course so excited to see that it's still going today. The competition is currently coordinated by My Green Lab and also connected to the International Institute for Sustainable Labs and it's going on right now for 2021 through July for any location worldwide that has labs from universities to federal labs to hospitals to companies and a single lab from a

location can participate or there could be a coordinated effort encouraging many labs at a campus to participate. And so at the University of Colorado Boulder, CU Labs, we'll be coordinating an effort for the laboratories on our campus this year and so we look forward to competing with you if you're going to participate as well.

And so the contest, yeah, it focuses on taking actions for best practices in these categories of good management, preventative maintenance of freezers, inventorying your samples, doing clean-outs of samples that you no longer needs, retirements and upgrades so if you have a unit that is ready to retire why not upgrade it to an energy efficient unit or even better, consolidate with others so you don't have to replace that unit at all, cutting edge practices, could be like barcoding samples to have inventories that are barcoded instead, and then temperature tuning. This is all about temperature choice. What is the temperature that your samples really need and what is the most energy efficient choice. So yeah, so on temperature choice 1 action that is promoted by the contest is considering to raise the temperature of ultra-low temperature freezers from -80-degrees Celsius to -70-degrees Celsius for energy savings and of interest on this top is the requirement that the Pfizer COVID vaccine requires ultra-low temps for long-term storage and according to this document found at the CDC link that I provided down below that storage can be anywhere from -60 to -80-degrees Celsius, which is of course great news for the -70 effort that is a part of the freezer challenge. Next slide.

Yeah, I absolutely love that the Toolkit includes the topic of shared equipment; I'm glad it was mentioned earlier in the poll. I mean in my opinion this is where a significant cultural shift by scientists toward shared equipment can have huge impacts for sustainability, especially for that mid to lower cost category of equipment. Researchers automatically think about sharing very expensive equipment because it's too cost prohibitive not to but there is so much untapped potential in this lower to mid-range category on campuses across the nation such as the equipment in these case studies that I'm showing here and there's so many benefits to equipment sharing, which are discussed at this link that I've provided at the bottom there to a page on our Green Labs website where you can find links to these case studies and the 16 reasons for enhancing equipment sharing. But importantly equipment sharing really needs a manager to make really sure sharing goes smoothly so I always promote a manager with this.

But we do have 2 case studies here from CU Boulder. For

example, this infographic for a case study where we wrote on the CU Boulder Biochemistry Shared Cell Culture Facility it's showing how much less equipment is needed to serve about 70 users using this facility because they're sharing compared to what would be needed if they were not sharing so you can see that little picture that has the shared and not shared section. There's so much more equipment. If these scientists were not sharing in this facility they would require so much more equipment and that requires so much more space. So this means – equipment sharing means lab space efficiency since there's less equipment to house, which of course is important considering how energy intensive lab space is and how expensive lab space is to build. And this case study goes into details of how sharing also avoids cost for both the scientists and the university, which is all documented in the study.

The BioCore is another effort that CU Green Labs started with a handful of engaged faculty members to migrate equipment from individual labs to become shared resources and this started just a few years ago and as you can see it's already having great impact by avoiding $900,000 in equipment purchases so far and we estimate that if this was expanded campus-wide there's people that have looked at this on our campus and it is believed that it would result in millions of dollars in avoided equipment purchases each year at CU Boulder so we are really hoping that we can get there. Next slide.

So lastly I wanted to share this website link to the Bringing Efficiency to Research Grants or Better Grants effort. This is an effort that I lead through the International Institute for Sustainable Labs and the goal of this effort is to connect efficiency and sustainability to the funding of science. In my opinion this is 1 of the most important changes that can be made to have progress on sustainability in labs. I mean if we're truly going to have widespread action for efficiency and sustainability by scientists and labs it needs to be connected with the funding of research in the first place. Actions such as encouraging equipment sharing, efficient space utilization, energy and water efficient equipment and practices and so forth, you know research universities could be making the connections, especially for shared equipment to start up packages offered to new faculty and there's great opportunity for research sponsors such as federal granting agencies to be making these connections to grants that fund scientific research of all kinds out there. You know 1 action that I believe would have real impact to get us there would be for offices and granting agencies responsible for policy and administration to have a person in that office whose role is to be working on sustainability related to

extramural grants and those responsible for even overhead, the overhead rate calculation, could also be thinking about efficiency connections and sustainability.

And I'm excited to see that the United Kingdom research funding is heading in this direction through their UKRI Environmental Sustainability Strategy, where they are committed to embedding environmental sustainability across all their investments by 2025. So regardless of when we get to the point of connecting efficiency and sustainability to research grant funding, scientists and institutions can start now to voluntarily include their actions in their proposals and show sponsors that they will maximize the impact of sponsor dollars. And this website link gives ideas for voluntarily including actions for efficiencies and proposals now and I hope you'll check it out. You know we also are working on an updated version, which will be released soon. Next slide.

Rachel Shepherd: Thank you Kathy and Shannon for presented on CU Boulder's progress and success and how you guys are working towards your goals. Unfortunately I think we only have time for maybe 1 question and that question is for you Kathy. What is your process to engage with scientists? Do you work with the PI or do you engage with other staff and students?

K. Ramirez-Aguilar: We work with all actually but I will say that our method for doing this has been to get an eco leader for every single lab to be our point of contact within that lab, a volunteer that's interested in doing that. We also hire team leads now, our program. As our program grew we added on team leads that could lead in their laboratory building on collective action that the scientist could be taking. One example was an autoclave project that happened in our biotechnology building so it was a great example of collaboration among scientists from many groups working together on that but we do that through our Eco Leader program. I will say that our recycling programs that we offer I think do open the door to a lot of engagement also because scientists are really engaged on wanting to recycle material and it opens the door for more conversation on things like energy efficiency and water efficiency.

Rachel Shepherd: That's awesome. I think we tried to answer other folks' questions just on the Slido itself as a response so if you entered in a question we tried to get to your question just in written form or if you want to see our responses to questions in written form please be looking at the Q&A section of the Slido. I think that's all we have time for so I just have a few announcements to make before we let you all go. Here are a lot of the resources that we talked about today that

you can click on in the Smart Labs Toolkit, programs and information that CU Boulder has provided, so please check out the additional resources here. Next slide.

I don't think we'll have time for poll questions so I think we're going to skip that but I encourage you to take the moment that we're supposed to have the poll question and check out the questions and responses in Slido in the Q&A box. So if you can go to the next slide, we're excited to announce registration for the 2021 Better Buildings Summit, Better Buildings Better Plants Summit, which is now open. The Summit is taking place May 17th-20th and will feature engaging and interactive sessions along with opportunities for attendees to network with their fellow industry peers and experts. To learn more and register for this virtual, no-cost event go to betterbuildings.com and it will be in the Better Buildings Solutions Center. Next slide.

Maybe that's the last slide. The next webinar will – there we go – we hope you join us for the next webinar, which is on March 16th and it's entitled Leveling the Slope: Helping State and Local Governments Reach Their Energy Goals. This webinar will demonstrate the Slope platform functionality as a tool and provide examples of the application assisting state and local energy planning. Next slide please.

We also encourage you to visit the new Workforce Development portal and take the next step towards a career in energy efficiency and get resources, information, training, education, and job opportunities. And then lastly to watch recordings of the Better Buildings Virtual Summit, the 2020 Summer Webinar Series, and technical presentations from our national labs we encourage you to visit the OnDemand Webinars Library where all previously recorded presentations are archived including this one.

And then I think this is now the last slide, which is that I want to thank our panelists today very much for taking the time to speak with us. Feel free to contact any of us if you have any additional questions, especially if we didn't get to it in the Q&A. I want to thank you all for joining this Smart Labs webinar today and I also encourage you to follow us on Better Buildings Initiative on Twitter for the latest news. You'll receive an email notice when this session is available on the Better Buildings Solutions Center where you could watch it or send it to other people to watch this webinar. So again thank you for joining and we look forward to seeing you on our next webinar. Have a great day.

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