Bri Colon: Welcome, folks. We'll just let others trickle in here in the next few minutes and we'll go ahead and get started. A few seconds, I should say. All right. Well, I think we can go ahead and get started, if we wanna go to the next slide. Welcome, everybody to the 2022 Better Buildings Summer Webinar series. We're dedicated to bringing you the latest actionable insight from leading industry experts. This annual series is a chance to explore topics, trends, and technologies that effect your organization as well as effort to accelerate energy efficiency adoption.

Before we get started, a few housekeeping note. Today's webinar will be recorded and archived on the Better Buildings Solution Center. We'll follow-up when that recording and the slides are made available. Next, attendees are in listen only mode, which means that microphones have been muted. But if you do experience any audio or visual issues throughout the webinar, please go ahead and send a message in the Q and A box located at the bottom of your Zoom panel.

Next slide. My name is Bri Colon and I serve as a fellow in the building technologies office. Within Better Buildings I support as the sector lead for higher education as well as retail food service and grocery. Next slide. Now I'd like to start off here today by setting the scene and introducing first off the institution that our speakers are coming here from and share some high level sustainability accolades comes from UC Irvine. So UC Irvine has been doing deep energy efficiency starting since the early '90s and they've really built on this expertise and experimentation over the years.

Attitude has played a significant role in their work and has demonstrated in their willingness to set bold goals and rise to the occasion to meet them. To do this work they have alter priorities when spending their budget often without experiencing budget increases. They are one of the leading global institutions in their delivery of lead platinum buildings and as costs of offsets and RECs increase in the market. Their model is fundamental to learn from to implement deep energy efficiency measures and reduce overall emission. So organizations across sectors can really learn from these best practices and take them back to their organizations in their unique context to implement.

Finally, UC Irvine is a Better Buildings challenge goal achiever. They achieved this back in 2014, which was seven years ahead of time from their projected goal year date. So overachievers and they're walking the walk in their work. They were recognized at that time by President Obama and we are excited to share with them in that experience. Next slide. Next up we can transition to our interactive platform that we'll be utilizing for Q and A, polling, and feedback. So if folks could go to slido.com on their mobile devices or by opening a new window in their Internet browser. Today's event code is hashtag or pound DOE.

If you'd like to ask panelists questions throughout the webinar you could submit them there and we'll look towards those questions and answer them at the end of this session. You're able to select the thumbs up icon for questions that you'd like to upvote them and that will rise to the top for those most popular questions to be addressed by speakers. Next slide. So to start off we would love to introduce our first poll here. So if folks could join us over at slido.com and respond to our initial question. If you do have any issues, again, please measure our text support team in the Zoom Q and A function.

We wanna know first just where others are coming from in our virtual audience. It's helpful for us to get a lay of the land as well as for our speakers to understand in advance of their presentation. So I'm seeing a good representation from consultants, higher education, not surprised. See that great representation there, local government, industrial, nonprofit, all of the bars are moving. This is so exciting and we're thrilled to have you all with us here today. We'll let those numbers level out here in the next couple seconds or so. Thank you for engaging again in this poll. This is really great and rich information.

All right. We're off to the races. It looks like they're leveling off here. Perfect. Great. Thank you. I think we can go to the next slide and feel free to keep inputting that information in that poll and that's been a great intro to our platform that we'll utilize. Next up I'm happy to introduce our presenters today and turn it over to them to talk more about how they've implemented energy efficiency at UC Irvine. So first off we have Wendell Brase. Wendell is the University of California Irvine's associate chancellor for sustainability. In this role he leads efforts by UC Irvine and assists other campuses throughout the UC system to implement UC's carbon neutrality initiative.

Brase is the chair of the energy services pillar for the University of California's global climate leadership counsel. For 25 years he provided leadership for an award-winning sustainability program in his role as vice-chancellor for administrative and business services. Next we're joined by Brian Pratt. Brian is the campus architect and associate vice-chancellor for design and construction services at the University of California Irvine. Currently he oversees all major academic building projects and leads the design and construction efforts for the campus delivering highly complex projects via design build. In his more than eight year tenure at UC Irvine he's overseen several project types including research facilities, laboratories, active learning classrooms, dormitories, and highly technical projects. Thank you so much for being here with us today, Wendell and Brian. I will turn it over to you all and we can go to the next slide.

Wendell Brase: Thank you, Bri. The first thing I wanna say is why we're doing this. UC Irvine's mission is to develop and to share climate solutions that can extend well beyond the campus and beyond California as well. I might just correct one little detail that you mentioned, Bri, which is I think you said we seldom had to seek budget augmentations or extra support, financial support, for this program. That wasn't quite right. We never have gotten one extra dollar in any budget in order to support the entire program that Brian and I are gonna talk about today. It was entirely self-funded by changing priorities and by having extremely good financial returns. So I wanna make that clear because that is a key pillar of this program.

Now sometimes when I present, what has worked for UC Irvine, skeptics – this is a reasonable skepticism to have – they assume, "Well, maybe it's easier in California." We have a mild climate. We have relatively higher energy costs. Maybe that's why we can make deep energy efficiency pay for itself. Now I'm not gonna answer this question right now, but I promise to circle back on this point in my closing remarks. First of all, let me say now is when deep energy efficiency is suddenly more important than ever.

Next slide, please. The first problem that concerns us is the risk of thermal overshoot. I know many climate scientists who are fearful that just with the greenhouse gases already in the atmosphere, we may be on a path on this planet to blow right past 1.5 degrees centigrade. There's also a lot of concern about whether the massive number of commitments made in COP 26 are following it will be met. Next slide, please. Finally, there is uncertainty about whether global cooperation will be undermined by international conflicts.

Next slide. This is one of the many headlines you may have seen. The optimistic view is well, Europe looks like it's on a path to decarbonize energy systems because of energy independent being an important priority. So that may happen. On the other hand, there is many pessimistic forecast about the impact of the war on global climate emissions.

Next slide, please. Now why are universities and institutions turning away from procurement of emissions attributes meaning RECs or offsets? Now when you look at the massive increase in net zero goals and commitments post COP 26 and a few of them before COP 26. The word net usually means outsourcing the problem. It means procuring RECs and offsets in a global market. This massive increase means that every offset and rec in the global market will be sold at a market clearing price. That's just economics 101. We can see from the way prices are going the demand is there. It's coming from lots of corporations who have the money and the commitment to spend it on offsets or RECs.

Now this is not a theory. Offset prices have quadrupled in the last year. Here's a troubling point that is starting to concern a lot of people. Entering a market, which is demand saturated, yields no additionality. That's the cardinal principle of offset advocacy and it's really undermined by the fact that a quadrupling of prices means every offset is gonna be sold. There's no additionality in entering a market like that. By contrast, deep energy efficiency has massive advantages and we're gonna talk about those.

Next slide, please. So this slide is about owning the problem instead of outsourcing it. The solution here is essentially permanent. It cost far less. In fact, it pays for itself. It's directly measurable, directly. It's what we learned in elementary school and it's what we learned from our mothers. Use less. That's the first principle. The problem of accounting is that a lot of what's called carbon accounting is really kilowatt hour accounting, which is conveniently overlooking what the carbon content was of every kilowatt hour at the point of production. So there's some problems that are overcome by deep energy efficiency.

Next slide, please. We'll get down to basics here in a minute. Hang on a second. Now let's focus on what used to be a scary question. How do we pay for deep energy efficiency? This photograph is an aerial of the academic core of the UC Irvine campus and there's some good news about deep energy efficiency. Let me just cover it at a high level. First of all deep is deeper than we ever anticipated or hoped for when we started this journey back a couple of decades ago.

Let me explain how we measure performance improvement. For retrofits it's pretty straight forward. We measured before and after energy use. So it's a direct measurement. Now for new construction we have to have a baseline against which to compare. So for new construction outperforming California's title 24, the energy code in California, which is considered one of the toughest energy codes in the United States, the extent to which we outperform title 24 is what we count as savings. Now we will detail a little bit in a few minutes how our deep energy efficiency program pays for itself. As I do that, I want you to keep in mind, this is not about a one-shot project where we got lucky, but rather a 25 year program extending it across the entire UC campus that you see on this slide right here.

Next slide, please. This is, just to use as an example, one of our smaller lecture halls on campus. I wanna talk about why is it technically possible to attain 50 percent energy efficiency improvements in new and retrofitted buildings across an entire campus and that's what we call deep energy efficiency, 50 percent or better improvement. So when you think back about how mechanical systems have been designed in buildings, the last half of the 20th century, for 50 years building mechanical systems employed worst case design assumptions in order to provide a margin of safety for healthful ventilation, for exhaust, for adequate fresh air intake, and for occupant comfort.

Now what do I mean by worst case? This is an example. You see the typical sign in a lecture hall on campus says the maximum occupancy. That's partly there because it's part of the fire marshal's responsibility to post that. It's also a perfect example of something that was used as the design parameter when this lecture hall was designed and built. The typical code requirements, 15 cubic feet of outside air per minute per presumed maximum occupant, presumed maximum occupant. Now that's the key part to this. The same example applies to other large assembly spaces on campuses such as dining halls, food courts, auditorium, indoor athletic facilities, arts teaching studios, offices, all classrooms of all sizes.

So it's always assumed by the design worst case parameter that those are always full, all the time, every seat filled. Well, that's not true at all. You can just think about all those things I just mentioned and they have highly variable rates of occupancy. Now a lab's worst case assumption is a little bit different. Their ventilation and exhaust in laboratories is to remove the hazard – airborne hazards. The worst case assumption in the case of the lab is that there's presence of airborne hazards at all times.

So before censors and smart informatics enabled precision control and real time sensing and the assurance of system performance, over design of HVAC actually did make sense. No longer however, precision control is just the right amount of energy being applied at just the right place at just the right time. Next slide, please. In 1992 we set the goal of outperforming title 24 by 20 percent for new buildings in order to close and accumulate a utilities budget deficit. It didn't really have much at that point to do with sustainability or carbon reduction. We had a budget deficit.

So we set this goal, beating title 24, because the campus was growing. So we thought as we built new buildings that outperformed title 24 we would catch up on and recover that deficit that they had accumulated. We also adopted a tool and we call it a tool because this isn't a document that sits on a shelf. It's called the lifecycle and sustainability performance standards. Here's a picture of it. This tool does not sit on the shelf unnoticed. It's been used for almost three decades, revised just two times, each revision making it slightly more rigorous.

Brian will show you key standards from this document in just a few minutes later in this discussion. By the way, this is available to anyone. It's open source as far as we're concerned. We will share it with anyone. Next slide, please. Why can't I get this to move? Sorry. We have a technical problem here we're fixing right now. Okay. Going forward in time I started with 1992. In 1993 we started to experiment in this project, which is a complex of four social sciences buildings.

We experimented using real time CO2 sensing in 1993 to regulate the introduction of relief air, outside air into the recirculating air system. In 1995 we raised the goal of outperforming title 24 from 20 percent to 30 percent, which seemed feasible 'cause 20 percent had proven entirely feasible. That utilities deficit I mentioned a few minutes ago was fully recovered by about 1996. Going forward in 2001 we set the goal of lead silver for all new construction. By the way, the campus has grown during the entire period that I'm discussing now for the past three decades. In 2004 we set the goal of lead gold for new construction. In 2008 we set the goal of lead platinum for new construction.

Now those of you who know about the platinum requirements know that it's virtually impossible because of the way the criteria are weighted, virtually impossible to obtain lead platinum without performing title 24 by 50 percent. Then in 2009 we focused more intently on laboratories. We turned toward laboratories because on our campus we noticed, I noticed initially that 20 percent of campus space was laboratory space, but it was consuming 65 percent of campus energy. I was so concerned about these numbers, I looked into a couple of big ten universities.

I looked into a couple of big research universities in the United Kingdom. I looked into some big research universities in the Northeast part of the United States and found this pattern was actually consistent across all the research universities that I looked at. So it wasn't that we were an odd ball. We needed to look at this though. Next slide, please. In 2010 UC Irvine was the first US university to employee the new Aircuity system for real time air quality sensing in laboratories.

Our first installation was in this building, the Sue and Bill Gross Stem Cell Laboratory which, because of this new innovation, outperformed title 24 by 50.3 percent. In 2010 we then adopted the goal of outperforming title 24 by at least 50 percent for all new construction, all new construction, not just laboratories. Now the one exception to all is actually medical care facilities and those are on a separate campus in the case of UC Irvine. But there are rigid codes in medical care facilities that have to do with infection control and so we have made some improvements in that area, but it's tougher to hit that 50 percent goal there.

Next slide, please. This slide really needs no heading. You can read what the president himself said when we had changed the 2020 goal that President Obama had set in the Better Buildings challenge seven years early. I remember the roar I heard from the crowd in the Angel stadium when he said, "It looks like" – what'd he say? "UC Irvine went ahead and did it done. So UC Irvine is ahead of the curve." I'll never forget the sound of the audience's response to that.

Next slide, please. Let's see. So remember that slide showing the maximum occupancy in that lecture hall, the design assumption being worst case condition at all times and all seats were filled all the time and it was operating around the clock. The lecture hall, that is the premise that used to be made in the latter half of the 20th century. Now in a laboratory the implicit assumption was that unknown airborne hazards could be in the air, that the lab might be occupied, and the wind conditions outside required a high exhaust stack discharge air speed. The overarching implicit and seldom stated assumption is that more is better.

Now you might wonder, do we think building systems engineering were careless or stupid? No. Actually that's not our belief at all. However, until real time censors and informatics were available that was a reasonable design assumption for all types of buildings on a campus. Real time sensing and informatics changed everything. Next slide, please. So why was 50 percent possible? First of all, some people wonder, gee, maybe the reason Irvine achieved that kind of deep energy efficiency was because our buildings were so bad to begin with. Well, that's not true. They were all pretty new buildings. We're a young campus as campuses go.

So all the buildings that we were achieving deep energy efficiency by retrofitting had been built to California's title 24 and maintained reasonably. We challenged a lot of common thinking though. The idea that more is better, the idea that waste had to be tolerated in order to provide that margin of safety. By the way, some of the things we did had nonlinear results. My favorite example is the exhaust fans that you see on the bottom of the stacks on every lab building on every campus and actually in any R & D center. With those exhaust fans it follows the Q rule. So cutting the exhaust speed of the discharge air out an exhaust stack in half cuts energy use by seven eighths.

So there were some nonlinear things that really helped us out when we got down to the nuts and bolts. So next slide, please. Can I have the next slide? The message here is it's not all about technology. Now I give the – this is just my way – it's half and half, but I give the nod to attitude. Let me explain what I'm talking about when I say engineering with an attitude. The engineers that we have on campus and facilities management and for that matter, the industrial hygienist we have in environmental health and safety, the consultants we work with, if you say to those people that such and such is a best practice or a standard practice, they'll say, "Let's see the data. Let's take a look at the data."

That's exactly the kind of question that should be asked in a research university. Any research university will tell you that they extol evidence-based data as a support for science and technology. So that's the right question. So part of what developed as we did this deep energy efficiency program was what I call a new culture of precision control and that's really important on a campus because it makes for a safer campus. I'll come back to that point in a few minutes, but first I wanna pass this over to Brian.

Brian Pratt: Thanks, Wendell. Next slide, please. So for new buildings we changed our design objectives and stopped doing certain things that didn't support lifecycle performance. We gave a high priority to design features and standards that did support lifecycle performance. So we stopped building buildings in the shape of a doughnut with wings. This is our 131,000 square foot science library. This was built in 1991. You'll notice that it has extensive surface area ratio of floor area to skin. Roof top, mechanical ducks just laying on the roof. There's a total disregard for solar orientation. There are spaces that create wind tunnels and it's functionally deficient due to its narrow loft sizes for the nature of the spaces that it's used for.

Next slide, please. These are both east facades of this building and you can see a lack of solar control, intense daylight direct sun streaming into the building. Once again, those wind tunnel spaces and disregard for solar orientation. Next slide, please. So we also stopped building buildings with unconventional materials and unusual detailing. This is McGaugh Hall, one of our large wet lab research buildings completed in 1991. This happens to use a cladding that ended up being degradable in UV. No solar control other than the use of reflective glass. So tremendous solar heat gain.

Leakage in the curtain walls. There is a transition between fiberglass panels with no flashing. Used caulking instead for about 46,000 linear feet of caulking on this building and even used an elaborate one quarter inch pipe drainage of seals and cladding in the air is space around the building. This resulted in $1 million in deferred maintenance in the very first year. So what did we do?

Next slide, please. We started building buildings that are more conventional and more responsive to passive solar design as well as active considerations. So this is our continuing education building, a 75,000 square foot office and instructional building built in 2016. The left hand image is a west façade and the right hand image is a deeper area of that west façade. This building is basically shaped like a C and it was shaped like that to maximize north access to daylight. In the left hand image on the south side you can see very deep solar shading.

On the right hand image you can see a PV solar array working as a shading device for the outdoor patio, gathering area. What we learned was that different devices and different components of our buildings need to do double and triple duty. This deep west façade under shade helps control that difficult west sun streaming in in the late afternoon hours. More importantly it achieves really terrific, natural north daylight.

Next slide, please. So this is the Susan and Henry Samueli interdisciplinary science and engineering building. We just finished this project. It's about 220,000 square feet of wet lab research, collaboration, and office space for the schools of engineering, information computer sciences, and physical sciences. On the right hand image you can see the north façade of the laboratory bar. This includes write up stations along the glass and the wet laboratory spaced inward from there that borrow light from the north façade. In the background of this image you can see the faculty office wing and these are faculty offices separated from the laboratory areas with much less intensive mechanical requirements.

The left hand image is the south and west façades. The south façade has support spaces for the laboratories which require more wall space and enable us to use punched openings with physical sun control for controlling of solar heat gain. You'll notice the west façade has saw tooth's with glass slots facing north to maximize daylight, but control that very difficult western sun. This project is 55.5 percent better than California's stringent title 24 energy code. It uses pre-concrete, precast panels, and it has exceptional north natural light into the write up in laboratories.

One thing I'd like to mention, through deep bend coordination we can – basically bend coordination modeling every single system in the building, it results in a lower floor to floor height, only about 14 feet. That's key because it doesn't initiate high rise code requirements that include intensive additive mechanical loads for pressurized stairs, et cetera. In this left hand image you'll also notice an exterior stair that is unconditioned space.

Next slide, please. So as Wendell mentioned, we prepared this tool outlining the principles we apply to our major capital projects and renovations. This is available through UCI design and construction services website and it tackles deep sustainability and life cycle standards and costs in the sections listed on the left. It's pretty comprehensive take on UCI design standards and costs. This outlines things we are going to do and things we are not going to do. The intention is for this tool to be actionable.

Very important to us is that we try to focus on performance driven aspects rather than being prescriptive to allow for our designers and engineers to be more innovative and evolutionary. Our standards focus on such things as massive efficiencies, ratio of exteriors, skin to floor area, and other fundamental drivers of unit cost. This process yielded savings that were intentionally channeled into life cycle standards in which energy and sustainability have the highest priority. The financial results of these practices are not a single new building has required a budgeting increase to fund our lifecycle and sustainability performance standards. We paid for these added costs by reallocating priorities and money as just outlined.

As Wendell mentioned and Bri mentioned, we have over 21 lead platinum projects with several more in the queue. Next slide, please. So this table is an example of one of the tables in the tool. This runs through building mechanical systems and addresses issues like static pressure, temperature set points, and air changes. Now as Wendell mentioned, the biggest impact is probably on labs and we host a smart lab one and a half day seminar that provides a deep dive into the principles. Aircuity is used to monitor real time air quality.

Results in modulated air changes for occupied and unoccupied labs based on real time air quality measurements. It wraps up when air quality is lower, ramps down when air quality is satisfactory. It also has very aggressive laboratory light power densities and we add bench task lighting to satisfy bench light level requirements. We borrow daylight into the laboratories through interior glass for wellness, but also for lower lighting intensities. This also talked about exhaust stack heights. These are addressed too. Mostly be a wind study, but it also has height minimums above the roof.

Next slide, please. So this slide discusses management of solar heat gain. This table runs through shading requirements based on solar orientation and it requires aggressive shading requirements on high performance glass use to minimize thermal heat gain. It's sensitive to solar orientation and physical sun control based on the façade orientation. So for example, the south, east, and west glass were required to reduce direct sun impact by 85 percent. That uses all kinds of devices including tree canopies, adjacent buildings, building overhangs, recesses, and fins, and so on. So we have a lot of tools at our disposal.

Next slide, please. So one more example is this is a summary table outlining other strategies and payoffs and the redirection of savings into areas with more value. So for example, when related to big picture building organization of building functions is that idea of consolidating non-labs into adjoining wings. Unconditioned outdoor stairs is another means to save massive energy quantities. We used herbal materials, long life, low maintenance. Interestingly enough, we strive to use no unconventional structure size, make, or foundation systems. As an example, we don't allow moment frames on our campus buildings due to the investigation and repair requirements after a major seismic event here in California. So with that, I'll turn it back over to Wendell and we'll go on from here. Thank you.

Wendell Brase: Thanks, Brian. So let me summarize just a little in closing. Brian has outlined how realigning priorities within building construction budgets pay the entire cost of our lifecycle and sustainability performance standards. Next slide. Oh, yeah. So this is basic in some ways. Some of the things Brian talked about go all the way back to those ratios of length to width for buildings, the ratio of floor area to surface area of the skin of the building. Things of that type are so basic they're sometimes overlooked in the design process.

When that happens you get pretty far into the design before you can actually benefit from thinking through the basic ratios that drive a lot of the budget. That's what happens when buildings get to a point in design where they can't do deep energy efficiency because the going in assumptions have been overlooked. So we don't do that. It's partly because it's outlined in this tool that Brian and I have worked on and Brian works with every day now in designing new buildings for the campus.

So what we did – the most important chart in a way, and I realize what Brian showed you was just pictures of the chart, the three key charts that came out of that tool, the lifecycle and sustainability performance tool. We don't have time to go through all of those item by item, but I'll post in a second here a workshop where we'll take a deeper dive on some of those things. It's important to note that the entire cost of our program was paid for just by making different choices, different decisions.

The most important table in a lifecycle report like that, or a tool – I should call it a tool, not a report – is that that table that had two columns on the left hand side was all the things we're not going to do anymore because we're using the savings from not doing those things for the right hand side, which is all life cycle and sustainability improvements. That's how we get the deep energy efficiency and it's paid for entirely by this program. Now for retrofit projects we use tax exempt bonds with a 15 year term.

Now the way those bonds were – the way the financial planning went, the parameter was that in the first year of a retrofit project that is an energy retrofit project, the savings had to be 1.15 times the debt coverage, the debt requirements. In other words, there was a mortgage payment and we had to have a surplus on top of that, a margin of safety in 15 percent. Now many of our projects, maybe all of them, are considerably more than 1.15 times debt coverage ratios. So they outperformed the financial requirement. These financing numbers are considered very solid. These ratios did not even include the co-benefits that could be monetized and they turned out to be much more valuable than we ever thought. Incidentally, we never once even talked about years of payback for energy efficiency project.

That way of looking at projects is a way to not reach deep energy efficiency levels. You never saw a project that had a three year payback that achieved 50 percent savings. So we looked at the debt coverage requirement and that was a much more rational way to achieve deep results. So we're doing a conference at I2SL, a preconference workshop. I2SL stands for International Institute for Sustainable Laboratories. It will cover in detail the economic value of all the co-benefits to which economic numbers can be assigned. That is economic – co-benefits apart from energy savings in our smart labs program.

It's fair to say, I think, that when co-benefits are taken into account, our lifecycle performance and sustainability standards have yielded and continue to yield far greater savings than they cost the university. Now keep in mind, this isn't a rosy theory. We now have three decades of evidence. Next slide, please. Here's a link for the workshop I just mentioned. It will focus on laboratories including detailed cost and benefits including economic value of all the co-benefits that can be assigned in economic value.

I'll give you an example of what I mean by that. We can't assign an economic value to the fact that our laboratories are safer now because there's no way that I know of of putting a dollar value on avoided human suffering or sickness. It would come from an airborne hazard problem in a laboratory. There are some things we can put economic values on such as air handlers and motors and anything that creates heat or movement in a building will probably last four times as long because all of those things are running slower in buildings where the air changes are lower, the ventilation fan or the exhaust fans are running slower. Those fans are not running as hot anymore. Air handlers are running cooler. Those things aren't gonna last twice as long. They'll probably last four times as long.

So even though what we're gonna cover in this I2SL workshop will be largely laboratory focused, many of the ideas and principles will be broadly applicable to all types of buildings and to deep energy efficiency renovations of all types. Now I'd like to ask our partners from the Department of Energy to summarize questions that have been raised during our presentation and Brian and I will try to cover them.

Bri Colon: Thank you, Wendell and Brian. Our Q and A is full of questions. So we're excited to be able to dive into additional audience input here. So we'll transition to that Q and A. If you haven't already, please join us at Slido.com and the event code is hashtag DOE to submit and upvote questions. So we'll start off here with moderating these. For one of the most popular questions about sharing the lifecycle and sustainability design standards tool. That link I saw was also included lower down in the questions, but it will also be included in the additional resources page that we send out as well.

So folks can obtain this tool and some of that follow-up material that will be added to the Better Buildings Solution Center. For the next question I see is, the market challenge overall with existing buildings. So I'm wondering Brian and Wendell if you could speak to some of the challenges and opportunities that you've found with existing buildings. I know this question specifically mentions to new construction maybe doing rather well in comparison. So what your experience has been with those existing buildings.

Wendell Brase: Well, actually with our older existing buildings that went through a complete deep energy efficiency retrofit project, they achieved much more energy savings than 50 percent in most cases. So for example, we had a number of constant volume buildings that had to be converted initially to variable air volume. Those buildings had a lot of cost. That's a big conversion in itself going from constant volume to VAV and in several cases, half a dozen at least, we had to do asbestos abatement in those buildings because in order to change out the systems they needed to be – they were built at a time when asbestos was being used in HVAC systems.

So all those things were paid for by the energy savings. The energy savings that the building that had to do all those things and cover a bunch of deferred maintenance that had been accumulating for 50 years, it had energy savings of 80 percent – 80 percent. It's using one fifth of the energy it used to before that deep energy efficiency program. So that's the best example. I think all of our buildings though that had to do a VAV or constant line to VAV conversion, you had that savings when we had one dual duct building actually that had to be converted to variable air volume. Again, the savings were so much greater on those buildings. They were well in excess of 50 percent. They all paid for themselves.

When I say they paid for themselves, I mean not just the cost of those improvements and the design, but see, in the background behind all of these precision controlled systems, there has to be a fault detection system. So the informatics layer now across the campus we're measuring over 400,000 data points, many of them every five seconds. That means that rather than depending as we did 50 years ago on overdesigning everything, and that was the margin of safety, now we have a system that we'll discover within seconds or minutes a failure of performance in any of these systems.

So it's a totally different concept of how you provide safety. This isn't theory. We've had zero – zero airborne exposures in 12 years now of smart labs retrofits and new buildings. Zero is a good number I think when it comes to airborne exposures. So all the things I'm talking about, the informatics layer, the fault detection system, everything is paid for and then some.

Bri Colon: Definitely. Thank you, Wendell. Speaking of some of that design, one of the next questions that seems very popular is posed as construction contractors and designers sometimes want to overdesign to ensure minimal complaints, issues, or follow-up after the project. So this person is interested in how you suggest overcoming this mindset to design for energy efficiency.

Wendell Brase: I think I'll toss that over to Brian. He's got a lot of experience in working with people who have that frame of mind.

Brian Pratt: Yeah. Thanks, Wendell. Wendell, during his portion of the presentation talked about culture. I think culture is a huge part of this. We have the data that shows that this approach is effective and aligning ourselves with designers and engineers that understand the data and buy into it is really key. It's also this culture – I noticed in the question it talks about complaints and follow-up and things like that. It's about risk. If we can describe our requirements in a performance way then we find that the design teams, the engineering designers as well as the architects, are very innovative in their approaches to how to manage some of these requirements.

So often we're not so smart. One of the design disciplines comes across and comes up with an innovation that we didn't even consider because we're talking about performance rather than being perspective. When we're perspective then there's a higher risk of falling short because the dynamics, the variables within any building design, as you know, are very expensive series of variables and each building is very different. So I would align this one mostly to culture, but also this issue of performance based criteria rather than prescriptive criteria. Wendell, do you have anything to add to that?

Wendell Brase: I couldn't agree more. This is about culture too. It's about culture and attitudes and it's not just about technical stuff. You can see that Brian and I are entirely on the same wave length and the results do speak for themselves.

Bri Colon: Thank you, Brian and Wendell. As a follow-up, I know we were talking earlier about some existing buildings. I'm curious if either of you would expand a bit more on any performance of deep retrofits for existing buildings on campus at UC Irvine?

Wendell Brase: Well, when we started doing this project we thought we would do the whole campus and in fact, we have done the entire campus. That makes sense actually, not only because it pays for itself, but also there's certain things that we did that when you take a broader systems view, a more comprehensive view, that actually improves the whole program. One is exhaust facts on buildings. So we didn't just model – see, when we reduce exhaust stack, air discharge, we extended the height of some of our exhaust stacks. In fact, one weekend we, with a helicopter, brought in exhaust stack extensions and put extensions on I think it was 9 or 11 buildings. I forgot the exact number.

I thought on Monday morning that I'd get a bunch of complaints from people who are saying you made the exhaust stacks higher. Guess how many complaints I got? Zero. By the way, the wind tunnel study that we had done to determine the necessary stack heights was done not building by building. It was done for the whole part of the campus where all the science buildings are. That was much more rational than doing it building by building. So we take this whole systems view of things and there are results for doing that.

Underlying all of this is a sense of responsibility that anyone in a university has, especially a public university. We're spending taxpayer dollars and tuition payer dollars. So we have to be accountable for this. Of course we have to balance that, but it's easy to balance actually with our responsibility to improve global climate emissions. They're totally aligned in this case.

Brian Pratt: I would just add on the accountability side, students are demanding accountability of energy and sustainability goals. Incoming freshmen are asking really tough questions about what our sustainability program is and using it as a differentiator when they select the university they want to attend.

Bri Colon: Thank you, Brian and Wendell. I think that definitely speaks to the values definitely of the student population and their agency and making those ultimate decisions and their education. Appreciate that. I think the next two questions too are in that spirit of research universities. Just wondering more about how you all track savings and how they're calculated from year to year. I know the question in tandem to below talks about if embodied energy is included in those calculations in terms of the growth of facilities. So in that spirit of how those calculations are tracked.

Wendell Brase: Well, no. We haven't really tackled embedded energy or embedded carbon yet. Now it is true though that one of the strong areas of academic research at UC Irvine is material science. I know a lot of those faculty in material science and they're working very hard on trying to come up with alternative types of materials that have a much lower embedded carbon content. In fact, in our advanced power and energy program, there was recently I saw a webinar put on by the person who heads up that program, Professor Jack Brower.

He demonstrated using hydrogen, a complete demonstration project to create green steal using hydrogen as the primary vector. So research is coming along in that area. We're also tracking carefully the work being done at UCLA. There's a professor there who has developed a different formula for producing concrete, which absorbs CO2 and over time actually concrete does absorb CO2, but this speeds up the absorption speed by a factor of I think about 14 so that it will eventually be carbon neutral, but much faster than a building that's built with conventional kinds of concrete formulas. So we're tracking all this stuff.

I think advanced timber products, especially products that are being proposed now that we'll use reclaimed cellulosic waste that is coming from forest management or in some cases from agricultural practices where it used to be burned. We're following all that. And the UC system will probably take some steps to put in place a policy that will require that a couple years out we actually will have to choose for structural materials between green steal, concrete that has a much lower carbon content embedded, or maybe advanced cellulosic materials made out of forest waste. So yeah. That's a little bit too big of a problem to tackle at a campus level, but as a system I think we'll make some progress and it'll probably come out of California at a broad scale because we have faculty at all the campuses. The all the UC campuses are working on this problem right now.

Brian Pratt: Yeah. I'd just like to add I really love this question because we get it from incoming students saying, "Gosh, 21 lead platinum's, that's great. What about embodied carbon?" It's a fair and great question and part of it is when we do build it's for the long term. These buildings will not be torn down and rebuilt, which is one of the greatest offenders in terms of embodied energy. The premise Wendell started with is build less. Now this question refers to a situation where UCI finds ourselves in where we are growing expansively very quickly. So we are looking at selection of designs that, for example, have a more balance sight and less truck traffic for exporting of soil and things like that. So this is a really great question and really I think the next shoe to drop for UCI in terms of our monitoring of our energy use.

Bri Colon: Definitely. Thank you so much, Wendell and Brian. I believe that's the last question we have time to answer. We do have some closing slides here in the last couple of minutes. I know Wendell and Brian have also mentioned a willingness in terms of following up though on some of those questions. So we can send that out in a resource, just the questions that we weren't able to get to, and we'll again, offer their contact information here too on a final slide that folks can also follow-up again with Wendell and Brian.

This webinar was our final installment in the 2022 Better Building Summer Webinar Series. We hope that you'll join us for the 2022-2023 webinar series and those topics will be announced soon on our Better Building Solution Center. Next slide. Each year the DOB also releases an annual report with key findings, updates, and metrics for the Better Buildings initiative. Please visit the Better Buildings Solution Center to explore this progress report for 2022 to learn more about how DOB and partners are working towards a more energy efficient future. There's a lot of great information in there. So encourage folks to check that out.

Next slide. If you're interested in learning more about the topics discussed today I encourage you to download our additional resources handout from the Zoom chat box. This handout contains links from resources from Better Buildings as well as from our speakers. That tool that Brian and Wendell spoke about is included in there. We hope that you enjoy and find this helpful. Next slide. Great. With that, I'd like to thank our panelists again, Wendell and Brian, for taking the time to join us today and share this fundamental information and impactful practices that have been implemented at UC Irvine. I know the room is flooded with virtual applause. Everyone is very appreciative of the time that you all spent here speaking about these initiatives.

Feel free to contact our presenters directly with additional questions. If we couldn't get to your question again today their e-mails are listed there. I encourage folks to follow the Better Buildings Initiative on LinkedIn and Twitter for all the latest news. You can find those handles on the left hand side of this slide. You will receive an e-mail notice when today's recording, slides, and transcript are made available on the Better Buildings Solution Center. So many reasons to check out the Better Buildings Solution Center. Thank you again, everyone, for joining us and we hope you have a great rest of your day.

[End of Audio]

Additional Speaker Q&A:

Better Buildings does not endorse or recommend any product or technology provider. The answers in this document are solely the opinions of the speakers based on their professional knowledge and experience.

Additional Questions

Audience member: How do you think about airborne infection control in buildings while reducing energy use? To address COVID for example, have you considered germicidal UV light or other energy efficient ways to increase ventilation/filtration?

Wendell Brase: Here is a generalized response that provides an overview, with the caveat that safe ventilation and exhaust is a specialized field for which we engage the firm 3Flow for specific technical recommendations and solutions. Our approach focused on improving the effectiveness of ventilation and exhaust, rather than the quantity, per se. Before modifying lab air-changes we developed a "risk-banding" program, evaluated and improved airflow dynamics where pre-existing problems were discovered, and performed extensive before and after testing to confirm that no increased airborne exposure risk stemmed from improved energy performance. This important topic will be addressed in detail in the upcoming I2SL pre-conference workshop: https://www.i2sl.org/conference/2022/agenda.html.

Audience member: What exactly is meant by doing better than Title 24 by 50%? Does this mean using 50% less energy than buildings that typically are right at Title 24 standard?

Wendell Brase: The pre-construction design process requires rigorous energy modeling based on Title 24 minimum requirements and on our proposed design. The final construction documents are based on this model, and confirmed by inspection during construction and metered energy performance post-completion.

Audience member: With more than 20 years of financial success in sustainable science buildings at UCI, why are some of the UC campuses lagging so badly in retrofitting and upgrading their existing science buildings?

Wendell Brase: Research universities are now designing new buildings for remarkably improved energy performance due to the track record that has been established by collaboration among I2SL (International Institute for Sustainable Laboratories), the DOE "Smart Lab Toolkit" resource tool, and shared results and lessons learned including safety as well as energy performance data. In fact, interest is now rising on the part of universities that have been procuring emissions attributes to meet their net-zero goals, especially now that prices of RECs and offsets are rising and questions of "additionality" are surfacing in a demand-saturated global emissions market.

Audience member: Can you please elaborate on your 'rapid fault detection?'

Wendell Brase: As discussed in the webinar, prior to precision sensors and digital controls HVAC and exhaust systems depended on design for non-dynamic worst-case assumptions. This imprecise margin of safety exacted a very high energy penalty which can now be radically reduced by precision, granular control that applies just the right amount of ventilation, exhaust, and thermal comfort inputs zone-by-zone, minute-by-minute. This is a complex system, however savings far exceed the added costs, including that of an information infrastructure that monitors and assures system performance real-time. This topic will be addressed in detail in the upcoming I2SL pre-conference workshop: https://www.i2sl.org/conference/2022/agenda.html.

Audience member: What advice would you give for campuses that are financially struggling in the wake of the pandemic, but would still like to pursue deep efficiency improvements?

Wendell Brase: Some campuses do not have the post-pandemic debt capacity to finance deep energy efficiency retrofit projects. However, the more progressive energy-as-a-service firms are increasingly capable and ready to go beyond "low-hanging fruit" projects and enter a longer-term contract as needed for a comprehensive deep energy efficiency program that covers multiple buildings as well as campus infrastructure.

Audience member: Is this SOP for research universities? Can we use the existing square footage without adding more?

Wendell Brase: Not clear about this question. Feel free to email me directly.

Audience member: How many UCI buildings are net zero energy, and are there any NZE or renewables requirements for new construction projects?

Wendell Brase: One large UCI project is net-zero energy, although in a research university committed to evidence-based climate solutions I must point out that very few institutional and business buildings are net-zero carbon, which is difficult to accomplish at building-scale and requires a grid-scale solution.

Audience member: Is your data that shows how deferred maintenance is funded through energy savings available to share? Would be great to see and share to make a case on our campus!

Wendell Brase: Our "smart labs" retrofit projects exposed and replaced all components in the HVAC and exhaust systems that were due or overdue for deferred maintenance replacement. I do not have a granular list of all such components, but overall about ten percent of these projects' costs was devoted to DM.

Audience member: How 'deep' have your operating systems (BEM, BAS) moved toward automation of all energy demand to assure ongoing energy optimization? How is misc. electricity loads / plug load managed?

Joseph Fleshman: The building automation system has various resets programmed, such as static pressure resets and supply air temperature resets, based on DDC zone feedback. Some laboratory buildings have panel-level submetering beyond the main building meter. Plug loads are generally not actively managed.

Audience member: Do you have an enterprise BAS or design standard to limit BAS vendor variety?

Joseph Fleshman: UCI has a master specification 23 0923 for Tridium Niagara 4. Master specifications can be downloaded from the UCI website at https://fm.uci.edu/. The specification provides performance-based requirements including BACnet IP connection capabilities. The intent is not to limit BAS vendor variety but to provide maximum options for competitive bidding of products that meet the technical requirements. One advantage of Niagara 4 is it can aggregate BACnet devices supplied by multiple vendors without being locked into a proprietary vendor, neither on the field device hardware side nor the Niagara programming/integration side.

Audience member: For the financial context of sustainability in a university research ecology, we calculate that the sponsored research income per square foot of research space may be around $400/sf.

Wendell Brase: I do not see a question in this comment, which is nonetheless interesting.

Audience member: How do you suggest a local government shift their design and procurement standards to reflect these deep energy efficiency practices?

Wendell Brase: Please refer to the tool we use: "Life-Cycle and Sustainability Standards and Costs" https://www.designandconstruction.uci.edu/_pdf/uci-life-cycle-design-standards-and-costs.pdf. This is an open-source document that you may adopt, or modify, for your own use.

Audience member: What is your EUI target for new lab buildings? Is there flexibility or is it a requirement that the energy modeling must achieve during design?

Wendell Brase: Over my entire career spanning three research universities, I have never seen value in EUI as an energy performance metric, since science and engineering programs vary so widely and EUI is a "one size fits all" concept while an in-depth, granular, precision approach is necessary.

Audience member: The new Senate-passed IRA bill allows for transferability of federal subsidies for energy efficiency and renewable energy projects so that non-taxable entities can access them. Will this change your approach?

Wendell Brase: We have not used energy service contracting or similar business models, although this legislative measure may make energy-as-a-service a more feasible model for institutions that have limited debt capacity.

Audience member: It sounds like outside air is a major source of energy savings with indoor air quality monitors. How does COVID-19 and CDC guidance factor into this strategy? How do you convince people to take risks?

Wendell Brase: This question falls outside the scope of our webinar. However, I will note that our process of right-sizing air-changes and reducing airspeeds through filtration media enabled making MERV-14 filtration our standard practice years before it was recommended for improved infection control.

Audience member: Do you set benchmarks annually for energy use reduction?

Wendell Brase: As a growing campus our annual goal is to continue to design and construct new space that outperforms California's Title 24 by 50 percent or more. And as new technologies are developed that might be effective for existing buildings, we field test and evaluate them.

Audience member: Other than a standard do you have a campus climate action plan with a target date for zero carbon emissions?

Wendell Brase: We do not believe that "zero carbon emissions" can be achieved without complete de-carbonization of the energy system in California, in which UC Irvine is deeply involved through its Advanced Power and Energy Program. Our goal is true zero GHG emissions, rather than "outsourced" procurement of emissions attributes, especially in a demand-saturated global market which raises troubling questions of efficacy especially for a university that considers evidence-based science a fundamental principle. You may recall that I discussed this in our webinar, and noted that these concerns are pivoting many institutions to investing in deep energy efficiency rather than continued reliance on RECs and offsets.

Audience member: Did UCI use any alternative financing strategies, such as a green revolving fund?

Wendell Brase: No, we used the tax-exempt 15-year term revenue bonds I mentioned in our webinar. I have never seen a green revolving fund large enough to underwrite a deep energy efficiency program.

Audience member: I saw on the list eliminating exterior insulation and sheetrock to reduce thermal mass - not sure I understand that -

Wendell Brase: In about 1993 Southern California Edison generously funded for us a deep modeling analysis by Lawrence Berkeley National Laboratory that revealed that in our climate a building with exposed concrete or masonry exterior walls of 12 inches or more thickness (exposed and uninsulated on the interior as well as the exterior) saves 8 percent on space conditioning energy due to the thermal mass cycling most hours of the year within the comfort zone we use for space conditioning.

Audience member: The continuing education slide with the building with windows and trees nearby made me wonder: Do you have any issues with bird strikes? If so, has this been addressed or incorporated into design considerations? If so, what works best?

Brian Pratt: We have worked closely with UCI biologists on projects to minimize bird strikes. Things that tend to work are: no funneling of birds between buildings to a dead end of glass, minimize large planes of flat glass, use frit patterns on glass.

Audience member: Why do you think the savings were ahead of expectations? Do you fault the models used to project?

Wendell Brase: The energy and dollar savings were slightly better than the models, which were intentionally somewhat conservative since the campus was a first-adopter for certain technologies, particularly in its Smart Labs Program. However, the pleasant surprise was that the life-cycle value of the co-benefits totaled an additional 75 percent on top of the direct economic savings due to deep energy efficiency. I will cover these co-benefits in detail in the I2SL pre-conference workshop we mentioned: https://www.i2sl.org/conference/2022/agenda.html.

Audience member: The co-benefits are so compelling - nice work making a broad case for these efforts! How have the co-benefits been shared with administration and others?

Brian Pratt: The campus leadership in general subscribes to the idea of deep sustainability, because not only is it the right thing to do, our students, faculty, and staff keep an eye on it, too.

Audience member: What were the most useful resources for UC Irvine in collecting data to make the cost reduction argument? On my campus, we are looking to replace the district heating system but are struggling to find comparable DHS replacement LCCAs.

Wendell Brase: Our first "deep" energy efficiency project was a new building, the Sue and Bill Gross Stem Cell Research Laboratory, on which we challenged the design-build team to outperform California's Title 24 energy code by 50 percent – an unheard of number for a laboratory. The project was completed on-time (2010) and on-budget by Hathaway-Dinwiddie and out-performed Title 24 by 50.3 percent. This result gave us confidence that the same level of energy efficiency could be attained on similar wet-lab buildings applying essentially the same design standards and technologies, for both new and retrofitted laboratory buildings. We set the same goal of outperforming Title 24 for non-laboratory buildings based on the hope that for less complex projects the goal would be equally attainable. This hope has been borne out.

Audience member: Do you have any regenerative buildings? Any buildings that have been certified by the Living Building Challenge?

Wendell Brase: No. Nothing that has been certified.

Audience member: Are all buildings metered individually or just select buildings?

Joseph Fleshman: Most major buildings are electrically metered individually, especially core campus and laboratory buildings. Some existing buildings have hydronic (high temperature water, chilled water) metering installed during retro-commissioning projects. Starting in the 2000s, new buildings now receive both electric and hydronic metering when constructed.

Audience member: Are these buildings effectively net-zero -- or how close?

Wendell Brase: The buildings we discussed in the webinar are on-average 50 percent more efficient than California's Title 24, regarded as one of the most demanding energy codes in the U.S.

Audience member: Great examples of sun shading suitable for CA climate. Same will create problems in ice/snow climates. That understood, any references/guidance to refer to for CO/WY/ND/SD/MT? Great presentation and thanks!

Wendell Brase: Your question reveals the importance of discerning between what energy innovations would be useful to "import" from UC Irvine, and which ones need to be specifically modeled, tested, and measured for your climate. You are wise to beware of "one size fits all" solutions in buildings as complex as those in a college or university.

Audience member: Would you consider a more holistic approach that isn't solely efficiency focused, such as the Living Building Challenge?

Wendell Brase: A research university has complex energy requirements, with energy use-intensity varying based on the type of research, the mix of fundamental vs. applied research and engineering, and safety factors that engender an energy component (among other factors). Moreover, most research universities have demanding energy reliability and quality requirements to protect research processes and materials that would be difficult to and costly to recover after an infrastructure failure or interruption.

Audience member: Have you performed deep retrofits on existing residential and office buildings on campus? If so, to what extent are envelope improvements part of those projects?

Wendell Brase: In the climate of Irvine, California, envelope improvements are of less value (with the exception of thicker insulation and high-albedo, which are routinely upgraded at the time of roof replacement) than demand-controlled HVAC; reduced duct, plenum, and filtration airspeeds; real-time CO2 monitoring to control intake of relief air; wavelength-selective window film; trees planted with locations and species that provide sun control, and best practice designs for lighting fixtures and controls.

Audience member: Wind tunnel studies? That seems far outside what many portfolio owners can achieve/ fund/ or justify. Were there grants provided for such studies?

Brian Pratt: We are starting to go away from physical wind tunnel testing and using CFD and other analytical modeling methods.

Wendell Brase: Wind tunnel modeling is now less expensive than in the past when the major expense was building the model with Styrofoam and balsa wood. Now an entire neighborhood of a campus, comprising the subject building and the neighboring buildings surrounding it, can be 3-D printed in a matter of hours. The savings of reduced stack discharge airspeeds, often possible with modest stack extensions (which on our campus have gone essentially unnoticed) follow the "cube rule," which means that decreasing stack discharge airspeeds 50 percent (not uncommon) reduces exhaust fan energy by a whopping 87 percent! Moreover, the exhaust fans will probably last at least four times as long (perhaps reflecting the square rule rather than the cube rule). For these reasons, exhaust stack airspeeds should be high on the priority list, and easily justified.

Audience member: Would the presenters please share what "whole-building air-quality" monitoring system they use as part of their deep energy retrofits AND/OR considered (brand/ model) and how they use it to control the spaces OA volumes provided by AHUs/ RTUs/ DOAS?

Wendell Brase: The primary system used for real-time air quality sensing in laboratories is the Aircuity system. It interfaces with the building HVAC control systems and a Skyspark system that consolidates all relevant fault-detection and system performance data. The overall system architecture and standards were developed with the assistance of Altura Associates.

Audience member: While I think it was mentioned as part of the presentation that there have been no disease transmission issues associated with the buildings IAQ schemes, I was wondering if they could further elaborate what they mean by that. Does it involve COVID-19 transmission as well? How did they measure that? Certainly some people got COVID that were in those buildings (be it from non-related parties they attended etc.) so how do we know for certain where transmission occurred? Also, I was wondering if the presenters could identify whether they changed the operation of the whole building IAQ monitors during COVID per CDC/ ASHRAE guidance (i.e. turn off the DCV controls)? If not, how did you go about meeting the concerns about risk and liability?

Wendell Brase: It is good that you asked this question for which I can offer clarification. I said that there have been no airborne exposures in our laboratories since we implemented the "Smart Labs" program – this refers to airborne chemical or particulate hazards in laboratories, not infectious disease transmission.

Audience member: It is my impression that California in general (including the student body, administration, governance, electorate etc.) has the right mindset to accept risks associated with MEP load sizing/ ventilation requirements/ etc. because of the acknowledgement of environmental damage and financial benefits of not doing those things. What do you suggest to those entrusted with showing improvement on the energy side, where the administration and governance mind-set is not AS favorable as California on accepting such risks?

Wendell Brase: There are several compelling points that can be made about risk management. In a research university, the most concerning airborne hazards and risks are in laboratory and patient care facilities. Since the latter facilities are specialized and highly regulated, I will focus my response of laboratories. Our laboratories are now safer in four ways: 1) The informatics fault-detection layer we mentioned in the webinar and referred to above detects both system problems such as faulty dampers, pressurization variances out of spec, excessive fume hood open sashes, problematic changes in windspeed and direction, airborne VOCs and particulates on a precise zone basis, and a number of other performance and safety parameters in real time. 2) When installing these "Smart Lab" elements we also measured and improved ventilation dynamics affected by supply and exhaust diffuser design and location. 3) With reduced air filtration face velocities we adopted the standard of MERV-14 filtration. 4) In addition to these building systems and controls improvements we implemented a system of "risk banding" that assigns minimum air-change rates zone-by-zone in our laboratories based on a risk-assessment process that evaluates materials and procedures. 5) All of these practices have created a culture of precision control, which extends beyond building systems to include safety evaluations and practices. We now have twelve years of experience that reveals that our laboratories are safer than prior practices, and they are also consuming less than half as much energy. Many of these areas will be discussed in more depth at the I2SL pre-conference workshop I mentioned this week.

Audience member: Thanks so much for your reply. I was wondering if you thought there might be applications of the Aircuity system for commercial buildings as well? I.e. specifically for buildings whose air-sealing is not possible or too expensive, using the Aircuity system to account for air infiltration as part of the delivered OA ventilation?

Wendell Brase: We have used a "stripped down" version of Aircuity for some non-laboratory buildings because it is so accurate in measuring CO2.

Audience member: I'm interested in how BAS and AFDD is managed across the campus given how integral it seems to the program. Do you have a specification for one or more native controls vendors or an enterprise BAS layer on top of a variety of native control systems?

Joseph Fleshman: UCI has a master specification 23 0923 for Tridium Niagara 4. Master specifications can be downloaded from the UCI website at https://fm.uci.edu/ The Tridium Niagara 4 optimization and graphics layer sits on top of a variety of native control systems, which have been upgraded with BACnet-capabilities. As individual proprietary control systems are upgraded to BACnet capable, those buildings are then moved from the proprietary server (e.g. Siemens, Johnson Controls) into the Niagara system. The goal is to eventually move all buildings out of proprietary servers and implement advanced programming at the Niagara optimization level, reducing the reliance on native field controller logic and proprietary vendors. Aircuity also can communicate with the BAS via BACnet for centralized demand control ventilation.

Why Deep Energy Efficiency Now Matters More Than Ever: An Actual Case Study, not a Theory

Additional Resources

Learn more about the topics discussed on the webinar by visiting the resources below.

Better Buildings Resources

- University of California, Irvine (UC Irvine): Smart Labs Initiative/Natural Sciences II
- UC Irvine: Developing an Integrated Smart Lab Program
- UC Irvine: Empowering Managers to Help Teams Find Deep Energy Savings
- Better Buildings Financing Navigator
- Better Buildings Higher Education Sector webpage

Explore more resources on the Better Buildings Solution Center

Other Resources

- UC Irvine | Life Cycle and Sustainability Design Standards and Costs
- International Insitutute for Sustainable Laboratories (I2SL) Annual Conference Registration Link

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This webinar was our final installment of the 2022 Better Buildings Summer Webinar Series. We hope you will join us for our 2022-2023 Webinar Series. Webinar topics will be announced soon!

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