

Sarah Stubbs: Good morning, everyone. Thank you for joining. We're going to give folks just a few more seconds to join and then we'll get started soon.

[Silence from 0:00:33 to 0:01:26]

All right, let's go ahead and get started.

Hello, everyone, and welcome to today's Better Buildings webinar. Dedicated to bringing you the latest actionable insights from leading industry experts, Better Buildings webinars are a chance to explore the topics, technologies, and trends that affect your organization, as well as efforts to accelerate decarbonization and energy efficiency adoption. Next slide, please.

Today's webinar is called "Inventorying Building Refrigerants and Reducing Leaks." Before we dive in, there are a few housekeeping points I'd like to cover. Please note that today's webinar will be recorded and archived on the Better Buildings Solution Center. We'll follow up today – or, when today's recording and slides are made available.

Next, all attendees are in listen-only mode, so your microphones are muted. If you experience any audio or visual issues throughout the webinar, please send a message in the Q&A box located on the bottom of your Zoom panel, and our tech support team will be in touch. Next slide, please.

So, my name is Sarah Stubbs, and I'm going to be your moderator today. I'm an ORISE Fellow at the US Department of Energy's Building Technologies Office, and in the Better Buildings universe I'm the Sector Lead for Retail, Food Service, Grocery, and Hospitality. Happy to be with you all today. We'll go on to the agenda slide.

So, today we'll do some welcome polls, kind of see who's in the room and what everyone's level of knowledge and comfort is with refrigerant or inventories and leaks. We have three great speaker presentations and then we'll have some live Q&A at the end. Next slide, please.

So, today we're going to be using an interactive platform for Q&A and polling, so I encourage everyone to participate in this. Please go to www.slido.com on your mobile device or open a new window in your internet browser. Today's event code is #DOE, or hashtag DOE. If you'd like to ask our panelists questions, please

submit them anytime throughout the presentation. We'll be answering your questions near the end of the webinar. You can also select the thumbs up icon for questions that you like, which will result in the most popular questions moving to the top of the queue.

All right, let's move on to our polls. So, we want to learn more about you. So, please join us over at Slido to respond to the following questions. If you're having any issues, please message our tech support team by using the Zoom Q&A function.

So, first off, what industry does your organization represent? Just – who's in the room? Who's around here? I'm seeing some responses roll in. So, lots of contractors or consultants. We have a lot of folks from the industrial sector as well. Also, a lot of folks from the federal government sector. I'm seeing commercial real estate, state and local governments both, some higher ed as well. I'm still seeing a lot of folks from the industrial space, which makes a lot of sense. It's a race between commercial real estate, state government, still lots of industrial contractors, consultants. So, we have a very wide range of industries here today. I'm very excited to have everyone on. All right, I think we can go ahead and move on to the next poll.

So, our next poll. So, what is your experience with creating a refrigerant inventory and tracking refrigerant use? So, one will be no knowledge, all the way up to five it's going to be very experienced. And then if you're neither one of those, somewhere in the middle, you can choose two, three or four. So far, we're seeing a lot of folks who have no knowledge – so, a lot of folks who are beginners. And then we also have probably the second most folks right in the middle there, right at number three, right in between. A lot of folks who have just a little bit of knowledge selecting two, and then the smallest percentage of folks at the five saying they're very experienced.

So, still seeing more than more than a third of folks on the line have no knowledge at all. So, we're really starting with the baseline and I think our panelists are going to be able to help with that today. We're going to start with the basics. What are refrigerants and why should you track them? Awesome.

So, thank you all so much for telling us. And I'm glad to see that folks who are still trying to learn some of the basics and intermediate skills are here and also really glad to see that we also have a handful of really experienced people on the line as well.

So, I think we can go on to the second – or. the third poll, which is focused on refrigerant leak reduction. So, similar to the last question: What's your experience with reducing refrigerant leaks? And similarly, if you have no knowledge, you can say one. If you have – if you're very experienced, you can say five. And if you're somewhere in the middle, two, three, or four. I see nearly half of folks who've responded so far have said one, no knowledge at all. And I'm really glad you're here because reducing refrigerant leaks is really important for efficiency and reducing emissions. And so, even more so than the first one. I'm seeing still over now over half of folks have no experience in this space. And then a much smaller number of people on the line are saying a little bit experienced or a lot experienced. And once again, we're going to we're going to talk about this in some detail. So, amazing. And then I think we can continue to move on to the next poll.

We've got one more audience question before our panelists' presentations today. So, this is an open answer. It's going to form a word cloud. What are you most hoping to learn about today? So, you can type into Slido, you can say just a couple of words or something longer if you want. What's the most helpful? And our panelists have great presentations prepared, but they can lean in on specific topics based on this if you give us these thoughts.

So, a lot of folks saying just the basics, "We want to hear the basics." We see a lot of interest in regulation, new refrigerants, greenhouse gas reporting, efficient data collection, data tracking and tracking at scale. Developing inventory and best practices. We'll absolutely be talking about those things. Regulatory updates. We've got some of that coming down the pike as well. Leak detection, absolutely. And tracking. And just digging more into refrigerants themselves.

So, our top ones are still the basics, leak detection, regulations and greenhouse gas reporting. I'm also seeing some refrigerant sources, emissions accounting, lots of data and tracking. Yeah, so I think we have a lot of great basic information for you all. We do have some regulatory updates. And then we have a great case study of how one specific organization is handling these practices. So, I'm still seeing some answers rolling in, but still "basics" is winning out. So, glad to see that a lot of folks who are really beginning their journey with refrigerants are on the line and hopefully we're going to be able to provide you all a lot of information on those basics and where you can get started, and with refrigerant inventories and leak detection.

All right, so I'm seeing the polls slow down. So, thank you all so much. This really helps us kind of know where you are in your refrigerant journey. So, I think we can go ahead and move on to make sure we have a lot of time for today's presenters. So, next slide, please.

So, we have a great lineup of presenters today. We have Heather Goetsch from the National Renewable Energy Laboratory. We have Chenise Farquharson from the US Environmental Protection Agency, and we have Pooya Soltanian from IKEA North America. Thank you to all of us for being here. Thank you – thanks to all of you for being with us today. Just getting all my words mixed up so we can go on to the next slide.

And I'm going to go ahead and introduce our first speaker today, Dr. Heather Goetsch. So, Dr. Heather Goetsch is a Research Engineer at the National Renewable Energy Laboratory, or NREL. She specializes in applying circular economy principles to decarbonize the building sector, with particular focus on building design, innovative low impact material use and reuse, and waste reduction and management. And with that, I will hand it off to Heather to kick us off today.

Heather Goetsch:

Awesome. Thank you so much, Sarah. Really appreciate the opportunity to be here and share a bit more about this important topic that we see coming up in the polls of understanding the basics. And it was really great to also see that there's a breadth of experience and of interest. And I hope that this first presentation will really help, like we're saying, set the stage to get you to where you want to be in your next step in that refrigerant management journey. So, if we want to go to the next slide, please?

Great. So, first, let's start off with what really are refrigerants and how is it different from other words we tend to hear all the time? So, a refrigerant is really this liquid or gas, a working fluid that has properties that allow it to really move heat from one place to another. Refrigeration uses refrigerants to do that, to remove heat from a space and then transfer that heat to another space. If you want to go to the next slide, please?

And with refrigerants, there's a lot of terminology that's used, a lot of acronyms for better or for worse. And so, it is worth taking a good second to remember what these different acronyms mean. So, CFCs are these chlorofluorocarbons that are – really, the main thing to remember here is that they're chlorine-containing

compounds that are really, really effective as being refrigerants but they're also effective at being – depleting the ozone layer. And so, one of the common examples that you hear about of CFCs are freon, or R12. And I like to think that this – we tend to do this a lot in science and generally in human nature – problems are often like a game of Whac-a-Mole and the refrigerant story is a lot like that. So, CFCs were great refrigerants but they had another unfortunate impact of depleting the ozone layer.

So, that led us to HFCs, which are hydrofluorocarbons. These are fluorinated based compounds that also are very effective at being refrigerants, don't have that ozone-depleting attribute, but they do tend to have higher global warming potential. And I'll get into what that is in a second. Hydrofluorocarbons do have properties where their phase change – that transferring heat – occurs at relatively low pressures and low temperatures that are really conducive to HVAC systems. So, it makes it a good refrigerant to use for that particular application.

There's also HFOs, which are hydrofluoroolefins. This is a new generation refrigerant that does have lower global warming potential and ozone depletion used to replace HFCs.

Natural refrigerants, you probably have heard a little bit of buzz about this. These are also simple compounds found in the natural environment that can be used as a refrigerant. Some examples can include carbon dioxide or propane.

There are also refrigerant blends. So, these are combinations of chemicals that when blended together can be quite effective at being a refrigerant and also being a low GWP. And so, GWP is the global warming potential. It's really a way of relating the impact of refrigerants. So, global warming impact can be related to the same quantity of carbon dioxide of that global warming aspect of carbon dioxide over a specified time horizon. So, if we go to the next slide...

So, this slide talks a bit more about that impact of refrigerants. Again, some other terminology that we tend to hear about in these conversations about refrigerants, but also just generally about carbon emissions accounting, you hear greenhouse gas emissions, you hear carbon emissions, you hear carbon dioxide equivalent emissions. And they may be used synonymously but there is a little bit of a nuance that is important to remember. So, the reason why we're all here is that refrigerants do act as greenhouse gases, so they do have an impact when they are released to the environment.

As I mentioned in the last slide, carbon dioxide is used as a reference point for greenhouse gases. And so, we use that GWP or that global warming potential number to determine the impact of that refrigerant in terms of greenhouse gas emissions. So, releasing a refrigerant doesn't release carbon dioxide, but it releases – that fluid does have a warming impact. And so, again, this is a way to relate that to carbon dioxide impacts.

So, for instance, if a refrigerant has a GWP of, say, 1000, it is the same as 1000 times the amount of CO₂ that's released as a greenhouse gas. So, in the bottom here, we're showing the 100-year global warming potentials for different refrigerants. So, you see in order of their impact – or, in order of their GWP. So, CO₂ has a GWP of one, but then, say, 410A, which is an HFC, has a global warming potential of around 2000. And so, it has 2000 times the impact of CO₂ if the same amount of that gas was – or, that entity was released. So, if we go to the next slide...

All right. So, where are refrigerants found in commercial buildings? Where do we need to be tracking them? In short, refrigerants are really found all over our commercial buildings and how we're accounting our impacts of commercial buildings. So, traditionally, we think of certainly HVAC systems or your air conditioning unit. And they can be also found in your refrigerators, your freezers. Depending on how you calculate your scope emissions, you may also need to include the air conditioning units of your fleet vehicles in that calculation. Also, small things like water fountains or vending machines that are cooled, they will also have refrigerants in them. And so this picture, this image here shows just where all over the place you can find refrigerants. The tricky thing then is tracking them and noting what type of refrigerant you have in each of these units or how often they're serviced and what was the measurement of the remaining refrigerant there, things of that nature. So, first, it's important to know where exactly refrigerants can be found in your buildings. So, if we go to the next slide...

And I've already kind of touched on this of why we care about reducing refrigerant emissions. But to put it in another context, this pie chart on the left-hand side shows the emissions from different sectors of our economy. The part in green is – shows emissions that are primarily from the buildings industry. And so, this part in the darker green are your scope one emissions, the lighter green are your scope two, and then scope three is an even lighter.

Refrigerants are – can account for six percent of the total US buildings-related greenhouse gas emissions. So, it is – also because of what I shared earlier of their relative impact with the GWP ranges, they're – that's why you all are here – right? – to learn more about how we can reduce these emissions. So, if we go to the next slide...

So, I mentioned the Whac-a-Mole conundrum. And one of the things to keep in mind is that, yes, refrigerants do have – they can have an ozone-depleting nature, but they can also have high GWPs. They can also have other things that we need to – attributes that we need to be considerate of. So, these alternative refrigerants can have high toxicity or high flammability. There are two ASHRAE standards that really focus on this. So, ASHRAE Standard 15 defines these categories of the relative high flammability and toxicity levels. You may have seen these, like A3 or B2L. That's what this refers to. ASHRAE Standard 34 also defines refrigerant classifications for chemical makeup, toxicity, and flammability. Some examples of those alternative refrigerants – ammonia is considered a B2L refrigerant classification and CO2 is considered an A1, so low toxicity and low flammability. So, if we go to the next slide...

All right, so here are some example refrigerants and their alternatives. Again, these are just some examples. We have – and we've divided it up by how they're used or where they can be used. So, packaged HVAC units, typical refrigerants are R22 and R410A. Their safety group classification and their relatively high global warming potential. Alternative refrigerants below that do show a different safety categorization but also lower GWP. And then the same thing on the – for the chillers. On the righthand side, you can see some examples of that. And then I just want to point out, I mentioned refrigerant blends earlier on, and so some of those refrigerant – those alternative refrigerants for chillers, those are – those blends that have actually quite a low GWP. So, if we go to the next slide...

Yeah, and so this shows some examples of natural refrigerants and their classifications. So, this table is actually taken from a fact sheet that is freely available that does focus on a topic that will be brought up in the next presentation. But here in this table, we're showing how R290, like propane, isobutane, ammonia, carbon dioxide, some example natural refrigerants, and how their GWP, their safety group classification compares and where they could be used.

So, some things to just note briefly about these natural refrigerants. Hydrocarbons – so, that's propane or isobutane – they do have a charge limit, primarily due to their high flammability rating. So, you're limited to how much you can have onsite. Ammonia is also a very effective refrigerant but does have a higher toxicity safety rating. And then CO₂ also has some – is a – it can be used as a refrigerant, but does require or can require a high pressure system that's needed alongside it.

So, if we go to the next slide – should be my near final slide – this is really to kind of set up the next two presentations. So, if we think about this from a higher level view, how do we even start thinking about reducing emissions from refrigerants? As is with most challenges that we face, we should first focus on, well, what is our current situation? What do we have? And in the case of refrigerants, determine if there really are any leaks at this moment. Second is to really know what you need. Sometimes we have way more than we need and there may be ways to avoid or use less refrigerants. This primarily comes into designing equipment or designing retrofits that could allow equipment to be downsized. So, sizing your equipment, maybe not for that peak load that only happens a percentage of the time throughout the year, but of course considering all of what the other implications of that might be. Knowing what the regulations are and their implications – and our next presentation will really get into that. And then finally, determine if there are opportunities for lower GWP options and what the side effects of that might be as well, like changing out equipment, and maybe you're at a point where you can change out HVAC system equipment. But yeah, so I think keeping these four things in mind is a great way to start thinking about how to reduce emissions.

So, my next slide is a thank you, and I'm excited to hear the rest of the presentations and feedback from you all as participants. So, thanks.

Sarah Stubbs:

Thank you so much, Heather. Next, we will hear from Chenise Farquharson. Chenise Farquharson is a Supervisor of the Emissions Reduction Branch in the Stratospheric Protection Division, or SPD, at the Environmental Protection Agency, or EPA, where she manages programs related to emissions reduction and refrigerant management under the American Innovation and Manufacturing Act and Clean Air Act.

Since joining EPA in 2008, she has worked on a variety of regulatory and voluntary programs, including serving as

Coordinator of EPA's Significant New Alternatives Policy Program in SPD, working with specialized sectors of use, such as motor vehicle air conditioning, and serving as team lead for the Chemical Data Reporting Program in the Office of Chemical Safety and Pollution Prevention. Chenise, the floor is yours.

C. Farquharson: Thanks so much, Sarah. And thanks, Heather, for kicking us off. That was a great overview of refrigerants and some of the things that we're doing on the regulatory and voluntary front to reduce emissions of HFCs. Next slide, please.

Before I jump in, I just want to provide a quick overview of what I'll be covering today. So, a quick overview of the HFC phasedown under the AIM Act. Talk about the program that was recently implemented under the AIM Act, the Emissions Reduction and Reclamation Program. Talk about the Section 608 Refrigerant Management Program that's been in place under the Clean Air Act for a number of years, since the early '90s. And finish up with one of our voluntary programs, GreenChill. Next slide, please.

So, many of you have probably seen this slide before in presentations from APA. This shows the overall phasedown of HFC, the schedule. And it shows starting in January of this year, the US reduced HFC production and consumption by 40 percent as compared to the historical baseline levels. And the next major step down will be in 2029, with the overall goal of reducing production and consumption of HFCs by 2036 to 85 percent of the baseline. Next slide, please.

So, to help EPA accomplish that goal, the AIM Act gives the agency the authority to address HFCs in three main ways. The first is to phase down HFC production and consumption through an allowance and allocation and trading program. That program has been in place since 2021, after the AIM Act was enacted in December of 2020. So, that was the first program that was established under AIM. The second way is to manage use and reuse of HFCs by maximizing reclamation and minimizing releases from equipment. And then finally, it's transitioning sectors to next-generation technologies through restrictions on the use of certain HFCs in a number of sectors and subsectors. Next slide, please.

So, I mentioned that the AIM Act was enacted in December of 2020 and we've been quite busy. Within the last – over the last three years, we've issued a number of actions, as you can see. The one – the most recent rulemaking, which established the Emissions

Reduction and Reclamation Program, was a final rule that was published on October 11, so a little over two weeks ago. And that rule covers a number of provisions for leak repair, use of automatic leak detection systems, and a number of other provisions. Next slide, please.

Next slide.

And so, I'll walk through some of the provisions that are related to leak repair and emissions reductions on the next few slides. But just to provide a little bit more background, Subsection (h) of the AIM Act, what it authorizes us to do, it allows EPA to do a number of things for the main purpose of maximizing, reclaiming, and minimizing releases of HFCs from equipment. But it also authorizes us to ensure the safety of technicians and consumers. And there is a specific mention in Subsection (h) that says that the agency can consider other rulemakings, other regulations, other programs, opportunities to specifically increase the reclaiming of regulated substances that are used as refrigerants. Next slide, please.

So, again, the final rule was published on October 11th. It established the Emissions Reduction and Reclamation Program for the management of HFCs and their substitutes, and we refer to the program as ER&R. And that final rule also implemented regulations to control, where appropriate, certain practices, processes, or activities related to the servicing, repair, disposal, or installation of equipment that contains certain HFCs and their substitutes. And so, as far as the estimated HFC emissions from this rule, from 2026 to 2050 the estimated benefits is around 120 million metric tons of CO₂ equivalent and then approximately \$7 billion in net benefits from the rule. And so, we do – this is a rule that in addition to the other rulemakings will further reduce HFC emissions. Next slide, please.

And so, there are a number of things, a number of requirements in the rule, but I wanted to just highlight the ones that are more relevant for this webinar. And so, I mentioned leak repair. And there are current regulations under the Clean Air Act, Section 609, that require owners and operators of appliances that contain 50 pounds or more of an ozone-depleting substance, they would be required to fix their leaks if the leaks are above a certain threshold. And so, in this final rule, under subsection (h) we finalized requirements for owners and operators to fix leaks in their equipment or appliances that contain at least 15 pounds or more of refrigerant that contain an HFC or a substitute for an HFC. So, we

basically lowered the threshold, the charge threshold to 15 pounds. But these provisions apply to HFCs and substitutes, unlike the 608 program, which only covers ozone-depleting substances.

We know that one of the best things that businesses and organizations can do in supermarkets is to identify and detect leaks before they get out of hand. And so, one way to do that is to use – is to install and use automatic leak detection systems. And so, in the final rule we have requirements in place where owners and operators of certain equipment, industrial process refrigeration equipment, commercial refrigeration equipment, these are appliances, large appliances containing 1500 pounds or more of refrigerant, would be required to install and use ALD systems.

And then there are also requirements in place for reclamation of HFC refrigerants. And so, starting in January 1st of 2026, any regulated substance being marketed – so, distributed as being reclaimed, which means certified reclaimers, reprocessed, re-blended, mixed, and brought these substances back to that 99.9 percent purity level, any regulated substances being marketed as reclaimed would only be required to contain up to 15 percent virgin HFCs. So, the majority of the composition would be comprised of recovered material. And then, starting in January of 2029, there are three subsectors that are covered and will be required to use reclaimed HFCs for the servicing or repair of their appliances, and the subsectors are supermarket systems, refrigerated transport, and automatic commercial ice makers. So, there are lots of other provisions in the final rule but these are the more relevant requirements and provisions related to leak repair and emissions reduction. Next slide, please.

Next.

Right. So, I quickly talked about the Clean Air Act Section 608 program. I'm not going to spend too much time on this slide. It's – so, under 608, we have the authority to regulate the emissions of, yeah, the – regulate the emissions of HFCs and also ODS, regulate the maintenance, the service, the repair, disposal of refrigeration and AC appliances. But the main thing is to prohibit the knowingly – the knowing release or venting of ozone-depleting substances and substitute refrigerants. You see there are requirements in place for technician certification, there are sales restrictions, and then leak repair requirements as well. Next slide, please.

Next slide.

So, this is one – I'll be talking about our – one of our voluntary partnership programs. So, GreenChill was launched in 2007 as a partnership between EPA and food retailers to reduce refrigerant emissions and decrease the cost of repairing appliances and fixing leaks. And so, GreenChill's mission is to incentivize and support the supermarket industry to transition to zero ozone depletion potential or lower global warming potential refrigerants. It's also intended to lower refrigerant charge sizes and eliminate leaks. And we also support the industry in adopting advanced refrigeration technologies and best practices to help minimize releases and emissions. Next slide, please.

So, a typical supermarket refrigeration system contains about 3500 pounds of refrigerant. And based on information from the Food Manufacturing Association, or FMI, we know that the national average leak rate is about 25 percent. The GreenChill partners report to EPA on an annual basis. And based on data, as of 2023, the average leak rate by GreenChill partner stores is about half of the industry average. So, they're in – this includes just best practices, trying to identify those leaks ahead of time, getting ahead of the leaks because we know that if the systems aren't installed properly, if they're not tight, if they're not leak tight, we know that those could be costly for supermarket – for the supermarket industry. And so it's a win-win for the agency. Next slide, please.

This slide illustrates the transition to alternatives in the supermarket industry. And so, you can see in 2007 when GreenChill was developed, R-22 or HCFC-22 was the predominant refrigerant being used. And since then, you could sort of see the transition to, I would say, more lower GWP refrigerants, but also there is a wider array of refrigerants. And R-22 now represents 10 percent of the installed stock of refrigerant. So, I think this is a great – I love this graph because it shows just the transition within the industry moving towards lower GWP refrigerants. Next slide, please.

I mentioned this before. So, the GreenChill partners they take proactive steps, preventative steps. They ensure that their appliances are properly maintained, their procedures and standards that they follow to help reduce their leaks compared to the national average. Next slide, please.

Right. So, it's tracking leaks, preventing – preventative maintenance practices, leak repairs, reducing leak potential. So, some of the things I've already covered. We are hearing from some

supermarkets that there are some challenges of finding qualified technicians to maintain their appliances and reduce leaks in their stores. But overall, the fact that they're taking measures to make sure that their systems are leak tight and using ALD systems, that's what's driving that lower leak rate threshold charge. Next slide, please.

And I'm getting ready to wrap up. I see Sarah's on. And so, just – this is – GreenChill is one of our success stories when it comes to partnership programs. GreenChill-certified stores between 2008 to 2024 have avoided up to 2.54 million metric tons of CO2 HFC emissions to date, so. And then – next slide, please.

Right. Lots of cost savings for supermarkets since the development of the GreenChill program. Next slide.

And just to finish up, we wanted to just put a spotlight on one of the GreenChill partners, Weis Markets. You can see there starting around 2007 their average leak rate, and then just throughout the years that leak rate has decreased. And that's the three-year average. Next slide, please.

So, I know I covered a lot. I had to sort of speed up there at the end, but I have a few links here that folks can check out. And if you have questions, you can certainly reach out to me. And I know there's a Q&A session at the end. So, thank you for your time.

Sarah Stubbs: Thank you so much, Chenise. I think we can go ahead and move on to our – *[video drops out]*

S: Oh. Looks like she's back.

Sarah Stubbs: All right. Thank you all. Sorry about that, having some tech difficulties. A quick reminder to our audience to send any questions you have into Slido at www.slido.com, event code #DOE. And now we will hear from our final speaker, Pooya Soltanian. Pooya, a professional engineer, holds a master of applied science in mechanical engineering. Presently, he works as the Cluster Engineer at IKEA North America Real Estate, focusing on construction projects and sustainability and climate-positive initiatives. His interests are sustainable passive design, infrastructure decarbonization, renewable energy production, maximizing energy efficiency while maintaining profitability, and value engineering and cost consciousness. Pooya, take it away.

Pooya Soltanian: Thanks, Sarah. I appreciate the opportunity. And thank you, Heather and Chenise, for the great presentations, and it's always great to hear the insight from the government and regulatory section. Within the next few slides, I'll be covering how IKEA is tackling the refrigerant topic, and basically I'll walk you over the roadmap that we have developed. Next slide, please.

Before I jump into the roadmap or the way that we're looking at it, I would like to go over a few backgrounds and information-related background about refrigerants. When we talk about refrigerants, there's always GWP that stands out but it's important to look at it from a holistic approach and look at GWP, ODP, and TWI. So, there are different ways that refrigerants are impacting the environment and it's important to look at it from a lifecycle analysis standpoint and look at it from every angle that a refrigerant could impact the environment. Next slide, please.

So, we started by developing a roadmap to basically look at it from – look at the refrigerant kind of challenge from more like a scientific-based way of looking at it. So, we started by defining the scope. So, technically, we wanted to look at and say, all right, so what do we want to achieve out of it? What are the boundaries? When we say refrigerants, what do we mean? Is it IKEA food? Is it our HVAC systems? Technically, trying to define the boundaries of the initiative. What do we want to be? What are the goals? What are the short-term and long-term goals?

The next step for us was to understand where are we – what is our current position? What kind of refrigerants do we use in our facilities? How much of it are we using? What are our leak rates for the refrigerants? So, basically, the current position audit and auditing the inventory of our refrigerants.

The next step was to measure the gap. So, we know where we are standing. We have some goals that we wanted to achieve. It's now the delta of the theme, where we are standing, where we want to be, or the point A and B, and then obviously evaluating the options or solutions to take us from point A to B, or technically from where we are to where we wanted to be and come up with a plan and implementation or execution plan to implement the solutions that we have kind of developed. Next slide.

Our next step was to do a portfolio study. IKEA operates all the way from East Asia to North America. So, we have assets that are located in different countries. So, for us, the first step was to look at it not only from the inventory standpoint but also from

regulations. How do we deal with refrigerants in our portfolios across the globe? One of the items was the policies and legislations, and it varies from country to country, and because we operate in the majority of these countries and screening it was important to know based on our goals what are the challenges that we have with the regulations in each country? Sometimes we're ahead, sometimes we're behind, basically our goals. When we're ahead, we would like to keep it that way. We would like to make sure that we take the extra step. And where we see there might be some challenges in complying with regulation, we will basically adjust our goals to make sure that we comply with the regulations. So, what we did basically was some analysis to make sure that we're in compliance in all these countries and locations. Next slide, please.

So, these policies are kind of – they have a direct and indirect impact. The direct impact is on the manufacturers and importers. Basically, the – we are the end users, so there's no direct impact on IKEA. But what it does, it pushes the industry to come up with equipment that they use, a lower GWP refrigerant. So, it's in our favor. It helps us to move faster towards our goals. It makes high GWP refrigerants less available and more costly. And at the same time, it helps industry to push for more availability and equipment that use lower GWP and consequently decrease the cost of ownership in purchasing these equipment. So, all in all, regulations are in our favor. It helps us to move faster towards our goals and be more successful in achieving the interim and the long-term goals that we have. Next slide, please.

Technically, looking at the roadmap and analysis, we come up with a few outcomes. One of them was to look at low GWP refrigerants. We tried to look at it from different perspectives that are outlined on the left side of the screen: GWP, safety, PFAS, capital cost, efficiency, and equipment lifetime. And based on our experience, one of the items that was really challenging was the safety. And that ties into the building code because sometimes we're willing to use the GWP, the refrigerants with lower GWP. However, the building codes, at the time, they're not adopting A2L gas classification. So – but fortunately, I see a lot of great movements in North America that more and more building codes are adopting the use of A2L refrigerants in the buildings. Next slide, please.

For the existing assets, we looked at some of the refrigerants that are kind of dominant of using more than the other refrigerants. And we looked at it from the end-of-life cycle standpoint. So, let's say we have a chiller or an equipment that needs to be replaced.

Instead of going with R410A that might be available in some markets, we would like to use the refrigerants that are suggested in the third column. Basically, these are based on availability and the type of refrigerants that are available in different countries. So, they have a lower GWP compared to the traditional R410 or R134A. However, the challenge remains with the safety classification of these refrigerants. Next slide, please.

So, for existing equipment, we looked at retrofit and drop-ins. A retrofit is basically end-of-life cycle management. And the drop-in is to use the lower GWP without doing any major retrofits. The challenge that we see with drop-ins is more related to the equipment retrofits. So, sometimes the drop-in refrigerants are not compatible with the system as is, so we needed to do some modification to the system, to the valves, and to the piping. So, that made this a bit challenging, specifically for smaller systems. And the other challenge was sometimes we needed to take out the existing refrigerant and drop in with a completely new refrigerant, which caused a little bit of challenges. But overall, for the existing equipment, if you're doing an end-of-life cycle, we make sure that we use lower GWP refrigerants. And at the same time, we focus on frequent leak checks. Leak checks is a good practice, making sure the refrigerant is being recovered. And if we need to do any top-up, we use recycled or reclaimed refrigerants. So, these are some steps that was the – that were the outcome of the portfolio study that we did. Next slide, please.

For new equipment, the first thing is we'll make sure that we use low GWP refrigerants. We use the equipments that have low leakage rate and they're energy-efficient. And as I mentioned earlier, we wanted to look at it from a holistic standpoint. So, not only GWP, but TWI and LCCP or indirect emissions are very critical for IKEA when choosing a system that uses refrigerant. So, these are the factors that are taken into consideration before choosing a system for any new application. Next slide, please.

This is the last slide, but I'll focus on the nine outcomes or opportunities and challenges that we identified based on the portfolio study and also our experience managing the program. The first thing is regular maintenance. It is super critical to have regular maintenance because being proactive is going to help us a lot to reduce the leak rates and to make sure that every equipment is maintained as per the manufacturer's requirements. Seal and insulate equipment, that helps a lot with reducing the leak rates. Or even if the leak happens, we make sure that there's no contamination. And insulation equipment is going to help us a lot

with reducing the energy loss. Employee training is super critical. The more the technicians and employees are trained, the more regular maintenance is going to be successful. So, these are all tied in together.

Equipment, trying to centralize equipment, that helps a lot with reducing the amount of refrigerant that we use for the same application. And it centralizes the use of the refrigerant, meaning that you have all your refrigerants kind of centralized in one part of the system. So, if any leaks happen, you know where to go. And then, even that helps a lot with the regular maintenance because you need to focus on that part of the system that has the refrigerant to make sure that there's no leaks.

Documentation and record-keeping, not only that helps a lot with lesson learned and transferring information within the organization, but it helps a lot with making sure that the O&M is being taken care of. Recovery is always important. Make sure that any refrigerant leaks and anything that we change is always recovered. Periodic leak testing is super critical because as much as you be proactive, there's still a chance that leaks can happen. Holistic approach. As I mentioned, it is always great to look at the challenge from every angle and try to make sure that you tackle it from not only GWP but from all the other angles and making sure that you look at the total lifecycle analysis of the system. Regulatory compliance is super critical. So, having a solid plan is always going to help us to make sure that we're in compliance with regulations in different countries. And last slide.

Thank you. "Tack" in Swedish means "Thank you." Thank you very much.

Sarah Stubbs:

Thank you so much, Pooya. And thank you to all of our panelists for insightful presentations. I think – next slide, please.

I want to quickly encourage all attendees to download our additional resources handout shared in the Zoom chat box, which contains some more resources that you can continue perusing after today. And we're close to the end of our time today, but let's move on to – I think we can take probably just one question. Thank you all so much for your participation, for all these insightful questions as well. I think we can go on to showing the questions.

So, even though we've run out of time because our speakers had so much wonderful information today, I just want to say that we will be providing some answers to our top voted questions as one of our

webinar follow-ups today as well. So, before we go to our closing information, I just want to highlight our highest question today for our panelists. So, what are common pitfalls slash issues that you see in companies' refrigerant management plans? So, any of our panelists just in the last minute or so that we have, any, I think, rapid fire thoughts on this question today?

Pooya Soltanian: I can take that. So, at IKEA, I think one of the – well, the main issue is how do we make sure that we capture all the inventory as is? And then obviously just looking at the rates, the leakage rates is important, but we need to have a goal to make sure there are some actions in place to maintain the system, reduce the leakage rate. At IKEA we put a percentage per site as the maximum allowed leakage rate and we always try to comply with that.

And the other thing is making sure that it's automated. Again, depending on the size of the company, it's important to have every data centralized, and the bigger you get, it's going to be more challenging to use just one Excel file. So, having a proper inventory kind of platform would be extremely helpful.

Sarah Stubbs: Thank you so much, Pooya. And unfortunately, I think we're going to have to follow up with these other questions offline. So, you all will receive a follow-up on that on these top-voted questions.

So, we can move back to the deck and go through our final slides here. So, just wanted to call out our fall webinar series. This is part of various webinars in the lineup. We have great presentations every Tuesday through the end of the year, and you can visit the Better Buildings Solutions Center to learn more and register. Next slide, please.

So, our next webinar will be on November 12th, titled "Growing Your Green Team: Engaging Residents and Staff for Successful Decarbonization Projects." Next slide, please.

Just wanted to call out that we're pleased to announce dates for the 2025 Better Buildings, Better Plants Summit, which will take place in Washington, D.C. from April 30th through May 2nd. So, in addition to engaging in interactive sessions, being part of Better Buildings and especially our Better Climate Challenge is a great way to continue to pursue these conversations, both with the DOE and – but with other partners as well. So, I do encourage you all to get more involved with Better Buildings if you're not already. And then final slide, please.

With that, I'd like to thank our panelists so much for taking the time to be with us today. Feel free to contact our presenters directly with additional questions. And then in addition, we will follow up with a Q&A document to follow up on some of the questions that we received today. I encourage you to follow the Better Buildings Initiative on LinkedIn and X for all the latest news. Our handles are next to their respective icons on the left half of the slide. And you will also receive an e-mail notice with today's recording, slides, and transcript once they're posted on the Better Buildings Solution Center.

With that, thank you for staying with us for an extra minute today. Really appreciate everyone being on today and have a great 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: Could you clarify the 15% virgin refrigerant in EPA's ER&R? Does it refer to the virgin components needed to restore the blend to 99.9%, or does it mean adding 15% blend refrigerant to meet the system's charge limit?

Pooya Soltanian: I'm not sure if this question is relevant to the content I shared.

Audience member: Any impact on performance by using low GWP refrigerants on old units?

Pooya Soltanian: We do not have enough data as of now to provide.

Audience member: How do I know if a product for ALD meets the regulation requirements?

Pooya Soltanian: I'm not sure if this question is relevant to the content I shared

Audience member: What are recommended methods of estimating refrigerant usage for a commercial building where no data is available on refrigeration/HVAC systems?

Pooya Soltanian: If you are referring to the amount of refrigerant currently in the system, I would say adding up system capacity based on name plates. If you are referring to system leakage, it varies depending on system setup (i.e., if this is HVAC, refrigerator, freezer/cooler, etc), how long the system is being used, regular O&M is being performed. In general, we are aiming for 3 to 5% refrigerant leakage each year

Audience member: For GHG inventory purposes, is the industry standard to include refrigerants or are they excluded because they are regulated?

Pooya Soltanian: At IKEA, we do include it in our emission goals.

Audience member: Is there a different national average leak rate for commercial refrigeration used in restaurants, or HVAC equipment?

Pooya Soltanian: Not sure about this.

Audience member: What are economical leak detection methodologies?

Pooya Soltanian: This varies based on system application/size. We do follow ASHRAE standard 15-2022

Audience member: I've heard that it's already common for larger commercial refrigeration systems at grocery stores to have automatic leak detection. Have you

received feedback from stores about how they'll be affected by ALD requirements?

Pooya Soltanian: I have to look into IKEA food and see if we currently have ALD systems in place.

Audience member: How does cost of recycled refrigerants compare to new? How is the availability? Any performance issues?

Pooya Soltanian: I'm not sure about the cost but I can definitely look into this. Overall, as the refrigerant phase out progresses, we see higher cost for phased out refrigerants as they are less available.

Audience member: Does it make sense to de-prioritize energy efficiency in favor of a lower-GWP refrigerant if the electricity has near-zero GWP (eg., in the PNW)?

Pooya Soltanian: Not sure if I understood this correctly, but overall, the lower GWP refrigerants, i.e. 454b not only has lower GWP, but also is more efficient than R410a. When evaluating our options, depending on organizational goals, we should focus on selecting the equipment with lowest available GWP refrigerant that meets all local code requirements.

Audience member: Pooya - you mentioned that one of the biggest challenges companies struggle with is automating refrigerant tracking. Can you share your experience with automated tracking?

Pooya Soltanian: What we are doing at IKEA is auditing the inventory of our HVAC/IKEA Food equipment and using a third party platform (tool) to create an inventory of refrigerants. This is a bit manual to do the audit at the beginning but once the data set is completed, all changes, leakage detections, equipment replacement, and all other actions that can impact type/quantity of refrigerants will be recorded in this data set and will be reflected on the reports.

Inventorying Building Refrigerants and Reducing Leaks

Additional Resources

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

Better Buildings Resources

- Commercial Refrigeration [program page](#)
- Industrial Refrigeration [program page](#)

Explore more resources on the [Better Buildings Solution Center](#)

Other Resources

- [The Hydrofluorocarbon Phasedown and Commercial Space Conditioning: A Guide to the Transition](#)
- HFC Allocation [Framework Rule](#)
- Allocation [Rule](#) for 2024 and Later Years
- Application-Specific Allowance Review Proposed [Rule](#)
- Technology Transitions [Rule](#)
- Residential & Light Commercial AC & Heat Pump [Subsector IFR](#)
- Variable Refrigerant Flow Proposed [Rule](#)
- Emissions Reduction and Reclamation ([ER&R](#)) [Program](#)
- GreenChill Best Practices [Guideline](#)
- [CAA Section 608](#)
- [AIM Act HFC Reduction](#)
- [GreenChill Program](#)
- [ENERGY STAR Portfolio Manager](#)
- [Refrigerant Emissions Elimination Forum \(REEF\)](#)

Up Next in the 2024 Better Buildings Fall Webinars Lineup:

Growing your Green Team: Engaging Residents and Staff for Successful Decarbonization Projects
Tuesday, November 12th from 11am – 12pm ET

This webinar will explore strategies for integrating resident and staff involvement into every phase of a decarbonization project, from design and education to implementation and promotion.

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