

U.S. EPA Heat Island Reduction Program

Spruce Up! Using Green Roofs and Green Spaces to Beat the Heat

Webcast Transcript

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Overview of Heat Islands and EPA's Heat Island Reduction Program

Slide 1. Spruce Up! Using Green Roofs and Green Spaces to Beat the Heat

Operator: Good afternoon and welcome to Spruce Up! Using Green Roofs and Green Spaces to Alleviate Heat Islands.

All lines have been placed on mute to prevent any background noise. If you require assistance during the call, please press star then zero and an operator will come back on the line to assist you. Thank you.

Slide 2. Spruce Up! Using Green Roofs and Green Spaces to Beat the Heat

Operator: Ms. Victoria Ludwig, you may begin your conference.

Victoria Ludwig: Thank you, Charlie. Good afternoon everyone. Thank you very much for joining us today for our webinar on green roofs and green spaces. My name is Victoria Ludwig. I'm the program manager for EPA's Heat Island Reduction Program. We are very excited to have all of you and we hope that you benefit a lot from the great speakers that we have.

Slide 3. Webcast Agenda

Victoria Ludwig: I will start by just giving you a quick overview. Here's our agenda. I will do a quick overview of what EPA is doing in this space and then Steven Peck from Green Roofs for Healthy Cities will provide the lay of the land and introduce us to what green roofs and green walls are and then explained a little bit about policies and case studies of what is actually happening on the ground right now at the local level in the U.S.

Robyn DeYoung, who's a coworker of mine at EPA, is going to present a case study that we did to analyze the various co-benefits of green roofs that are in existence and projected to be in existence in Kansas City, Missouri. And then Katrina Managan from Denver City Department of Public Health and Environment will talk about the nuts and bolts of the process they recently went through to develop ordinances and a program to promote green buildings and green roofs in Denver.

At the very end, we will hopefully have at least 15 minutes for questions and answers and we'll explain in just a sec how that will work.

Slide 4. Webcasts now use Adobe Connect

Victoria Ludwig: The conference will end up at 3:30 in 90 minutes and now I'm going to turn it over to my colleague, Alexis St. Juliana, to give us some housekeeping rules.

Alexis St. Juliana: Thanks, Victoria and thank you everyone for joining today. We hope everyone was able to get on easily. If not, we have a few troubleshooting tips. First, you might

try a different web browser. If you're using Internet Explorer, you might try Firefox or Chrome. You may also be prompted to download the latest version of Adobe Flash Player or Adobe Connect plugin. If you continue to have connection issues, please check with your information technology department about your internet security setting and Adobe Connect also has fairly extensive online help pages that may be of assistance.

Slide 5. How to Participate

Alexis St. Juliana: There are two options to listen to today's webinar. The first is through your computer. Please make sure that your computer speakers or headphones are unmuted. The second option is to call into the phone line. If you experience audio feedback while on the phone, try muting your computer speakers; and then all participants, whether connected via phone or computer, will be muted throughout the duration of the webinar.

Slide 6. How to Participate

Alexis St. Juliana: There are three ways to participate today. The first is that participants can enter questions in the question and answer (Q&A) box on the right hand side of your screen. Please let us know who your question is for more and we'll moderate all those questions at the end. If there's anything we don't have time to answer, we will post those responses on the EPA site within a few weeks. Please also note that the hyperlinks you see on your screen today are active. So if you see something that interests you, go head and click on that hyperlink and it should open that page for you in an internet browser.

Slide 7. How to Participate

Alexis St. Juliana: The second way to participate is through a series of poll questions that we'll put on the screen today. It should be fairly simple to participate but users on mobile devices or tablets may need to exit full screen mode and tap on the poll icon which looks like a slip of paper dropping into a ballot box.

And then the third and final way to participate today is to complete our webinar feedback form. At the end of today, we'll share a link. You should also see that link in the Q&A box.

Slide 8. Overview of Heat Islands and EPA's Heat Island Reduction Program

Victoria Ludwig: Thank you, Alexis. Okay, folks. Let's dig right in.

Slide 9. Overview of the Heat Island Effect

Victoria Ludwig: I think several of you have been on our webcasts before, so I'm going to be quick about this but just for everyone's benefit what is the heat island effect? In a nutshell is really kind of a micro-climate at the urban scale where urban temperatures are much higher than the outlying areas whether that's the countryside or just the outlying suburbs. The temperature differences are quite significant to the point where a lot of cities don't even cool down in the evening and that is a very big risk for public health.

The graph is a hypothetical example but the point you can see is that the cooler areas are the ones

where there is greenery and where there are less buildings and roads and the other thing to notice is that heat island effect is a complex thing that has many factors that contribute to it but a very important part is that the temperatures are higher both at the surface level of the city as well as the air. Those two combinations together produce the heat island effect.

Slide 10. Causes

Victoria Ludwig: What causes the heat island effect? It really is the reduction of green areas, wet areas, and trees and those are the areas that remain cool and keep temperatures down. When cities build up and we use conventional materials to build roads and buildings, those are heat absorbing, they are dry, they're impermeable, and they lead to heat being stored in the city and not being released.

Dense development unless it has some great – unless all the buildings have green roofs on them and other things that causes urban canyons where the heat cannot get out and it even exacerbates the heat island effect. Also waste heat from the air conditioners that we have on the top of our buildings, coming out of our windows, and car engines that does have a significant impact on the heat that's produced in an urban area.

Why do we care about the heat island effect? It has numerous negative impacts. It causes an increase in energy use for air conditioning which indirectly releases more greenhouse gases from the production of conventional fossil fuels. It increases air quality detriment. It reduces air quality. It's a public health threat both because of the air quality issue but more importantly because of the risk of heat-related illness and even death. It also has a tendency to increase stormwater runoff and really wreak havoc on a city's ability to manage its stormwater runoff.

Slide 11. Heat Island Effect Strengthening

Victoria Ludwig: But the good news is there are solutions which we'll talk about in a second, but for more bad news, the scientific research has always had understanding over the heat island effect and the temperature differences. But this study that was done by the United States Global Change Research Program (USGCRP) shows emphatically after they did an analysis and an assessment of hundreds of scientific studies. It shows and documents the drastic temperature differences between urban areas and outer areas such that you can have seven degrees Fahrenheit higher in the daytime and it still stays higher in the city at night time by up to five degrees Fahrenheit. These are numbers that are generated from a multitude of studies, so there are some cities that have much higher temperature differences but the important thing is that this is a documented scientific analysis by the U. S. government showing that the heat island effect is real and also the U. S. government has shown that it is getting worse.

Slide 12. Heat Island Effect Strengthening

Victoria Ludwig: The USGCRP in its latest climate assessment issued a key finding for the first time that they have high confidence that the heat island effect in the U. S. will strengthen in the future. These folks do not issue a key finding lightly, so it's based on sound science and it's a call for action and therefore but it gives us more scientific evidence that the heat island effect is real and is continuing.

Slide 13. Heat Island Reduction Program Resources

Victoria Ludwig: But as I said, we have many solutions. One of which hopefully EPA is contributing to.

Slide 14. Program Overview

Victoria Ludwig: EPA has a Heat Island Reduction Program as I was mentioning. The mission is to work with a variety of stakeholders, principally local and state government policymakers and practitioners but also we work with universities, other federal agencies, and national associations like Green Roofs for Healthy Cities. We work with the industries that are involved, the roofing industry, the pavement industry. We work with all of them to provide outreach and technical assistance that helps our stakeholders make decisions that will reduce the heat island effect in their cities and do it in an effective and sustainable way.

Slide 15. Heat Island Program Resources

Victoria Ludwig: How do we do this? We have several resources. The Compendium of Strategies. If you have time to look at only one thing, I would recommend that. It's expensive an extensive guidebook that has detailed information on the science of heat islands as well as each of the main mitigation strategies, one of which is green roofs and trees and vegetation. It also has examples of what policies are being done at the local level. Right now for that, we have a great website. We recently updated our web page that is focused on green roofs, so please do check that out.

Victoria Ludwig: The Kansas City study that Robyn is going to talk about is on that page now and we're making more updates to our basic page that talks about how to – it tells you the basics of heat islands and we're doing a web page that focuses on the very important issue of the equity side of heat islands.

Slide 16. Heat Island Program Resources

Victoria Ludwig: We also have a database on our website that has some specific examples of what cities are doing to reduce temperatures in their cities. We have these webcasts. There's a great one you might want to listen to that we did recently on cool roofs and cool pavements and what's going on in Los Angeles (LA) and San Antonio. We have a quarterly newsletter. You can click on that link to sign up.

Slide 17. Contact Information

Victoria Ludwig: We definitely encourage you to do that and please reach out to me anytime. We are now putting out some Tweets and Facebook posts, so we encourage you to check that out which gives some information on this very topic, it points you to our resources.

Poll Question 1

Slide 18. Poll 1

Victoria Ludwig: I'm going to wrap up because I want my speakers to get the most time as well as the poll questions.

Alexis St. Juliana: Victoria, I have a quick update. It looks like a lot of people are getting error messages when they're trying to enter the webinar today. If anyone happens to be connected to the phone and hasn't connected to the webinar software, I have contacted some people that should be able to help. But in the meantime, I suggest they continue listening on the phone and reference the slides that we sent this morning, and we will have a recording after the fact. And operator, if you could double-check that people do not need to enter a passcode when entering the audio conference, we would really appreciate that. Thank you.

Operator: Sure, no problem.

Victoria Ludwig: Thank you, Alexis. The first – if you are able to get into the software, we have a quick poll question. We would like to find out more about what you're thinking these days. So please let us know, multiple choice, what benefits of green roofs and green spaces interest you the most? Is it the air quality improvements? Is it the energy use benefits? Is it greenhouse gases? Is it the overall benefit or the heat island itself, the improvements to human health and stormwater management benefits? I'll give you like 10 seconds to vote please for as many as you care to. And then we will put the results up. People are... Okay, let's see how we did. Is there a... Oh, sorry.

The most – looks like the most appealing is the heat island effect. The next one is stormwater. We have some – the third up is people who are – human health, air quality, and greenhouse gases. Last but not least are the energy use benefits, but you're all concerned about people are – all those benefits are of an appeal to you, so that's a good news. Thank you for voting.

Green Roofs and Walls: Strategies for Fighting the Urban Heat Island

Slide 19. Green Roofs and Walls: Strategies for Fighting the Urban Heat Island

Victoria Ludwig: Let's bring up our first speaker. His name is Steven Peck. He is the founder and president of Green Roofs for Healthy Cities which is the North American green roofs and wall industry association. Since 1996, he has worked to advance the green roofs and wall industry by facilitating research and demonstration projects, organizing conferences and workshops, writing articles, building institutional capacity, lecturing, publishing, and advocating for policies and standards at all levels of government.

In 1999, he began publishing and editing the quarterly green roofs and wall magazine entitled The Living Architecture Monitor. It's a great one if you haven't checked it out yet, please do. And in 2007, he co-founded the Green Infrastructure Foundation which is a charitable arm of Green Roofs for Healthy Cities. That is dedicated to advancing all forms of green infrastructure. Steve is a wealth of information and a great expert, so he's the perfect person to give us a broad overview of these strategies. Steve, I'm going to turn it over to you. Thank you.

Steven Peck: Thanks for having me, Victoria and welcome everyone to the webinar. A couple of quick pieces of news. We just got news today that the first state government New York state government has passed a \$15 per square foot tax incentive to help promote green roofs development in areas where the urban heat island is a real problem. So that's a really good positive development to kick off the start of the presentation with, I wanted to share with everybody.

Slide 20. Green Roofs & Walls: Tools to Address Stormwater & the Urban Heat Island

Slide 21. No title

Steven Peck: So I am wearing two hats on this call but I want to start off with a couple of quotes that I often I think put into context some of the challenges that we all are aware of and working on.

Slide 22. Overview

Slide 23. 1. About Green Roofs for Healthy Cities (GRHC)

Steven Peck: So two hats that I wear: one is the industry association made up of our members, our mission is to develop the green roofs and wall industry across North America through a variety of different means. We've been at it now for almost 20 – coming up on 20 years, we started pretty much with zero in terms of green roofs and wall coverage and now we are implementing millions of square feet of these technologies in cities across North America every year.

Slide 24. 1. GRHC Activities

Steven Peck: What we do to promote the industry and its many benefits is we have conferences. We have two Grey to Green Conferences coming up which cover all forms of green infrastructure, not just green roofs and walls, one is in Minneapolis and the other one is in Washington. You can see the dates there. As Victoria mentioned, we've been publishing The Living Architecture magazine which has case studies for policies, the latest technical developments, the latest in research. The Journal of Living Architecture, a peer reviewed scientific journal is embedded in The Living Architecture magazine that has articles that are peer reviewed every quarter and we also do online training. We have a professional accreditation program, so that you can get people who are working on your projects that have a baseline of knowledge about how to properly designed, install, and maintain green roofs. That's been in existence for over 12 years now and you can find out more about that on The Living Architecture Academy, our online training platform.

Slide 25. 1. About the Green Infrastructure Foundation

Steven Peck: The other organization I represent is the Green Infrastructure Foundation, it's our charitable arm. We have two main programs with that organization; one of which may be of interest is the green infrastructure. Sure that's where we work with local governments. We take an area of the city which is devoid or doesn't have a lot of green infrastructure.

Slide 26. 1. Green Infrastructure Charrettes

Steven Peck: We assemble local designers along with community stakeholders and we do what's essentially a green infrastructure makeover and then we subject those designs and ideas to a cost-benefit analysis. We develop tools to monetize the benefits of green infrastructure as much as possible and so we can make the economic case for implementation. So anybody who's interested in that, they can contact rlilauwala@greenroofs.org and get more information about that program.

Slide 27. 2. Nomenclature –Green Roof Basics

Steven Peck: So a little bit of nomenclature in terms of basic information. Green roofs come in essentially two different flavors; intensive green roofs – often referred to as roofs gardens – have more than six inches of growing medium on top of them. They almost always have irrigation systems. They are almost always accessible for the occupants of the buildings. They support woody plants like trees and various grasses. The other end of the spectrum is the extensive green roof which is a light-weight system, six-inches or less of growing medium. Sometimes they are irrigated, sometimes not. Sometimes accessible, sometimes not. Lower maintenance, lower cost approach to green roofing. So you have those sort of two basic types. And then we have modular systems which come in trays that are sort of pre-fabricated that can be laid onto a roofing membrane and we have loose-laid systems where all the layers are built up one at the time. There's two different approaches that we have.

Slide 28. 2. Green Roof Components

Steven Peck: Here are the basic components of a green roofs assembly. There are a lots of different variations on this theme but these are sort of all of the major elements. This technology has been in existence for well over 50 years now. We are installing hundreds of millions of

square feet worldwide. This is not a new technology by any stretch of the imagination. It's proven and it's a very functional way to improve the sustainability of the building and the surrounding community.

Steven Peck: Three of the critical things you have to pay attention to when designing a green roof is to protect the waterproofing. Make sure you don't take and have any problems with the structural loading and then of course sustaining the plants over the long haul. Those are the three sort of major design criteria. We have a lot of other design objectives that are built in things like food production, needs of species, biodiversity, human use and enjoyment. There are a lot of other things you can design in green roofs above and beyond this but these are the main things that we strive to achieve with all green roofs.

Slide 29. 2. Nomenclature –Green Wall Basics

Steven Peck: In terms of green wall basics, there are basically three types of green walls. There are green facades which are climbing plants that utilize climbers and there's a structure that either is attached or self-sustaining made of cables or grid-based system. The plants grow in planters or in the ground and it takes time for them to establish. Think about ivy leaves without the suction cups of the ivy touching the building envelope.

Then we have a whole variety of living wall technologies which are affixed to the actual side of the building envelope. They are either soil based or hydroponic. They can be felt-based systems. They are also a variety of recycled plastic-based systems that snap in and out and onto a grid. And then we have retaining living walls which have a structural role and also support plant life. So three different types of green wall systems are in the marketplace, a lots of variants.

Slide 30. 3. Big Idea 1: Keep Water Onsite and Grow Plants

Steven Peck: So here's the big idea I think that we need to work on collectively in the 21st century and it's a little bit different from how we develop cities historically and the idea is we need to keep the water on site and use it to grow plants and it means to institute policies that keep the water that capture that stormwater and retain it on site either in drainage layers in terms of the green roofs assembly or in cisterns – a variety of cisterns that can be on the roofs or in a basement or on the side of a building and then we use that water during our hot periods of time to sustain plants.

We have a whole tremendous array of benefits that result from that. And we tackle two of the challenges that are posed to us by climate change: one is the urban heat island and the heat waves that they're projecting are going to increase in cities around the world and also the more intensive storms.

Now typically we think about getting rid of the rainwater as fast as possible, so it's a little bit different from the way the industry civil engineers currently think and it requires innovation and policy innovation and we're to move us towards the technologies that facilitate our being able to accomplish these objectives.

Slide 31. 3. Big Idea 2: Cooling the City is Like Building a Power Plant

Steven Peck: When we start to cool the city using technologies like green roofs and walls and urban forest, it's almost like building a power plant. If you look at the research that's been done as we decrease the temperature as if we can get enough green walls and roofs, and urban forest, and reflective surfaces in our city; we can actually reduce the temperature and when we do that, we reduce the consumption of energy fairly significantly and we need to do more research to quantify this benefit on a city by city benefit but there's a huge opportunity here that hasn't been fully realized. We keep building power plants to supply more power and by looking at the whole city and energy efficiency and cooling the city, we can potentially generate the kind of support that's equivalent to building new power plants to supply new power.

Steven Peck: The other thing is that managing stormwater with these technologies is another major benefit and many cities have been able to monetize those values and are putting their funding into technologies that save in terms of their stormwater management infrastructure costs. So there is an energy side of the equation from an infrastructure and investment point of view and there's a stormwater part of the equation. Obviously, there is a human health aspect as well but in terms of the real tangible stuff, you put those things together and quantify those benefits and there's an economic case for significant investment in these technologies.

Slide 32. 3. Big Idea 3: A Role for Public Policy!

Steven Peck: And a lot of cities now are realizing this. If you step back for a second and you just think about green roofs, one of the things that's really cool and unique about green roofs technology is that we can leverage wasted roof space up to 30 percent of the land area. When new investment is going on with buildings, we can pretty much put a mini infrastructure system by using regulations on top of that building.

So we can leverage the private investments in new buildings for public good. They're all these public and private benefits that exist and we can create a lot of local jobs. We're not importing these systems from far away countries. The maintenance is local. A lot of the design and installation, it's all done locally. So when we invest public dollars in green infrastructure like green roofs and walls we're really seriously creating local job opportunities and possibly improving social justice.

Slide 33. 3. Green Roof Benefits Are Public and Private

Steven Peck: So as you can see there's a wide range of benefits that are public and private in nature, particularly with the green roofs and so it's kind of a natural public-private partnership which is why a lot of cities that have regulated the use of green roofs haven't had tremendous backlash or pushback from the development industry because they realized that they can also benefit by the use of these technologies.

Slide 34. 3. Green Wall Benefits Are Public and Private

Steven Peck: With green walls, it's the same type of thing, a little bit less benefit. This industry is a little bit less mature than the green roofs industry but lots of potential benefits that still haven't

been fully realized given all the wall space that we have on our cities around North America

Slide 35. 3. Selected Cities With Supportive Policies

Steven Peck: So here's just a list of a couple of cities, a handful of cities that if either required green roofs through regulations, New York being the latest, so new development is required to put green roofs on, green roofs and/or solar in the case of San Francisco, and green roofs in Toronto. Some cities have been out for a long time and then there's a whole ton of cities that have a variety of regulations or incentives often linked to stormwater management that support green roofs. And the best cities in terms of the most market development are usually the ones that have a combination of regulations and incentives for existing buildings and new buildings, so that the benefits can be aggregated to make the business case and get more green roofs and walls filled.

Slide 36. 3. Lots of Policy Tools

Steven Peck: So there are lots of policy tools. I think some of these are covered in the information that Victoria talked about online. It doesn't have – if the city is cash-strapped, you can use things like density bonusing, developers love that to get green roofs implemented. There's grant funding, there's laws and regulations, there's stormwater fee credits. I just told you about the tax credit abatement from the City of New York because the green area factor which is a requirement for a certain number of green space around the new development which could be a green roofs or wall. There are a lots of tools available in the policy tool box to make this happen.

Slide 37. 4. How it Works –Plants Are Fueled By Water

Slide 38. 4. How Plants Reduce Urban Heat Island

Steven Peck: How does it work? Essentially, the way it works is through the evapotranspiration. There are a lot of different mechanisms that play that help cool a building so you save energy inside the building and cool the outside air but the main thing is the water that comes down, it's evaporated from the growing medium and it's transpired by the plants and that is what helps to cool the surrounding area.

Slide 39. 4. Water + Plants = Urban Heat Island Reduction

Steven Peck: We use evapotranspiration to cool our bodies off when we sweat. When we sweat, it's the same kind of process. We create - we put water on the surface of our skin, it evaporates and it cools us off. And that's also why it's so hard to live in areas which have a 100 percent humidity. When evaporation shuts down and we feel terrible because we're not getting that cooling benefit. This is a chart. There is a lots of the scientific research out there showing the outside air temperature, the green roofs surface, and the non-green surface and you can see the benefits that exist.

Lots of research has shown that standard block roofs can get upwards of a 169 degrees Fahrenheit, even higher, so they're like hot plates that heat up the city whereas a green roof is usually in the range of 90 to 119 degrees and that depends on how much water is in the system,

the type of plants and so forth. But it's a significant difference. When you put a green roofs on a block roof, you remove the hot plate and replace it with something that's going to cool the city. So it's a tremendous advantage for the urban heat island.

Slide 40. 5. Case Study: Chicago City Hall Green Roof

Steven Peck: Chicago City Hall – one of the first and iconic green roofs has over 260 species of native plants downtown Chicago, very hot.

Slide 41. 5. Case Study: Chicago City Hall Green Roof

Steven Peck: If you look at the thermograph of that, that was taken of that site, you can see from this image, the green area which is darker in color on the roof, compared to the dark area and you can see the temperature – a 151 degrees Fahrenheit down to 74. So you can see and there are a lot of these types of images out there that show the benefits and of course that translates into energy savings in the year. So there's your hot plate on the one side – on the right side and then there's an air conditioning there on the left side.

Slide 42. 5. Case Study: Studios 5c Green Façade (Tempe, AZ)

Steven Peck: And it's the same kind of thing with green facades and living walls. This is in Tempe, Arizona. It's a green facade based on trumpet vines.

Slide 43. 5. Case Study: Studios 5c Green Façade (Tempe, AZ)

Steven Peck: A thermograph of that shows you the different temperature differentials between the area that is green with a shading and evapotranspiration and partially greened and then the raw building envelope at 51.5degrees Centigrade. This is saved about 10 to 20 percent of the cost of air conditioning compared to a contemporary-type standard building in Arizona

Slide 44. 6. Getting There: Living Architecture Performance Tool

Steven Peck: So we developed something called The Living Architecture Performance Tool. It took us over five years, a lot of scientific research and consultation. This is kind of like Leadership in Energy and Environmental Design (LEED) for green roofs and walls. There's a 110 points that are available across eight different subject areas including human wellbeing, social justice, health, climate, energy, and we are now in the process of certifying projects. Certified silver, gold, platinum against this rating system. There are mandatory requirements built into this, particularly around the area of maintenance which can often be a challenge.

Slide 45. No title

Slide 46. No title

Steven Peck: Here's just a quick look at some of the points and the prerequisites that are built into it and this tool is really meant to help designers and also help policymakers that, for example, want to introduce a grant program, they can reference this, the standard, it will be released next year after we finish beta testing it and you can reference it something that outside

parties have to achieve a certain level of performance and then they get financial support.

Slide 47. 6. Getting There: Living Architecture Performance Tool

Steven Peck: So there's a lot of different applications for The Living Architecture Performance Tool and we are very excited about it. We think it'll help standardize the industry in terms of what's required. We think it'll help improve the performance of these systems. You can download it free of charge from the Green Infrastructure Foundation. Please take a look at it if this is something that you are interested in or you're thinking about developing some policy.

Slide 48. 6. Projects in Pilot Phase (2019)

Steven Peck: Here's some of the firms that are going through the beta phase, testing it out, just work out the fine details, wide range of projects

Slide 49. 7. Conclusion

Steven Peck: So in conclusion, we need to seize the day, right? We have this amazing opportunity in our lives to improve the future and present wellbeing of people living in cities. We know the urban heat island is a growing problem. There's a ton of scientific evidence suggesting it's going to get a lot worse before it gets better but we can tackle this one and in doing so, not only do we get at the urban heat island but we also improve human wellbeing and we save a lot of money in terms of infrastructure. We're already spending a lot of money to address these problems. We just need to look at redirecting some of it and creating incentives in the marketplace so that our members and your local stakeholders can build healthier and more sustainable communities for everyone.

Slide 50. Thank You!

Steven Peck: Here's some more information and thank you very much for your time and I hope you guys all have a great summer and please feel free to contact us if you have any further questions.

Victoria Ludwig: Thank you, Steven. That was an awesome presentation. I really commend you. You and your organization have been a major force in promoting green roofs here in North America and if anyone has ever been to the – any of the conferences that they do or the regional symposia, they are fantastic. I would highly recommend it. So take note of the dates that are on there right now. We also have some of them mentioned on our web page. So thanks again, Steven. Great presentation.

Poll Question 2

Slide 51. Poll 2

Victoria Ludwig: Before we switch to our next speaker, we're going to do one more quick poll question. If you want to vote, if you could vote again. This one is asking what benefit of green roofs and green spaces would you most like to quantify or measure to have some hard evidence of the benefits? Would you like to know more about the air pollutants, the energy use, the greenhouse gas emissions, the heat island effect, public health, or stormwater runoff? You can check as many as you like. Please take a second or two to vote.

Okay. Great. Let's show the results. Let's see, we have again, I think stormwater runoff was the highest in the previous poll, that's the number one benefit you would like to quantify. We have some help for that. The next one is heat island and then it looks like public health, greenhouse gases, and energy use are tied for third place and air pollutants are bringing it up at the end, so definitely the EPA we're interested in trying to help you understand how to quantify these and we're trying to understand how others have done that, so that we can spread the news. So it's good to get this feedback. Thank you.

Environmental Effects of Green Roofs, a Case Study in Kansas City

Slide 52. Environmental Effects of Green Roofs, a Case Study in Kansas City

Victoria Ludwig: Okay, let's switch over to our next speaker, Robyn DeYoung is going to speak. She's a senior environmental specialist at U.S. EPA. She started her career as a state environmental regulator at the great State of Ohio EPA, where she developed a statewide Emissions Reduction Trade and Banking Program and then after that, she went to EPA, where she was my co-worker in the State and Local Energy and Environment Program. Her specialty is quantifying the emissions impacts and other benefits of clean energy programs and green infrastructure measures. She was the creator and the main developer of our Avoided Emissions and geneRation Tool (AVERT) tool that EPA developed which you'll hear about in this presentation. But now, Robyn now works in our Office of Water, where she's tackling clean water issues and developing a report to Congress on integrated stormwater plans under the agency's National Pollutant Discharge Elimination System (NPDES) program and she did not put this on here but I'm going to take the liberty of letting you know. Robyn is also a field hockey Olympian. So take it away, Robyn.

Robyn DeYoung: Victoria, thank you for that plug. I have been very excited about celebrating the women's soccer World Cup championship, especially being a former international athlete, so thanks, that's a lot of fun. Hi, everybody.

Slide 53. Estimating the Environmental Effects of Green Roofs: A Case Study in Kansas City, Missouri (KCMO)

Robyn DeYoung: I'm Robyn DeYoung and I'm really excited to talk to you all today about estimating the environmental impacts of green roofs in a case study in Kansas City. We published this case study in August of 2018 and you'll get a link at the end and I encourage you to read it. This is just a high-level overview of what we did and we wanted to show the multiple benefits of green roofs in Kansas City and green infrastructure in general green roofs is one of them is a priority in the Kansas City region.

I wanted to give a special thanks to the Mid-America Regional Council, MARC, especially their environmental program director, Tom Jacobs, who helped tremendously in helping us collect the data and reviewing the document and I have the privilege of going to the Mid-America Regional Council charrette on green infrastructure in November of 2016 while we were developing this case study. And there were over 60 professionals there looking at prioritizing what the green infrastructure goals are in the area, looking at how they could build local partnerships and commit to implementing these key strategies. And so this green roof analysis that I'll talk about today is one very small piece in the larger scheme of all the green infrastructure that's happening in the Mid-American Regional Council which is basically the Kansas City metro area, so I just wanted to give a plug for that before I get started.

Slide 54. Today's Presentation

So I'll give you a quick background on some of the green roofs that have been built in Kansas City. You can see some pretty pictures in those examples, then I'll go into this analytical framework that the goal is for it to be replicable across any city in the U.S. And then the results that we got from the case study itself and some conclusions.

Slide 55. Motivating Factors for KCMO to Adopt Green Roofs

Robyn DeYoung: So you already heard from Steven about what the benefits are of green roofs, so I'm not going to go into that. I'm going to jump into the motivating factors for why we chose Kansas City and one of the reasons is they've been having stormwater and sewer overflows into their rivers and so before a consent decree with EPA in 2010, there was over six billion gallons of untreated sewage flowing into local streams and rivers every year as a result of stormwater runoff and that green infrastructure was a part of that consent decree; they said that they would do some green infrastructure along with other items to mitigate that problem.

Ozone and particulate pollution or you can call particulate matter ($PM_{2.5}$), fine particulate matter, there isn't any violations right now in the Kansas City area. Their air is meeting the National Ambient Air Quality Standards but they do want to maintain that status and they felt like green roofs can help with that. And then lastly the urban heat island effect which many of you are here to listen about that impact and there has been temperature studies on the temperature within the metro area of Kansas City and outside of the metro area and there was 4.6 degree Fahrenheit average temperature that was basically warmer in the metro area and compared to the rural area and so, especially during the summer months and so the heat island effect is an issue in the Kansas City area.

Slide 56. Green Roofs in Kansas City

Robyn DeYoung: So we looked at all those three things then we thought, well Kansas City would be a great place to do this type of analysis and what we did is we looked at what Kansas City – what green roofs are currently taking place in Kansas City and we looked at – we talked to a local architect and some others in the area and they were about 450,000 square feet of green rooftops that have been built since 1999 to 2015 and this isn't a lot of green roof space, so if there's a city out there that has more than this analysis will even show you greater benefits than what you're going to see today but the good thing is that you continuously saw incremental improvement across the years and I have these two local pictures here and I'm looking for... Here we go...

So the photo on the left is the Kansas City Central Public Library and this is the roof deck open to the public for reading and relaxing and like what was said before is that having a green space is a great convening area for those who at the public library maybe want to read and be outside and then on the right hand side of the photo is the roof of a parking garage at Cosentino's food market downtown and they gave us permission to show this website and they're able to do events on the rooftop.

Slide 57. Example: Kauffman Center for the Performing Arts

Robyn DeYoung: The next – so then we have one more example that I wanted to share with you

and that is of – this is a center – the Kauffman Center for the Performing Arts that was built in 2011 and green roofs was part of the design. It covers parking structure and a belowground portion of the complex. It actually is the first and largest permitted green roof stormwater detention facility in the State of Missouri. And it's been able to save \$56,000 dollars a year in water costs and they got an Award of Excellence in 2013 from Green Roofs for Healthy Cities, so thanks for that, guys. So that is just one example of how this green roof is able to really help with the stormwater problem that the city had been facing and is continuing to improve every year.

Slide 58. Elements of the Analytical Framework

Robyn DeYoung: So let's get to the analytical framework. We wanted to make something replicable. We wanted to do it with free tools that anybody can access and we wanted to be able to look at the multiple benefits of green roofs from an environmental standpoint. So the stormwater retention, the heat exchange and evapotranspiration. So we're able to look at the heat exchange and evapotranspiration, we were not able to get to temperature but that is one step towards temperature, so we're getting closer and building energy savings and then the change in power plant emissions, so the air quality that we talk about today and the emission reductions that we're talking about today are a result of lower energy being consumed in a building and how that translates to lower emissions from power plants that don't need to generate as much electricity because there's lower demand on the grid. And then what are the monetized health benefits from the air quality improvement? And we'll go through all of those next.

Slide 59. Green Roof Methodology

Robyn DeYoung: So here are the steps that we decided to take and again I encourage you to go and read the analysis and the case study in the report because we have a nice infographic that doesn't fit here on the steps and all the sub-steps. Of course you need to first obtain any local data that's necessary, then we wanted a project what a green roof growth would be based on historical trends. We calculated the water, heat, and energy impact using a green roof energy calculator and then we looked at the emission reductions and then we monetized the benefits.

Slide 60. Obtain Local Data

Robyn DeYoung: So because we're in headquarters in D.C., we thought it was very, very important to discuss the building types and numbers and where the existing green roof installations and any policies that can influence green roof data with local officials, with the state, and again the Mid-America Regional Council, MARC, was very, very helpful in helping us dissect that. And so we needed to know the number of buildings that had green roofs, how large those green roofs were compared to the rooftop, and if there were any existing policies and there weren't any existing policies at the time; people were doing green roofs on their own because they found benefits for themselves or for the consent decree for stormwater and there were probably more out there that are in the Greater Kansas City area. We just looked at Kansas City, Missouri.

Slide 61. Project Green Roof Growth 2020 Projection Scenario

And so then what we did is we took the growth rate from 1999 to 2015 and we just extrapolated

out to say that well, this trend has gone thus far, it's going to continue and we projected out to 2020 that there'd be at least 700,000 square feet of green roof top being installed over time.

Slide 62. Calculate Energy and Water Savings

Robyn DeYoung: And so we were able to use this green roof energy calculator which was really, really helpful because this calculator has built-in assumptions that originate from a more complex, a whole building energy simulation model and that's the Department of Energy runs their EnergyPlus model, so there's actual measurements of roof surface data and soil moisture and variables. And we were able to take this combination of direct measurements and modeling data that drives the tool and use this very easily accessible online calculator that you can download if you click that link and it has over 100 cities in this built into the tool and has many, many runs already built in the tool, so you can get the information within just a couple of clicks as long as you know all the inputs, like the square footage of the green roofs and what building it is and the growing media depth et cetera and that basic information can be put into the calculator. It was jointly developed by Portland State University, University of Toronto, and Green Roofs for Healthy Cities.

So that was our first step was to put in the green roof information into the calculator and it gave us the roof water balance, the energy balance, and the electricity saving which was the essential part for the next step which was to quantify the avoided power plant emissions.

Slide 63. Quantify Avoided Power Plant Emissions

Robyn DeYoung: So we took the energy savings from the Green Roof Energy Calculator and we were able to put that into our AVOIDED Emissions and geneRATION Tool, AVERT. And that estimated the nitrogen oxide, the NO_x; the sulfur dioxide, the SO₂; and the carbon dioxide, the CO₂ emissions at power plants because of the lower demand that all these buildings in Kansas City now have because the green roofs that are on their buildings. And we can get that at the regional, state, and county level emissions.

And I guess I don't have the actual amount here but when you go into the report, you'll get that the total emission reductions and since I have the report in front of me, I can tell you what they are. For just the Kansas City – for the Kansas City area, we have 2,000 – about 2,600 pounds per year of SO₂ reductions, 1,800 pounds per year of NO_x, and then 90 a year of PM_{2.5} reductions, and we also have the CO₂ reductions of 1,100 tons per year. And then we have a broken out by county, so you can actually see how each county in the Kansas and Missouri area could benefit from the emission reductions.

Slide 64. Estimate Economic Effects of Improved Air Quality

Robyn DeYoung: And then last but not least, we use our COBRA tool, our tools, our CO–Benefits Risk Assessment tool, is another free tool that can be downloaded and found on our EPA website and it will tell you what the reductions in a lot of the health incidences are when you have lower air quality, outdoor air quality in your region or in your locality. So you could look at the premature mortality, how there's less hospital admissions, and other asthma exacerbation, et cetera, and what we did is we estimated the impacts from that and we found that the economic benefits to society were \$35,000 to \$80,000 in 2020 from the public health benefits

from reducing the particulate matter and the SO₂ and the NO_x. So that's \$35,000 to \$80,000 in public health benefits because of these green roofs that were installed in Kansas City that we assumed in 2020.

Slide 65. Results of KCMO Case Study: Projected Environmental Benefits

Robyn DeYoung: Okay. Great. So here are the results that we just talked about. So there are other – stormwater was one of the top things that you guys had in your poll that people are interested in and the green roof energy calculator quantifies 29 inches of annual stormwater runoff that it can capture during rain events and then here's the electricity saving and it also has a cost savings given the utility rates in the Kansas City area. And then here are the emission reductions that I just mentioned as well as the health benefits, the economic benefits of improving public health by lowering the outdoor emissions.

Slide 66. Conclusions

Robyn DeYoung: So in conclusion, what's nice is that if you're making decisions and people want to know what they're investing in and what they're going to get out of it, you can quantify the environmental and health impact of green roofs. And when you look in the study itself, you can see that what we've done is completely replicable as long as you have the local data on the number of green roofs that have been installed and that you think will be installed in the future, you can always do. You could do something different, you could decide to do a retroactive analysis. If you have a lot of green roofs happening, you could say well 10 years ago, we had all these green roofs installed, so what benefits are we getting today? And you could do that type of analysis. You don't have to project out into the future.


As long as you have the number of green roofs, how big they are, and some of the information related to the vegetation itself, you can do this analysis using the three tools that you can find in these links here. And of course the green roof policies and incentives will bolster the environmental outcome and I thought that Steven talked and gave a lot of great examples and the New York City example that just came out, the breaking news that we got today on the phone call. So consider those things so that you can get more green roofs installed and the access to the report is here on this link at below.

Slide 67. EPA Web resources

Robyn DeYoung: And then lastly, here's some other EPA web resources, I think Victoria already talked about that and we have a Soak Up the Rain: Green Roof web link as well for the water-related benefits. And if you have any questions, I'll be here for the remaining of the webinar. Thank you.

Victoria Ludwig: Thank you, Robyn. That was really great presentation. The work that you did on the case study, it was the first time that we did anything like that at EPA and it was really fun to see the results that came out. A great demonstration of our tools and how they can really help make a decision a little easier, hopefully for local practitioners. So I do encourage everyone to check it out please. And Robyn brought up questions which is good.

If you are watching on the screen, please you feel free to enter your questions anytime in the box



and if you can direct them to a specific speaker, that would be great. If you are on the phone but unable to watch via the web, please check your email for an email from Sarah Chadwick. She sent out a new link that should work. The first one was causing errors, we apologize, but we found a link that will work.

If you look in your email box, Sarah Chadwick, she sent an email to all the registrants. It has a new link for getting online and if you are not able to get online and you have a question, you can just reply to Sarah's email and enter a question for the speakers and we will catch those hopefully because we do want to do some Q&A at the end.

Poll Question 3

Slide 68. Poll 3

Victoria Ludwig: But we have a great final speaker before that though I want to do another poll question, the last one, if you could help us understand. The question is, how does your organization or community promote green roofs and green spaces? You can check as many as you like. The ones to choose from are: air quality standards, do you do you demonstration projects, and do you have incentive programs, outreach and education, tax credits, tree and landscape resolutions or ordinances, zoning and do you have zoning and building codes? Do you do none of the above because you're still beginning? Or do you have some other ways? We love to hear those. You would type the response in the Q&A box, so that we can see those. These are just a few of the things we know that you can do but we wanted to try out some and see what was going on out there with you guys. So take as much time as you need here.

Okay, great. The overwhelming result is, it's outreach and education which is first and foremost as we all know before you do anything else. Then looks like the next popular one is the incentive program, after that demonstration projects, some of you incentivized the green roofs through air quality standards, some do the next popular one it looks like – some of the – all the other ones are kind of even and then of course other. We'll be interested to see those and if you do none of the above, we hope that you are getting some information today that can help you try something else. So thank you for your help with that poll.

Denver's Green Building Ordinance Development Process

Slide 69. Denver's Green Building Ordinance Development Process

Victoria Ludwig: I'm going to move on to our third speaker who has some real hands-on ground work experience with this issue. Her name is Katrina Managan. She leads the Buildings Team within Denver's Climate Team at the City Department of Public Health and Environment. Through the Energize Denver initiative, she insures that Denver achieves its climate goals for buildings. The goals include things like that buildings must use 30 percent less energy by 2030, 50 less energy by 2050, and have 50 percent less thermal heating emissions by 2040 and that eventually all new buildings are net zero energy by 2035. Energize Denver includes the benchmarking requirement, the energy program created under the City's Green Building Ordinance. It also includes the 2019 Building Code Update and the Energy Smart Leasing Program. Katrina's five years with the city build on eight years of previous experience, researching building efficiency, market growth strategies at Johnson Controls and advocating at the federal level on energy and climate policy. Katrina, we're really anxious to hear about your city's experience. Thanks for joining us. Go ahead.

Katrina Managan: Thank you so much for having me and hello, everyone. Thank you for joining and listening over an hour into the webinar. I'm glad we still have a bunch of yourself. I want to talk today about the urban heat island. I'd frame the challenge in Denver because it's particularly challenging. It's one of our biggest challenges and then tell you about our Green Building Ordinance and how that's going to help adjust the urban heat island in part through green roofs but also through a number of other strategies.

Alexis St. Juliana: Katrina, we are getting a few requests for you to speak up, please.

Katrina Managan: Okay. Is that better?

Alexis St. Juliana: I think so. Yes.

Katrina Managan: Okay. Let me know if you're still not able to hear me.

Slide 70. Urban Heat Island and the Green Building Ordinance

Slide 71. City and County of Denver Climate Action Plan (2014)

Katrina Managan: We'll go to the first slide which shows or my second slide that shows the priorities in Denver's Climate Action Plan and as you can see increases in temperature and the urban heat island effect is the number one climate adaptation challenge that we face in Denver and if we go to the next slide...

Slide 72. Projected Change in Denver's Climate

Katrina Managan: ...you can see why. This shows the projected changes in Denver's climate and

as you can see sort of under this is business as usual. We would see just by 2050, 36 days per year, over 95 degrees and historically, we had six days per year over 95 degrees and so the urban heat island really would exacerbate that of course for the people that live in our urban core.

Slide 73. Where Your Summer is Headed

Katrina Managan: If we go to the next slide, you can see just where the urban heat island or you can see sort of what that transition looks like, Denver is going to feel a lot more like Texas.

Slide 74. No title

Katrina Managan: And going to the next slide, you can see a map of Denver showing our urban heat island and how it tracks along highway corridors, the big red area on the left for nighttime temperatures shows our downtown core and some neighborhoods around that, that will really not cool off well at night which is particularly problematic when you have more days over 95 degrees.

Slide 75. No title

Katrina Managan: If we go to the next slide, you can see a map of heat vulnerability by neighborhood. And a lot of the neighborhoods that are red for those of you who aren't familiar with Denver are some of our lowest income neighborhoods and I think a lot of the reason that we have more heat vulnerability in our poorer neighborhoods is if you go to the next slide...

Slide 76. 50% of Denver homes do not have air conditioning

Katrina Managan: ...50 percent of Denver homes do not have air conditioning that's because you didn't need air conditioning. Historically, in Denver you can open your windows at night, let in all the cold air, close them in the morning, and your house would stay cool all day because it gets cold at night in our dry high altitude climate. But when it's 95 degrees and we have an urban heat island and things don't cool off at night then we've got a real problem for people in our city.

Slide 77. Green Roofs to Green Buildings

Katrina Managan: So all that to frame what we started doing? So I want to tell you a story of this next slide about the process that we went through to get to our Green Building Ordinance. So just to make sure we're on the right slide because I'm not able to follow along online. I think it's #77 with the circles across it and so, on November 7th of 2017, a citizen-led green roofs initiative passed through the voter-led initiative that was on the ballot, that was an ordinance largely taken from Toronto and that was copied and put on the ballot by a bunch of really motivated citizens that understood the benefits of green roofs.

It required green roofs or solar panels, or a combination of the two, on new and existing buildings and it actually required existing buildings to have both solar panels and the green roofs installed at the time of roof replacement. There were a bunch of challenges with that original ordinance. One; it violated our state water law by requiring green roofs to retain water. It contradicted our building code in a number of ways. It was really challenging for existing buildings because of the weight of the green roof; 90 percent of them couldn't have supported

that weight. And also just the way the requirement was written, it was disproportionately burdensome on certain sectors.

So we convened a task force of stakeholders from both sides, so those who put the ordinance on the ballot and those who worked against it and a bunch of folks in the middle to think about how we might make some changes to the original ordinance and that group reached a consensus on June 7th which I think is pretty rare in today's day and age where both sides can actually come together. What we did was add more flexibility and increase the benefits, so we honored the vote. The new ordinance then had to get drafted. We passed our Green Building Ordinance through City Council last year on October 29th of 2018 and finally approved the rules just a couple months ago.

Slide 78. Green Building Ordinance Increases Benefits

Katrina Managan: So just to tell you a little more detail on the next slide about how the Green Building Ordinance really increases the benefits. These are the four benefits we were working to increase. These are the four benefits we really identified from the original ordinance. One is the urban heat island reduction of course. The second is adding green spaces to our city, people like having more green spaces. There's water and stormwater management benefits as you've heard and of course greenhouse gas emission reduction benefits from the solar panels, in particular.

Slide 79. Green Buildings Ordinance

Katrina Managan: If you go to the next slide, I will review the options and the plan and the structure of the Green Building Ordinance. So all buildings under the Green Building Ordinance over 25,000 square feet, new buildings or existing buildings, when they replace their roofs have to have a cool roof. Plus, they have to have one of the following compliance options. As you can see this is somewhat similar to the original ordinance where you can do a green roof or green space now anywhere on the site so the green doesn't have to be on the roof anymore. The proponents while they loved green roofs realized that often they won't be accessible on the rooftop and that green space on the ground could provide that green experience. And often greater stormwater benefits and it just may be more appropriate on some sites and so the same square footage is allowed but it can be on the roof or on the site. And then there's a combination of green plus solar or energy efficiency, so we added some flexibility there. Or an option just for solar or energy efficiency that's equivalent to that solar and then we added LEED certification pathway since we felt like those benefits for LEED gold buildings really added up to the same level of benefit.

For existing buildings, we have again a green roof or a green space on the site. There's an option for both and both of them to pay the city to install offsite green on behalf of the building. And that feels relatively high because when we did a whole cost analysis and fee study, we discovered it's actually quite expensive for the city to find and install new green spaces. So we're hoping and the task force's hoping that not very many people will pick that option. There's an option to install solar or enroll in the energy program which has a bunch of energy efficiency options for existing buildings with a little more flexibility.

And I can go in – I think I'm going to dive a little bit deeper here in just how much green space is

required or how big of a green roof because I think that this group will be the most interested in.

Slide 80. Green Buildings Ordinance: Who is Covered

Katrina Managan: So the green roof or green space on new buildings can again be anywhere on the building or the zone lot and the green area has to be equivalent to the lesser of three options: either 10 percent of the gross floor area, 60 percent of the total roof area, or the available roof space.

So for existing buildings, it's a little bit of a smaller green space because of the weight problem. Green area has to be equivalent to 2 percent of the gross floor area of the building or 18 percent of the total roof area or again the available roof space for existing buildings. So I'm talking somewhere between for existing buildings 18 percent of the roof or new building 60 percent of the roof is the coverage requirements.

Okay, if we go to the next slide, you'll see who's covered just to review with buildings over 25,000 square feet. All new buildings, all existing buildings, when they replace the roof and all additions over 25,000 square feet.

Slide 81. Exemptions Ordinance does not apply

Katrina Managan: There are some exemptions. Of course a building under 25,000 square feet is exempted. This is on the next slide. There's parking structure or temporary building, single family homes, and any time a small piece of the roof is being fixed, so less than 5 percent of the roof. There's an exemption.

Slide 82. Partially Exempt Must still do a Cool Roof

Katrina Managan: And then there is a partial exemption where residential buildings that are four or five stories or under 62.5 feet in height or a roof that's just being recovered or any existing green roof where they've already met the requirements or an emergency roof replacement, they still have to do a cool roof but they don't have to pick one additional option in addition to the cold roof.

Katrina Managan: So this is actually something we added. A lot of these exemptions existed in the original ordinance and they were just exempt. And instead of just exempting them. We said that you still have to do a cool roof. The cool roof requirement was also not in the original ordinance. So all the original ordinance had those partial coverage of the green roof. So that way we delivered a lot more urban heat island benefit in particular for voters by holding all the other benefits equal or improving on them and then adding the cool roof requirement on top of that because cool roofs are great for mitigating urban heat island as I'm sure everyone on this call are well familiar with.

Slide 83. Questions?

Katrina Managan: With that, I'm happy to take any questions. And yeah, I'll pass it back to our moderators.

Question and Answer Session

Slide 84. Question and Answer Session

Victoria Ludwig: Thank you, Katrina. That was a great explanation of the complicated process that you went through but I think it's really fascinating and a great example of the real world and how these things work when you want to have a green roof or an environmental policy and put it into practice, so I think it was really creative what you came up with and as you said, it's a hallmark to different sides of green which in this day and age is not too common but city governments usually are the ones to get that kind of thing done, so thank you for your efforts and for presenting today.

Victoria Ludwig: With that folks, I want to start the question and answer session. Again you can still type in questions in the chat box as we're going through. If you're listening in on the phone, feel free to send an email to me at ludwig.victoria@epa.gov or you can reply to the email that Sarah Chadwick sent you earlier in the hour. But this is the fun part.

We're going to start – let me see who's the first victim is, I think it was you, Steven. Let me see, Steven. Okay, one second. Okay. Steven, how much experience do you have or do is out there with installing green roofs in hurricane-prone regions? What are the, if you have experience, what are the special considerations that must be accounted for in those climates?

Steven Peck: There are standards for roofing materials that are well established in hurricane-prone areas. Some jurisdictions like I know South Florida have specific requirements that pertain to green roofs but there are a lots of different techniques and there's an American National Standards Institute (ANSI) standard for wind uplift. If you Google ANSI standard, we developed it, it's with the Single Ply Roofing Industry. We developed and actually just recently updated a wind uplift standard that has a whole bunch of measures that can be undertaken to reduce any threat of green roofs being torn off buildings.

Having said that there's a lot of talk about that but there's very little evidence to show green roofs flying off. In fact, the evidence that does exist demonstrates that green roofs outperform traditional roofing systems during hurricanes, not the other way around.

Victoria Ludwig: Wow, that's really interesting. Good to know. And with recent news today of what's going on in New Orleans, I think that was a very apropos question and thanks for your answer. The next question is for Robyn. Let's see, where did they go but I remember what it was. The question is, how were the increased public health benefits specifically tied to green roofs? Is it possible that there are other – yes, could you explain a little bit more about how that link was made?

Robyn DeYoung: Yes, sure. I can do that. When there is lower energy savings, we plug that into our tool AVERT – the AVOIDed Emissions geneRATION Tool. And that's able to specify which power plants in the Kansas City region would lower their generation and then lower their emissions. And then based on the location of the power plant and the emission reductions in those different counties, we put that into our program model and COBRA – the CO–Benefits

Risk Assessment health and mapping tool, that has a built-in reduced form air quality model inside of it and so when you say well, we lower the emissions in these counties, it takes that and says, well based on that here's how the air quality has improved and then it looks at what the population is related to where the air quality has improved and then it takes the literature review of what the monetized health benefits are, so it actually has the dollars associated with less asthma exacerbation. Or let's say, you have less hospital visits, it's able to look at what the dollar value is of that or you have less sick days of the dollar value of that and it says well, in this location where there is emission reductions and improved air quality, this is how the health benefit accrue. And I'm looking at the question that Ben asked and you also asked about what about all the other factors like for example; maybe there are other policies out there and this study does not look at those factors. This is a slice of this one green roof analysis; however, you can do a more comprehensive analysis if you wanted to. If you knew that there were more electric cars, then COBRA has the ability for you to lower the emissions in the transportation sector. If you knew that there was - any of the transit sectors if you had, so you can look at industrial sector too. So if you have that information, you could do a combined analysis that shows how the health benefits are increasing from other sectors of the economy. We just have the power sector for the case study.

Victoria Ludwig: Okay. Great. Thanks, Robyn, for catching that second part of Ben's question. I think this is a question maybe for either Katrina or Steven. Are there any other examples, I think similar to Denver that where green roof projects were developed that involve participation of citizens in the process of that. So cases where the professional technical stakeholders and the citizens have met and agreed on a final program or project. So either...

Steven Peck: I'm not aware of any other citizen-led ballot initiatives around green roofs anywhere in North America. I'm not aware of it. I think it's unique.

Victoria Ludwig: Okay. Great. I think it is true based on what I know and I think what I've seen is as a compliment to that question is that other cities have where they always – they usually do involve the citizens at least in the maybe the citizens do not initiate the program or put something on the ballot but when a city is developing a policy for a green roof incentive program, they do have usually public listening sessions and task forces and citizens advisory group and I'd be happy to research some more of those. I think the District of Columbia has done something like that. We can share that example after the webinar. Thank you for that question. Let's see... I think... How much time...? We have some time... Let's see...

Katrina, what do you think about your process of the city went through is the most replicable elsewhere in terms of things that weren't specific to the Denver context or the Colorado legal framework? What things do you think other cities could really take and run with based on the lessons that you learned?

Katrina Managan: Thanks for the question. I think the most replicable part of our process is this concept of laying out the goal. And then asking your stakeholders how to reach that goal. So in our process the goal was to honor the vote and make sure that we delivered as much or more benefits for voters as the original ordinance and the original proponents and the rest of the community did not care very much how we reached that goal, a lots of technical experts in the real estate sector and green building experts did care a lot though about how we reach that goal

and they wanted to make sure we reach the goal in a way that actually works for all buildings in Denver. And is not disproportionately burdensome on one sector over another and so I think if you set the goal, no matter what goal it is that you want to achieve, do you want to mitigate urban heat island or reduce greenhouse gas emissions or cut energy consumption in buildings and then you ask a group of smart stakeholders how to reach that goal, they can help you find that path and we ended up having sort of four goals and the four benefit areas that I named that we defined from that original ordinance, right? The four for this project were urban heat island, adding greenspace to our city, stormwater management benefits, and greenhouse gas emission reductions.

Robyn DeYoung: Thanks, Katrina. That is good detail and I think that speaks to the importance of outreach and education for the public so that they have as much stake in it as you said the real estate industry and they can be an informed part of the decision making process, so thanks for your answer. I think, Steven had to go to another meeting. So Robyn, I'm going to put one to you. Could a similar analysis be done for other cities in the U.S. that same that you did for Kansas City?

Robyn DeYoung: Yes, that's a great question and I definitely think that this analysis could be done in any city in the United States that well, I guess Alaska and Hawaii would be tough because the AVOIDed Emissions and geneRATION Tool doesn't have data in Alaska and Hawaii, so they contiguous United States because you can enter 100 cities in the Green Roof Energy Calculator. If you're not one of those one hundred cities, you could use a city nearby as a proxy because a lot of times, it's based on the weather data that is available and it's probably very similar even if you're not in that metropolitan area, so I would say, yes.

Katrina Managan: This is Katrina. If I could jump in, I would just note we did a lot of analysis to figure out and quantify the benefits of the original Green Roof and Solar Ordinance and our findings were actually quite different from what Robyn presented. I don't think the methodologies are all totally settled on these things. So if someone on the phone is doing that sort of analysis, I am happy to share what we did. We hired a third party Stantec as a contractor to quantify all the benefits of the original ordinance for us and land all the costs that also all the benefits and so and we have some different conclusions actually. So I'm just happy to share if anyone's trying to do that.

Robyn DeYoung: Yes, I mean that's a really good point. Thanks, Katrina, for saying that because what we've developed is something that it is using free tools, it doesn't have all the costs and benefits available. It's one place and there are probably many other ways to do it and so, it's not the only way. It's just one way and I really encourage people to investigate what makes sense for them. They might need more comprehensive analysis. They might want different information in terms of output. It just depends on the stakeholders need, so very good point.

Katrina Managan: I would note the big difference just for folks I thought your analysis is super interesting but just to note the big difference is that we found the green roofs and cool roofs have similar urban heat island benefits across all the studies and we found that the color of the roof doesn't affect energy consumption in the building very much. I think new buildings because they have R-30 insulation under the roof. It affects it a tiny bit but it doesn't actually lower energy consumption much in the building, according to all the analysis we did. So big difference from

your findings that suggest of note where I'm not sure all of that's perfectly settled.

Victoria Ludwig: Yes, thanks for that discussion, guys. I think you're both – yes, it's really true, at EPA we try to keep on top of the different science and research that's out there comparing different mitigation strategies and quantifying benefits and there are different methodologies, different opinion scientifically for sure and then there's also a big difference between I think the real test will be when you maybe start to measure the outcome of...

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Victoria Ludwig: ... for anybody who is on the line-- if you do a program you would want to try to get an after the fact measurement in the real world of how those green roofs benefited things versus modeling and all of the projecting that was done at the beginning. But very interesting discussion. Thank you, both. It is 3:30 here on the east coast of the U.S., so I want to wrap up by saying thank you to all of our participants for joining. We apologize again for the technical difficulties at the beginning. We will be sending an email very soon with the audio recording so that you can listen to this right away. Then after that, we will develop a written transcript including answers to the questions that were not covered today. We will post that on our website again with all the presentations. We will also send an email at that point, so you know when everything has been posted. You can also check our website for an announcement on that, get on our newsletter mailing list for an announcement as well as all kinds of other news. You can click on the link right there to get to our newsletter. Please check out our website and keep an eye out for further webcasts that we will be doing. When you click off the screen, when you exit out of Adobe Connect, you will be taken to a feedback form. We really hope you take two minutes to fill that out. We will read it and incorporate your feedback into our planning. I also again want to thank Steven Peck, Katrina Managan, and Robyn DeYoung for your time and expertise. All the professional experience you have, you were willing to share with our audience today. So thank you again for all the preparation and for being here today. I think that's it for me. I'm going to say thanks again and let Charlie take us home. Thanks, Charlie.

Operator: You're welcome. Ladies and gentlemen, this concludes our conference for today. Thank you for participating. You may now disconnect. Speakers, please stay on the line for a short post conference.

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