

Chicago's Sustainable Streets Pilot Project

Neelam Patel: Great. Thank you, Matt. I just want to, again, encourage people to send questions. We're running a little over, so we may not get to all the questions. But we will answer these in writing and post them to our website. So please do continue to submit your questions. And again, now we have our last presenter, Janet Attarian, from the City of Chicago. In her presentation, she will pull together all of the concepts that we've heard, both on sustainability initiatives, as well as cool pavements to help reduce the heat island effect.

Janet Attarian is the project director of the Chicago Department of Transportation Streetscape and Sustainable Design Program and works to turn Chicago's streetscapes, river walks, and pocket parks into great urban places. She's originally in the design and management of hundreds of public works projects, and her accomplishments include the City Streetscape Guidelines, the Wacker Drive reconstruction project, and the Millennium Park Bicycle Station. So I'd like to turn it over to Janet from Chicago to talk about some of the new programs that she's working on.

Slide 1: Title Slide

Janet Attarian: Thanks, Neelam. I know we're running low in time, so I'm going to try to go fast. So pardon me if I sort of glaze over some things. But there are some topics, I think that have been certainly well covered by others, so, I will try to go through that. Let's see – we'll change slide. There we go.

Slide 2: Chicago Climate Action Plan

Janet Attarian: So just to kind of give a start off for Chicago, we do have the Chicago Climate Action Plan. And that is a plan that very specifically addresses our mitigation and adaptation efforts to reduce our greenhouse gas emissions. But as part of that plan, we actually did do a detailed climate analysis of what might happen to Chicago in this region, given our current emissions and even what would happen in the lower emission scenario. You'll see here, if we actually were able to meet the Kyoto Protocol.

So you can see, that either way, we are definitely looking at increased precipitation and also increased – in the number of days that exceed 100 degree temperatures, both of which are obviously very affected by pavements or - and certainly needs to – pavements need to adapt to these kinds of conditions too. So we have both aspects. As mentioned, you know, having all these pavements certainly does have a big impact on our ability to infiltrate and on the urban heat island.

Slide 3: The Urban Form

Janet Attarian: In Chicago, just our roadways are about twenty-three percent. From what I have been able to learn from talking to other cities, that's fairly consistent in major cities across the country. It's about a quarter of the land area. And that doesn't include things like parking lots

and all that. It definitely gets more up to the numbers that Kamil talked about, the forty to fifty percent when you start to add in those numbers.

Slide 4: Adding to Urban Design Framework Plan

Janet Attarian: So what we're trying to do here in Chicago is we actually set up a committee to sort of look at all these surfaces. So not the interior of buildings, but the roof and skins of buildings, the sites around buildings, the public right of way. To look at all those things and see if we could come up with a comprehensive set of strategies to address them, and also, to look at all of our initiatives across the city and sort of see, you know, do we have barriers in place and so forth. So those were organized around air, land, and water, and quality of life principles. Obviously, a lot of the things we're talking about today fall on the air principle, although there's obviously lots of synergies here, urban heat island in particular.

Slide 5: Urban Heat Island

Janet Attarian: Again, this has been touched on, so I'll go quickly. But you can see when you map and these are – this isn't all the warmer areas, but these are those sort of worst areas where it's really bad, if you will. Sort of some of the imagery that Kamil showed earlier, in the city. And again, you can see that the grid is definitely showing up, and the other thing that really shows up heavily in Chicago is our industrial areas and our parking lots.

Slide 6: Urban Heat Island

Janet Attarian: And of course, the interesting thing is then to look at this with our canopy cover, and of course, see not surprisingly, the strong relationship between the two and why we need an integrated strategy when we're looking at these things.

Slide 7: How Complete is your Street?

Janet Attarian: So the way we sort of been approaching all of this, and I know this is a little bit broader than we're even focused in, but I'll drill down pretty quickly, is sort of in creating our own, if you will, rating system. It's nowhere near, you know, the complexity of a LEED in terms of that we design points and all that kind of good stuff. But, when we started thinking about this seriously back in 2004, we said, "Well, we don't have any of those tools." There's a lot more of them – sort of coming onto play and we said, "How are we going to start to organize our efforts? What does it really mean to have sustainable roadways, sustainable pavements, sustainable streets?"

Slide 8: Green Alley Program

Janet Attarian: And so we began to sort of come to these certain sections or goals, if you will, that we wanted to start to organize ourselves around. And you can see they're listed here, and urban heat island is certainly a part of that. And I'll talk about this a little bit more in detail, project specific. So about that same time we started thinking about our alleys. Our alleys in Chicago represent a fair amount of land area. They're about – five of them are midway airports.

So they're just – they are spread throughout the city. We have a pretty consistent alley system behind every one of our roads. We actually think it's probably one of the biggest alley systems in the – in the country.

Slide 9: Chicago Examples: Green Alley Program

Janet Attarian: And so it represents a lot of pavement. And it also is a problem for us because it doesn't actually have, for the most part, any storm sewer system in it. And so over time, we were getting a lot of flooding complaints, and we wanted to look at those – this problem, and see if we could solve it in a more sustainable manner than the way we had been, which is basically, rebuilding the alleys with the sewer system, you know, impermeable, often asphalt surfaces. So we attempted to do a couple of things. Obviously, our main goal was to look at storm water, but we didn't want to stop there. We wanted to look at the urban heat island effect and see if we could affect that by looking at the design of our pavement. We wanted to look at recycled content. We even wanted to look at the relationship of those things, to dark sky lighting, and improve our lighting. Because in Chicago, actually, we light our alleys just as much, if not more than the streets, which obviously ties into some security issues. But therefore, how we light our alleys is really, really critical to our energy use and also the quality of life, because all that light basically goes into everyone's adjacent homes and bedrooms and windows.

Slide 10: High Albedo Pavement

Janet Attarian: So we developed a number of materials for this. We developed permeable asphalt, and a permeable concrete mixed design. We built that ourselves. We conducted our own lab testing, sort of worked with local materials. We really didn't have that stuff regionally at that time, and so, we sort of had to, you know, invent the installation methods, the mixed designs. We did some innovative things like adding ground tire rubber to our asphalt, which was permeable asphalt, which is the first time that had been done. But we also created what we call our high albedo traditional concrete mix by adding slag and lighter aggregates to the mix.

Slide 11: Wider Implementation

Janet Attarian: We also included those things in our permeable concrete, to kind of see what those impacts would be, and you can see, in this chart here that we took some measurements. These were – these measurements were done about six months after winter, after they were put in. So we were pretty happy. You can see the SRI numbers for, if you look at that, Glenwood and the Harding locations. The lower one under the Glenwood and the Harding are both of our high albedo mix designs. And you can see the SRIs are above 29. So that, of course will get you a LEED point, if you are using this on a building site.

What's also interesting to note, though, is that the permeable pavement, even with the slag, the permeable concrete, even with the slag, still has lower numbers, and that is because of course, it doesn't – because of the sort of Rice-Krispie texture of it, it doesn't reflect in the same way, even though it still has some of those agents that – and really all the same materials. Of course, as we've discussed, there might be other offsetting benefits with the fact that it's permeable, has lower densities. Those things are a little bit harder for us to measure. And so that's actually one

of the things that we're still trying to work on. You can also see in this slide that I specifically said, we didn't allow fly ash. And not because we don't think fly ash in pavements is good, but because fly ash definitely darkens the pavement, and we wanted to avoid that.

So the Green Alley Program sort of really gave us the impetus and the confidence to start expanding what we were doing. We started using all of these materials, including permeable pavers, which were also throughout our infrastructure, permeable parking lanes, parking lots, parkways, plazas, all these kinds of things.

Slide 12: Maxwell Street Permeable Market Plaza

Janet Attarian: One of the next projects that we did was actually a streetscape project in combination with a local market that we have, weekly market. And what we did was we took over an adjacent parking lot, that was, I think, a little over an acre, and we again, didn't have any sewer infrastructure on it. So instead of doing that, we made it permeable. We used high albedo pavers. We put in a fair amount of vegetation. The slide you see here is before a lot of the seeding and stuff going in and very new vegetation. But sort of, again, combining those strategies to sort of maximize our benefit. One of the things we couldn't do in this parking lot, which you traditionally see, is trees in the middle. And the reason we couldn't that is because, every Sunday, it's got tents packed, and so, we had to maximize that space for the use of the vendors, and not sort of create obstacles with trees in the middle.

Slide 13: Market Plaza: Preliminary Monitoring Results

Janet Attarian: But one of the things that's really interesting about this program – this project is that it's one of the projects that we had been monitoring, actually, with the EPA, and I think this is a really interesting slide, because, while it's not directly related to Albedo, I think it does kind of go through this issue of how do permeable pavements possibly effect the urban heat island. And that is that we had temperature probes in the - underneath the pavers. One in the 2-inch setting bed, one in this 12 inches underneath that, and one in the 2 feet that was underneath that, in addition to a just an air temperature probe above ground. You can see the different lines there, and what you're seeing is that this past winter, even on our coldest day, on January 7th – or excuse me, January 16th, when we got to minus 7 degrees in the air temperature, even the temperature probe that was directly below the pavers, so in those first 2 inches, did not dip below freezing.

And so what that shows is that we're getting that convection. We're getting that more consistent temperature, because of the connection to the earth which, you know, stays at a constant 55 degrees, which is great for us in terms of helping us to know about all those kinds of things. But I think it also – it sort of explains why permeable pavements can help in other ways with evaporation and the ability for them to cool off quicker, and those kinds of things, or hold less heat.

Slide 14: Lawrence Avenue Streetscape

Janet Attarian: Some of the other efforts, of course, that we do is, you know, in marching along with things like the complete streets efforts, and contact surface design, we take a lot of streets that we have like this in Chicago, very narrow sidewalks, a lot of asphalt where we don't have even room for trees, and we do things like this. We're widening sidewalks, so we can add trees. We're adding bio infiltration swales at the corners to pick up water. And of course, mixing it with all of our alternative mode of transportation and all those kinds of good things to affect the urban heat island.

Slide 15: Lawrence Avenue Streetscape

Janet Attarian: But we're trying to bring more of this together in what we call our Sustainable Streets Program. And we have a pilot where, I'd like to say, pretty much threw everything in the kitchen sink at it, and so, you know, what would it mean if we have the equivalent if you will, of a platinum streetscape. I say that, as you can get in lead right, you can get the platinum rating. So we wanted to know what would a platinum streetscape look like. What could we do if we try to take advantage of everything we had, sort of, out there, post the technology barriers.

Slide 16: Cermak/Blue Island Sustainable Streetscape

Janet Attarian: And so we set up, you know, you'll see these are the kinds of categories that I showed earlier. And then, what you're seeing here is specific goals for this project that were set up in conjunction with those categories. And you can see again, there are some urban heat island issues here. But, really, the whole pavement technology affects many of these. And that's what I'm going to sort of walk through on this project on how we used these kinds of pavement technology techniques to effect our energy efficiency, our recycling, our urban heat island, beauty in community, alternative transportation, water management, all of these things, actually, are all being addressed through our pavements.

Slide 17: Urban Heat Island

Janet Attarian: So when it came to the urban heat island, per se, there were several strategies that we are implementing. One of them is, again, with our experience from the Green Alleys, using slag in our concrete mix. Another one is a microthin concrete overlay, over our asphalt. And the other one is using permeable and high albedo pavers, and with that, actually, putting some photocatalytic cement face mix to some of those pavers. And I'll talk about that more in a little bit. And of course, increasing our treatment canopy cover, and increasing our landscape surfaces as a whole.

Slide 18: Pavement Technology – Asphalt

Janet Attarian: So just a sort of step back, give a little bit of history on what we've been doing with asphalt, in particular, in the city. And several of these efforts has sort have been interwoven and some of these projects that I've showed you and what I sort of highlighted at the bottom is what's going into the sustainable streetscape project that I'm talking about right now. I think, some things to know is that we have piloted the warm-mix asphalt, pretty small-sized project. It was on one of the residential streets.

But, once again, when we introduced, you can see in 2006, with the Green Alleys, when we got the permeable asphalt and the GTR, that really sort of opened us up and we started trying a lot more things. We found that GTR is a great addition to a lot of our pavements, and we started adding those. You know, looking at the warm-mix, looking at our recycled aggregates. We tried the shingles this past year, which is very successful.

So we're trying to figure out what's the best technology, and push the industry, and also, it's a – it's a yin yang too, especially with the warm-mix, because, as mentioned – as Matthew mentioned, you know, until you kind of have a whole planet making warm-mix all the time, you know, how much of those benefits do you see? On the other hand, you're not going to ever get a plant making warm-mix if you don't start asking for it. So you know, how do we start that ball rolling?

So in this project, we will be doing a warm-mix asphalt. It's going to have a 15 percent RAP, and I was very interested to hear Matthew talk about the ability to increase RAP in warm-mix, 'cause what we are finding with our designs right now, is that we actually have to keep it down. So we wanted to bump that fifteen percent up, but we couldn't maintain the quality. So we needed to keep it fifteen percent. However, we could use the ten percent GTR. And then, what we're doing, on top of that, with the albedo, is putting the high albedo microthin concrete overlay on top of that.

Slide 19: Pavement Technology – Concrete

Janet Attarian: In terms of concrete, as I mentioned, we started off with the slag. But, some other efforts that we've done is to include recycled wash water, from the plant, in here, so we're saving energy and resources that way. We've also been redesigning our permeable concrete designs to better work with our maintenance equipment, and looking at that. And also, different ways of installing it, because it can be, especially in an alley, where we have very limited access, it can be very difficult for us to install. And so we actually did an installer with - putting the asphalt into an asphalt paver, which we got some pretty good results, very high strength, almost 2,000 psi, and still maintaining really high permeability. And then, on this project, we're going to do three percent recycled aggregates for the first time, and the recycled wash water, and the slag. So can we combine all those things together and see what we get.

Slide 20: Micro-thin Concrete Overlay

Janet Attarian: I talked about the micro-thin concrete overlay. They'll be over 100,000 square feet going in. The minimum SRI in our specification is 0.36. We're going to be doing some outer lanes on a very high (ADT) road. And we're also going to be doing a very large major intersection. I actually have a picture of that in a little bit here.

Slide 21: Integrated Infrastructure Design Example: Blue Island Cross-section

Janet Attarian: So to sort of bring some of these things together, and talk about how we're sort of trying to find those synergies in the design, to sort of maximize our sustainable benefits, this slide is a cross section through the Blue Island section of this project.

Slide 22: Photocatalytic Permeable Pavers

Janet Attarian: And what you're seeing here is that we've created permeable parking lanes and bike lanes that are created with obviously permeable pavers. These pavers have a high albedo surface, so they obviously help us with urban heat island. They are - also have this photocatalytic cement, which helps with air quality and also with some self-cleaning, to keep them, so that they remain with a high SRI, because, of course, we know, these things drop considerably with - over time. And so - and also, actually, this helps us with our lighting and our uniformity. And I'll talk about these things in a little bit more detail.

So this is a plan, and you can see, what's sort of highlighted in gray with sort of lighter brown on top of it. Those are the bike lanes. But that whole area, the gray plus the bike lane is the area which are going to have these pavers with the photocatalytic cement is going in a surface mix. That's going across the top of these pavers. And again, they will have a - start off with a pretty high SRI of at least 0.45. The manufacturer is saying we can get closer to 0.55.

Slide 23: Photocatalytic Cement in Pavements

Janet Attarian: The photocatalytic, we've done some testing. We developed with the manufacturer this mix design, and had it tested to make sure it really works. Photocatalytic cement basically is using titanium oxide to speed up the catalytic process that already happens in cement, to make it so that it essentially removes a lot of your organic and even some of your inorganic pollutants, and washes those away. So it has an ability to sort of, maintain its cleanliness and also remove some pollutants depending on the conditions of the air up to 8 feet from the surface. The other interesting aspect of this...

Neelam Patel: Janet?

Janet Attarian: Yes?

Neelam Patel: This is Neelam. I just - a quick - I just wanted to kind of message out to the audience. We are coming to the end of the time that we had allotted for the webcast. But we are going to continue on. I do encourage you, if you have questions, please submit them. We will have them answered in writing and circulate the answers to all the participants on the webcast today. And, again if you do have to leave, we thank you for joining us. But, if you can stay, please stay until the end of Janet's presentation and some of the questions and answers that we'll do when she's done. But if you're not able to stay, all these information will be available on our internet, and we'll send it out through the - through your e-mail addresses when you registered on to GoTo meeting. Sorry to interrupt, Janet.

Slide 24: Energy Efficiency

Janet Attarian: Well, that's OK. This is also helping with lighting. I know a lot of people are concerned about using reflective pavements, and that we might actually reduce the dark skies because, you're basically reflecting light back up. But what we have found is that if we use the reflective pavement, we can really then possibly lower our wattage in combination with things like going from high pressure sodium to white light sources like LED and metal halide, sort of taking advantage of the blue lumen argument. You know, using cutoff fixtures, using the white light, we can lower the wattage, and with the reflective pavements, we can kind of create – we cannot - not kind of, but we create a better uniformity, which is a very important factor when you're trying to make arguments for lower lighting levels, which here in Chicago, is a really big deal, 'cause we are one of the brightest cities in the country, when you look at it from the sky.

So we are also using that in combination. And that's why you see a lot of these pavements being specified in the outer lanes, because it really allows us to take advantage of this. And obviously, having those self-cleaning properties is also important if you're using it to help you with your lighting calculations.

Slide 25: Benito Juarez High School Water Feature

Janet Attarian: Another example of sort of pulling this all together, is one of the things that we're doing on this project is we're partnering with a renovation that's happening with a high school design here. And essentially, what we're doing is we took an impermeable plaza that they had between the old high school and the new addition, we made it permeable. We captured the water underneath that with a membrane. It all gets focused along with roof water, into a zero-depth water feature, then goes into a bioswale, and then if there's anywhere left after that, it could actually go over into their ball field and infiltrate.

I think what's interesting about this from a pavement perspective is, again, you're combining you're landscaping, your permeability, and these are all high albedo pavers in really trying to create spaces that are beautiful and attractive and educational.

Slide 26: Integrated Infrastructure Design Example: Parkway Bioswale

Janet Attarian: Another example of course is the – is the landscaping aspect of this, which is, again, being done in combination with the high-albedo asphalt - pavement. So this cross section you're seeing here, the car is driving on the microthin concrete overlay, the water is all going into an adjacent bioswale, which provides, obviously, large stretches of native landscaping, again, helping us with the urban heat island.

Slide 27: Project Examples

Slide 28: Beauty and Community

Janet Attarian: Another example on this project is at one end, we have this pretty much awful corner. It's a big asphalt parking lot. And we were able to get a quarter of that and turn it into a sort of cascading bioswale planter and add a lot of green space, takeaway some pavers, a pavement, and create a gateway to the area.

Slide 29: Education

Janet Attarian: Another aspect of this project, of course, is education. With all of these things, it's really important we explain what we're doing. We think this is really a fundamental goal of any of these projects. And so there's a self-guided walking tour as a part of this. There is going to be kiosk on solar and wind-powered lights throughout the project, which are going to be explaining everything that you're seeing, how it works. So there's a whole bunch of efforts in conjunction with this effort to explain to people, you know, what we're doing and why we're doing it.

Slide 30: Commissioning

Janet Attarian: Commissioning – this is often something people talk about with buildings more than roads. But we think this is absolutely critical, especially, 'cause we're in such learning phase right now, and trying to figure out all these things. So the Green Alleys, the Maxwell Street Project, and the Cermak/Blue Island Sustainable Street Project are all receiving a lot of monitoring. The Cermak/Blue Island is being fully monitored from a storm water perspective, after our MWRD. We've got monitoring wells, just a whole host of equipment in there.

Slide 31: Meteorological Station

Janet Attarian: But, these things are really critical for us to sort of find out, you know, what works, what doesn't, what's the most cost-effective procedures, and what's really going to help us with the overall life cycle. Some of the efforts on this project that specifically relate to pavements and urban heat island, is we installed meteorological station at this large intersection. So that's a picture you see of that Ashland/Blue Island/Cermak intersection as it currently is. This station is constantly telling us real world information about temperature, air temperature, the surface temperature. So right at the surface, you know, humidity, a whole bunch of other information, which is great because this is going to be one of the – this is the intersection that's going to be covered with that microthin concrete overlay. So we're going to be able to hopefully get some sense of the impact on that local microclimate, which is very hard to tell when you're talking about urban heat island on a specific project.

Slide 32: Air Quality Pre-Data Collection

Janet Attarian: We're also – in conjunction with the photocatalytic cement, doing air quality data. These are pictures of the data, we did preconstruction. And obviously, we'll be following up with that.

Slide 33: Maintenance

Janet Attarian: And of course, we've been doing a lot of monitoring on the maintenance of these pavements, because that's just critical. We don't want to throw them out there, and then have them not work. So we've been looking, as you've seen, albedo, SRI, been doing on-site and lab

infiltration testing, and run many different kinds of maintenance equipment over these kinds of things, to develop a maintenance protocol and sort of bring all of these together.

Slide 33: Contact Information

Janet Attarian: So that was a very fast version, but hopefully, we'll get some good questions, and maybe answer some things I left out. So thanks.