## Austin Heat Island Mitigation

Norman Muraya: Hello. Yes, greetings from Austin, Texas. Let me pull up the screen here. All right. So it's back on there and as far as taking control.

Neelam Patel: Yes, you have controls if you just want to put in slide then we can view your presentation.

Norman Muraya: Showing up on there?

Neelam Patel: Yes, it is.

Norman Muraya: Oh, OK. Excellent! OK, greetings from Austin, Texas, but those were great presentations. It's gotta be hard to recap this. I took a lot of notes. Let's jump in right away.

Slide 1: Title Slide

The first photograph I have here at the very top is thinking back on when life was simple – 1913 at the turn of the century, Austin, Texas had electric rail trolley cars and the powers generated behind the electric. That was before the century of carbon. Fast forward to 2007 – in 2007, we started our climate protection plan. At that particular time, United States was the most polluting country in the world. Texas was the most polluting state in the nation, and Austin was the capital of Texas.

We're very much concerned about the heat island, and what our future will look like. Currently, within the last two years, we led the nation in – the metropolitan areas in job creation, and the same time our population is doubling every 20 years. What does the future look like?

In Austin heat island mitigation, there're five different sections which are involved in those cooperative efforts. The first one is one I'm involved in, that's the Energy Efficiency Services. That's energy efficiency, and I'm also currently the benchmarking chairman for the LPPC, which is the 25$^{th}$ largest public power. The other component is the Urban Heat Island Initiative, and then we also have our Austin Climate Protection Plans started in 2007, and the Austin Green Building Program.

Slide 2: HI Mitigation Implementation

There are five different implementations that I'd like to take a look at for heat island. The first one is the Green Roof Advisory Council, and then the second one is the wind in terms of avoiding the engine heat through electric vehicles, thermostats and many other technological innovations.

And then the third component is when we drill down within absorb and use of solar energy, and this is different from buildings that absorb energy but they'd be ready to back. This is where you

absorb and take it out of circulation and one of the components is there – the one that Matt just spoke about, and that was on trees, and then the second component would be our solar roofing which at a million square feet turns out to have pretty significant impact.

And then the fourth component is our green building rating systems, and then the final on that will go to the actual cool roof, which is a reflective material and what has occurred here in terms of market transformation, in terms of our code requirements, and a few minor components which are still rebated through energy efficiency rebates.

Slide 3: Green Roof Advisory Council

The green roof advisory was started about two years ago, and I was also a member of this and what it seeks to do is try to make recommendations combining all of the city resources, bureaucracy et cetera in order to advance green roofs and, again, this is under the category of absorbing and using the solar energy hitting the metropolitan area. The biggest hurdle we had with this region of the country is the fact that our summers are very hot and dry, and so our main solution to that is the – using air-conditioning condensate water that the average single family home produces between 5 and 20 gallons of, and that's just being extracted out of the atmosphere and dumped right back into the ground without being utilized.

The picture to the right is our city hall which implements all the latest green technologies, and the condensate return there is enough to power the waterfall we have there, as well as some of the vegetative material, although most of the plants planted outside that you see are native species that do not require any irrigation.

Another bullet that they have within the arsenal is for new construction to allow for variances to energy and stormwater credits. In general, whatever resources they can put together to advance green roofs.

Slide 4: Wind Powered Electric Vehicles

The next component is wind power to electric vehicles. Austin and the state of Texas have a very high potential for wind, often is currently at about 12 percent. What we try to do with wind is we try to get vehicles to operate from that wind so that we do two things. Number one, we remove the engine heat from the grid itself, and at the same time, we also have less power being generated at the power plant, so that type of engine heat.

We started the National Plug-In Hybrid Campaign in 2005 at the aftermath of Katrina when we're the host of the World Energy Engineering Congress. We started the National Plug-In Hybrid and were the first city to sign off on it, and as you know last year electric vehicles finally hit the market. Austin has been an early adopter of that. We, currently, in 2012 already have 800 plug-in electric vehicles.

The chart that you see below shows that EPRI forecast for the Austin area is about 17,000 vehicles by the year 2020. That's an awful lot of vehicles that can be taken off the grid, use wind energy which predominates between 1 am and 6 am in the morning, as well as remove that load

from a traditional generation which in the state of Texas predominantly called. And again, I point out that electric vehicles do have option of using other resources or being able – being powered anytime, but that's where our focus has been is on the wind resource whenever possible.

Slide 5: Tree Folks

Getting back to the absorbing and using energy, we also have the Tree Program here which has been pretty consistently planting about 3,600 trees, and their main recommendation is the deciduous trees on the South and Southwest, and for this particular region in the county, that turns out to be up to 25 percent of the household energy. It's very significant, and at the same time, we also have energy closure – Energy Sale Disclosure ordinance which allows when you sell a property, you have to have an energy audit and show the energy use of your property, and so factors like that do actually help you sell your property. Everybody is forced to take a look at that during the closing ceremony.

The fourth component is similar to the City of Chula Vista where we have a shaded parking ordinance and that – for the new lots, you have up to 15 years obviously because trees take a lot to grow and our goal is 50 percent canopy cover, minimum of that has to be 80 percent native large shade trees and the reason for that is they survive things like last year which was mentioned by Matt was the hottest year in the Texas history since our recordkeeping in the 1890s.

Slide 6: Solar PV Roofs.

And then the final one is the one I really like and that's having a tree planted within 50 feet of a parking space. Solar PV rules – this is also under the component of absorbing and using solar heat. So what the panels do on the rooftop is number one, that they shade the roof so that the head does not enter into the – into the structure itself and have to be removed and then, of course, they generate electricity which means that the power plant use is also reduced as well.

In 2012, we're one of the leaders in solar energy, very aggressive program. We've got 40 megawatts – but I meant to explain that the City Austin, we also have our own utility Austin energy. In 2012, we had 40 megawatts of solar PV which is equivalent to 4 million square feet. Out of that, 3 million is actually outside of the city limit, but 1 million is actually within the city in both commercial and residential sectors.

And just to put that within perspective, our entire central business district is only 10 million square feet. Our goal by 2020 is 200 megawatts of solar. That would be about 20 million square feet. So this is something that was actually aside from the consequence for the urban heat island effect, but the fact that these panels are absorbing, you know, anywhere probably about 20 percent of the heat in keeping a lot of it from the structure, and so having a very significant impact.

Slide 7: Green Building LEED Ratings

And the final component of that is our municipal buildings owned by the city. We've got about 45 buildings with 80,000 square feet of solar PV panels installed.

Green building LEED program – with Austin Energy, we – the part that I want to point out here is that we actually quantify the savings from our green building rating programs. We're the first green building program in the nation, we started in 1980 and we're very active within the community, and again, the options are similar to what you heard from Chula Vista, that we require that 50 percent of the state landscape have vegetative material, or vegetative shading, and the other option is in terms of your parking. If you can have all of your parking underground or you can have structured parking and then have the top floor be reflective.

Slide 8: Cool Roofs - Austin

And then finally, we get to the meat of the program and that's the cool roofs program in Austin. The picture you see there is for our downtown central business district schools skyline, and the best solution that we have to offer is the white reflective roof, as well as solar panels also added on top of that in the mix, and what our program has done is we've gone from traditional roof in Texas which was about 5 percent reflectivity, black rubber membrane into over 90 percent, but long-term let's just call it 75 percent reflectivity, and the net impact has been coding that 100 percent of all new and existing roofs are required to be reflective.

And then right now, with our commercial rebate program, it's about 1.4 percent, it's a minor category with spray-on and that's the one that does not have to – is not mandated by the code. And then as far as the responses of the community, they've actually been a very good blend of technology and solutions and environment, and especially by extending the roof life by up to three times. The traditional roofs were too notorious to leaks.

The way this all started was – in 2001, we had virtually no reflective roofs. In 2003, we applied for a grant for the Texas Energy Office, and at that particular time, similar to what we saw in some of the other cities, we had about 40 percent of our land cover being just pavement, and then we also had black roofs which were traditionally flat-built roofs with black rubber membrane or asphalt on top. What this grant allowed us to do is essentially double the number of incentives that we're providing for projects from 15 cents to 30 cents per square foot.

The total impact was we did 262,000 square feet which is a 300 percent increase over the previous year, and then we went ahead and modeled this using the IPMVP guidelines and using DOE's program eQUEST, and the net impact at the end of the year was 180,000 kWh and 330 kW removed from our peak generation.

Slide 10: Code Adoption

The next page, after 2003 was in 2008, we adopted IECC 2006 with its local amendments and the local amendments incorporate the reflective surfaces, in commercial new, as well as both the re-roofs were required to come with a minimum 70 percent reflectivity. The exception to that was if you had a vegetative roof, if you have a rooftop pool, or if you had PV installed. We actually got a lot of support from the community, the new construction like this new technology

as I mentioned, the old roof were notorious for leaking, that's why roofing is the oldest profession and then they were fairly cost effective. The extra cost was not that significant.

The resistance we got was number one, in the existing reroof, the code was different. In the past, the code only enveloped new construction. This time it also dealt with any permit that needed to be pulled on the existing construction, so that was very different and that was a lot of growth pains in the community. And then the second one was there's a lot of resistance on the foreground reflectance, and that's similar to that photograph I showed you, where you have a higher rise looking down at a lower building which is reflective and saying that might be an annoyance to some of the tenants in there.

Unlike Chula Vista, we haven't made as much progress in the residential section. Most of the constructions roofing material here is composition singles which are very rough and non-reflective, and so we're still working on that particular aspect.

Slide 11: Roof Conversions

As far as the roof conversion, just exactly what took place is we went from a traditional black rubber membrane roof which was measured to be average of about 5 percent reflectivity.

Some of the roofs were balanced and those ones at least performed much better, and then the one went to as a white reflective roof minimum 75 percent reflectivity, and this was two different methods. One of them is the TPO cover that would be put on or simply sprayed on where you just spray the paint on top of the surface. With the TPO, what it consists of is you stretch a rigid insulation over it, and then you put a TPO stretch on top of it, it ends up having a very durable, very high-performing, very attractive roof and it's pretty easy to get a pretty lengthy warranty on those particular roof surfaces, and as I mentioned that technology has just – building owners have loved it and it wasn't even there 10 years ago.

Slide 12: Cool Roof Results

The cool roof results – we're very fortunate that the National Laboratory – Lawrence Berkeley National Laboratory actually came down here and performed the study for us and that allows us to be represent these numbers that I'm presenting to you with a very high confidence level, and what they measured was before and after, they took a look at the load, they took a look at energy consumption, emission, cost and try to coming up with an average building.

The reason they did that is we found out that the results are very much a function of, of course, the building type, how much insulation he have in the roof. If you have enough insulation it doesn't make much difference what you have below, the type of ventilation, the interaction of the roof and filling systems and then the air-conditioning itself – what size, the efficiency and the albedo on the roof material.

Slide 13: Roof Results

So here're the results – the great thing about some of these projects is it's highly visible and with the black rubber roof, what we sometimes would do is we would do part of our surface and then bring our clients so they could take a look at what is going to be after and before, and we'll bring a temperature gun and they could shoot the temperatures and they can see it's 165 degrees with a black surface and then when we put the TPO, it come down to about 120 and on the spray-ons – it's actually – the spray-ons are not as durable but they bring the temperature down to sometimes about 100.

So very visible towards a surface, someone can walk on barefoot versus one in which we can actually have an egg cooking on the surface. So that's a real visible sale of energy. Now, unfortunately, the energy savings are not quite on that order of 30 percent that you see on the high visibility and that's why I've shown this next plot –where you're seeing more or less closer to about 11 percent and, again, as we mentioned that's because you already had insulation and other things in between. It wasn't just a naked surface that was interacting with solar temperature.

The result from an absolute point of view, this was an average building that we chose for big bucks, about 100,000 square feet and the peak demand saving was pretty significant – about 14 percent, because the peak demand is when the sun is beating down and that's saved about 35 kW, and then the energy savings were quite a bit less, because energies over 24-hour period and over the entire year, and there was 11 percent but at the same time, the total energy savings were closer to about $800 per month, whereas on the kW, the savings would be about $500 per month.

Slide 15: Replication in other Cities

And with that, we come to our final slide, and I'd like to summarize, as well as to – if asked to bring together some points – if you will try to replicate this in other cities, this is what I would recommend. Number one is that the solution – there's no silver bullet. The solution is going to be multifaceted and continuous. The times are always changing, and you have to put all those different components in there to come up with a solution to keep adopting it and making changes as necessary.

The second one is code adoption. If you can get code adoption in there, then in our particular case, 100 percent of the retrofits are reflective. The third one is community and contractor education. You work with the community, want to get buy-in, and you do not want to force people do things that they do not or that they do not understand. In this particular case, we're very fortunate, once they understood what they are doing; they are very much on board with it. And then the fourth one is the official temperature readings by showing graph being an infrared or the temperature charts et cetera, the energy reduction is very visible and that's a big selling point.

And then the final one if you have incentives available, of course, that allows you to have a relationship work where the customers come to you and that makes the products lower cost, the vendors can sell with us well.

I appreciate the opportunity, and I think we can go to our question-and-answer time.

## Poll Questions #5

Neelam Patel: Great! Thank you. And before we do go to the question-and-answer time, we do have a poll question.

As Norman mentioned, addressing the heat island effect, cooling your community does need to be a multifaceted strategy. He talked about some cooling strategies that are being used in Austin. Which one of these cooling strategies are you most likely implement in your community, based on your local climate condition and also your local environmental priorities and local political priorities. And please remember that the applications of these strategies are very much dependent on the unique characteristics of each community.

So we just want to get a sense of what you would do based on – or what you could do based on what Norman shared from Austin.

And if you can show the result please. Great! Oh, the number one strategy that other folks might – be likely to implement is planting trees and increasing greenery. So that's very good to hear. So the Texas Tree Foundation, Matt did provide some good information on this. So hopefully that was helpful, and the other thing I'd like to acknowledge and clarify is based on some comments that came in through speaker – through participants.

When we talk about using green vegetative roofs as a cooling strategy, it's very important to consider your local climate condition. In areas that are drier, it may not be an effective strategy because of the energy required to maintain the roof but also because the rain roof medium. So the soil that is use could not only be an insulator to temperatures within the building but also could transfer heat to the building. And so, those are the things that do need to be considered on very local places. I mean it was very interesting to see how Austin was using the condensation from their air-conditioning units to water the green roofs. So again, you have to make sure you consider those factors in your plan.

And the other issue I did want to address is using solar panels for shade and Austin – this is use for shading parking lots or even buildings, and it's important to note that while you are deflecting heat from going into the buildings by shading the buildings or the parking lot, the solar panels themselves do generate heat from their process, the photovoltaic cells themselves do generate heat which then can heat up the air temperature surroundings solar panels.

So again, this is not to say that solar panels are – as a shading technique – are not a good strategy. The point of sharing that with you is to reinforce that you need to think about your local condition. So for example, if you are in an area that has a lot of wind or convection that moved out your air, then the heat generated by solar panels may actually be removed from your micro-climate – from your neighborhood or from your city. And so, it's important to think about some of the unanticipated consequences or effects from these strategies like green roofs and solar panels.