Cool Roofs

The following is a transcript of the Cool Roofs webinar. This webinar was presented May 23, 2011 for the Sustainable Energy Resources for Consumers project, which is part of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy.

Blaise Stoltenberg*:* Hello, this is Blaise Stoltenberg at National Renewable Energy lab. Myself and my colleague Kosol Kiatreungwattana will be presenting cool roofs today. Both Kasun and I are members of the solar and buildings section inside of the climate at the lab.

My background is I'm a mechanical engineer. I have focus in building energy efficiency and renewable energy technologies. I give assistance to federal agencies and solar projects and also to technical assistance projects and building energy efficient technologies.

Kosol Kiatreungwattana*:* Hello everybody. My name is Kosol Kiatreungwattana. Yes. As Blaise mentioned we are with the solar and building technology department and the registered official engineer in the state of Colorado. There's experience focusing on both energy efficiency and solar energy.

My experience over 15 years and I do the – all the technical leads and the technical assistance through – for the agency projects.

Blaise Stoltenberg*:* First of all, what is a cool roof? Well, when some lightening strikes a roof, the roof heats up. Looking at the picture in the right hand corner you can see the difference between a cool roof and a non-cool roof.

Looking at the white roof on the right hand side, you can see it's about 90 degrees compared with the non-cool roof, which is about 144 degrees under similar like conditions. Why would you want a cool roof?

Well, by the virtue that a cool roof is cooler it reduces air conditioning needs since the heat is not transmitted from the roof into the building. It improves indoor thermal comfort during the cooling season and also due to the fact that it is cooler, we believe

it is less heat derogation of roofing materials therefore increasing the service life of a roof.

Stepping back for a second and thinking of a larger view what cool roofs can do. It is estimated that if every roof in the world was a cool roof we can save over 24 billion tons of CO2 over the lifetime of a roof of 20 years which is equivalent to taking 600 million cars off the road for 18 years.

So, there's quite a bit of potential here. Next, how does a cool roof work? We look at two primary metrics or elements of a cool roof, solar reflectants, and thermally metrics. Looking at the diagram in the upper right, you see the sun strikes the roof. When the sun strikes the roof – the sun energy strikes the roof it is either reflected or it is absorbed by the roof.

The reflected radiation or solar reflectance is that fraction which is reflected. It's a scale of zero to one, one being 100 percent reflectance. Now, looking at the part of the _____ that's absorbed by the roof now your roof is heated up and the energy is now either transmitted into the building or through the roof into the building or it is readmitted or rerated its space again.

Looking at the second metric of thermal admittance, once again this is on a scale of zero to one, one being 100 percent perfect mirrors. For a cool roof, we like to see roofing materials that have a higher value or values near one for both solar roof reflectance and thermal readmittance.

Which means that either the energy is reflected or readmitted back out into space and not transmitted into the building. We also have another index called the solar reflectance index or SRI. This is a value that takes both solar reflectance and solar admittance.

You might ask why we need an SRI value. Well, there's some materials that make very good cool roof materials but are in very high need of either reflectance or admittance but are in low in the other values. So, this one metric takes the – both of these and then like a foil, which is high in reflectance but low in admittance which still can be seen as a good cool roof material.

Whereas, due to its slow admittance, it may not be considered if we didn't have the SRI. One other thing I wanted to make a point of is not all cool roofs have to be white or a light color. The upper row here is cool roof materials.

Visibly they look the same as non-cool roof materials directly below but as you can see by the reflectance values they are all very similar and very good in terms of cool roof characteristics. Now, I'm going to pass it over to Kosol to carry on.

Kosol Kiatreungwattana: We going to talk about the application for the existing roof and then for the new construction or the roof replacement. For the existing roof a typical application is for the roof cording with the cool roof.

Cool roof cording is contained the white or special reflection pigments that reflect the sunlight. The coding is similar to a thick pane that's reflecting the both outer wirelets. Preventing the chemical damage and also leaving some water protection as well. A typical cool roof coding is about five years.

We recommend that any roof that need a cool roof coding, you might consider towards the end of the roof but still have a useful light. So, once you apply and then it's gone about five years. The roof's ready for a new roof or roof replacement. A three typical roof cording materials, they are either going to be water based like a _____ or a solar based such as the silicone and both have a strong and then a weak application.

Or actually would be a pretty – a good pretty strong but it's less durable to the weather compared to silicone and urethane. Urethane is very, very strong but a little bit more difficult to work with.

For the new construction in roof replacement, we're going to go over a little bit but I'm not going to go in detail of each roof type. Because you guys are probably familiar with all these types of the roof. Two typical roof that we talking about like in terms of low slope or steep slope.

What's the definition of these – anything that I'm verifying 12 would be a low slope because they're low slope and anything above on that side 12 would be considered as steep slope. For the low slope you can see that the – starting with the single applied membranes this type is – either it's going to be a TPO or PVC membrane either or the EPM which is usually comes in the black color but it also can reproduce in white or cool colors.

The roof is contained the light color after that such as marble chips and also with the reflective aluminum pigments. Or the modified

sheet membranes have the protective cording that provide heat resistance, like resistance and fire resistance.

For the polyurethane forms, it's oddest this type of material that basically is corded and it's periodically recorded. And this type of cording that applies to this new roof preventing again the ultraviolet and the water damage.

The accurate is the pretty common application for this type of cording. For the steep slope, a typical that you might have seen a lot is asphalt shingles or other types of shingles with wood or polyurethane or metal.

So, for the asphalt shingles – it's usually like – it's not recommended for the roof cording so you need to replace with a shingle that will be effective type of shingles. It's not going to be a cording and it's recommended for most cost effective to wear them to shingles reach the end of the life before you replace the cool roof.

For the wood polyurethane and the metal then it can be made to be a cool roof specification. For other roof the most common is clay, concrete, and slate. The colors may not retain – maybe retain or not with the aging depending on the type of surfaces.

Selecting cool roof type that retains better surface properties can give better lifetime energy savings for the cool roof. For the metal roof, these metal roofs have better application on the low and steep slope roof. It's very often that is corded with full type of silicone for strength

There are many, many colors that can achieve the cool roof foaming. And usually like the unpainted might not meet the actual the cool roof on the both reflective and admittance but may be qualified for the SRI as another criteria to consider as a cool roof.

There are cool roof minimum requirements for this other program that's really quite popular from the CEC California energy commission from the lead green certification from DOE and the energy star. You can see that has identified solar reflectance, solar admittance, or the SRI solar reflective index.

And you can see this number has specified on board initial and then the three years that use the initial – some of the products that have been testing for as a new product and also they will evaluate the performance again after three years. That's what the three year numbers mean.

A typical most popular rating that you will see on the cool roof is the CRIC cool roof ratings council. This is the non-profit that they doing and they are testing the roof - cool roof product and lists the initial performance and the three year performance on their website.

Also, the energy star you can search through the product lists that qualify as the cool roof on from the various types of roofs and also the manufacturers. I will hand over back to Blaise.

Blaise Stoltenberg*:* Thank you. So, we want to present a couple of case studies here. The Florida Solar Energy Center accepts augment testing these products and actual buildings. They have found that many homes that they have tested that there's an average 19 percent reduction in cooling energy.

Looking in the picture here in the upper right, we have two homes that they use as test sites. They're less than a block away from each other, they're identical floor plans. One uses cool roof technology and energy efficient technology. Whereas, the other is a standard house for the area of Lakeland, Florida.

Looking at these two houses they found cool roof allowed a 76 percent reduction and overall summer heat flex. And also at peak times, the cool roof attic was 40 degrees cooler than the standard house attic.

Looking at a few of the economics of the cool roof, if you're doing new construction the cool roof options are usually similarly like costs or maybe a slight premium for the materials. The labor to install should be the same between a cool roof and standard materials since they are roofing materials.

If you're looking at cording as Kasun was mentioning, if you're cording the roof it's probably an addition to the roof and that can add significant costs. And you might want to do some cost analysis before you do something of that nature.

As far as maintenance between the cool roof and a non-cool roof should be very similar. There have been some concerns mentioned that in – because cool roofs are cooler, you do not evaporate moisture as easily so in moist climates or in colder climates moisture that sits on a roof may lead to some degradation of the roof.

Energy savings, in all the case studies we've looked at there have been an energy savings. There are rebates and incentives out there

but we encourage you to check these before you go do a project to confirm that they're still in effect and enforced.

Later on we'll see a website that we can go to check on those. A/C equipment savings, if you are replacing your air conditioning units when you're doing a cool roof or new construction; by putting a cool roof on a building you can reduce the cooling modes. And by reducing the cooling modes you might be able to downsize the equipment that – the A/C equipment and therefore see a savings from that downsizing of the equipment.

Also, there is reason to believe since cool roofs are cooler there's less damage to the roof or less derogation to the roof due to being – the materials being rushed less hot or less warm. This is the cable that came out of the guidelines that came out for selecting cool roofs from the Department of Energy.

Looking at installed costs, it can be about the same costs or maybe a little bit of a premium for the costs that might cost more than that in that regard. There are some rebates, I mentioned before here is the website where you can go to see what rebates might be available.

Those can help the economics to your project. Also, as I mentioned if you are able to downsize your AC or air conditioning units, then that can give you a savings or cost reduction in installation costs.

Looking at energy savings; if you're in the cooling climate you will see cooling savings. If you're moving towards the heating climate then you might not see as or less cooling climate then your savings will be less. If you are in heating climate you can pick a hit on your heating energy savings.

Which means that your heating energy costs may go up because you're getting less energy from the sun that is radiating into your house and heating your house.

Kosol Kiatreungwattana*:* And for this section, we'd like to introduce an online tool to calculate the cool roof savings. This is the tools that was doubled up by Oakridge National Lab and this is the web link that you can go receive that.

The program was reading and calculate the calculator that you can do the calculation for various locations and the conditions. And

the buildings – another assumption is the buildings are not – don't have the thermal mass in this calculation.

So, I did the – a simple showing the calculation for you. This is the assumption that we put into the model on the rate, the efficiency of the air conditioner, the type of the heating speal that we going to use for gas and then also with the costs of the natural gas that we put in there.

The heating efficiency is about 70 percent and the base line that we have – the roof installation about R5. So, once they put information in this model and run and see that energy costs savings, you can see that we did eight various major cities. And to show you what kind of savings that you can get.

So, this saving is normalized for a square foot per year, this type of savings that you can see that for the warmer climate, the cities such like Phoenix and Miami, you can see a significant savings.

There are two columns on each showing a net savings and the cooling savings from the cooling; you can see why it's not the same. The net savings a little or can be slightly lower than the cooling savings because of the – a time that ____ you might – for some of the other climates that needs some heating you are going to get a small penalty.

And it would be a lot more penalties for the climates such as in Chicago that has a less required heating energy. On this page, you can – we're showing that the cooling lows from the bad roof which is the baseline and then the cool roof; you can see the significant cooling lows reduction with the cool roof.

On this slide, it showing that with the same energy savings and it's same. Cooling savings you can – this kind of showing the equivalent installation that you have to add to achieve these kinds of savings from the cool roof.

So, you can see that a cool roof. By the way, we are not discouraging you to stay away from the installation to your roof but this is the idea that's showing you that the cool roof have a similar effect as you're adding the roof installation.

Blaise Stoltenberg*:* Okay. We have some conclusions here, we have lots of conclusions. I'll write some of these briefly. First of all, cool roofs do reduce clean load. If you are replacing you're a/c

equipment or its new construction you can potentially downsize the equipment due to less cooling load.

They do produce energy savings and produce comfort. They're most effective in warm climates or what we call cooling climates as you saw on the graphs in the previous slides where the largest cooling savings were in the warmer climates of Miami, Phoenix, and those areas.

Cool roofs can increase heating costs in what we call heating climates or cooling climates. We believe that it can also extend roof life due to less heat derogation of materials since they are cooler.

And also, in one of the last slides there some showing we can achieve similar savings through adding installation through the roof and such areas as like Chicago. We saw that it took a little bit of installation to achieve the same that savings in cool roof because of the penalty of heating and energy that we take in the cool roof.

So, if you're in a cooling or a mix climate or a heating climate, it might be good to look at compare a cool roof with adding installation into the roof or the attic.

Cool roofs will offset CO2 and reduce urban heat island on effect. Here are some references that we used in preparing this presentation. First of all, the guidelines for selecting cool roofs and is a very good resource for understanding cool roofs and looking at the different types of cool roofs as criteria.

Also, the DOE cool roof calculator was used to design some of the slides and comparisons between installation and cool roof and energy savings. And then we have a few more fact sheets and design briefs and also the cool rating council that actually does testing on cool roof materials and gives you the data on thermal admittance and solar reflectance.

And that's all we have for you today. Thank you very much.

Kosol Kiatreungwattana: Thank you. If you have any further questions, you can submit all of your questions to the technical support tab in this - through the website. Thank you, bye-bye.

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