Danish Toolkit on Energy Efficiency in New Buildings

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For more information, see the clean energy policy trainings offered by the Solutions Center.

Webinar Panelists

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This Transcript

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Vickie

Hello everyone. I'm Vickie Healey with the National and Renewable Energy Laboratory and I'd like to welcome you to today's Webinar that is hosted by the Clean Energy Solutions Center. We are very fortunate to have a great panel of speakers today who will be informing us on the Energy Efficiency and Buildings toolkit that was developed by the Danish Low Carbon Transition Unit under the ministry of Climate, Energy and Building. Next slide please.

Before we get started I just have one important note I mentioned before we begin the presentation and this is a little disclaimer which I'll read now. It states the Clean Energy Solution Center does not endorse or recommend specific products or services and the information provided in this Webinar will be featured on the Solutions Center Resource Library as one of many… that practices resources that are reviewed and selected by our technical experts. Next slide.

Before we begin, I'm just going to go over a few of the Webinar feature. For audio, you have two options. You may either listen through your computer or you can listen through your telephone. So, if you do select to use your computer, please select "My Speaker?" option which is located in the audio pane. And by doing so, this will eliminate possibility of feedback and echo. But if you choose to select to listen through your telephone, a box on the right side will display the telephone number and the audio PIN that you need to use to dial in. And panelists, I would just like to make a gentle reminder to you that we ask you to please mute your audio device while you're not presenting. And again, this eliminates the possibility of background noise. For all of our attendees, if you have technical difficulties with this Webinar, you may contact the GoToWebinar's Help Desk which is… the phone number is 888-259-3826 and they will be happy to assist you with any troubleshooting. Next slide.

For questions, if you would like to ask a question, we ask that you use the questions pane where you may type in your question. And if you're having a difficulty viewing the material through the Webinar portal, you will be able to find PDF copies of the presentation following this Webinar and I sent out the link to where the presentations will be located throughout the Chat function. So, you should all be able to see that link. Also, I'd like to let you know that an audio reporting, and again, the presentations will be posted physically in the center's training page within a few weeks.

We have an exciting agenda today prepared for you and this is focused on Denmark's knowledge and experience on how to improve the energy efficiency of new buildings and addressing some of the barriers state encountered in their experience and also the subsequent toolkit that was developed by the Danish Low Carbon Transition Unit. And as you can see from the slide, that we have a very impressive group of panels presenting today on this topic. But before our presenters begin their presentations, I'm going to provide a very short informative overview of the Plane Energy Solutions Center Initiative. And then following the presentations, we'll have a question and answer session and we'll wrap up with a little survey to get your feedback on the Webinar and we'll close with final remark.

So, this slide provides a bit of background in terms of how the Solutions Center actually came to be. The Solutions Center is an initiative of the Clean Energy Ministerial and it's supported through a partnership with UN-Energy. It was launched in April of 2011 and it's primary lead by Australia, the United States, and there are other sub-countries involved. Outcomes of this particular unique partnership includes four of developing countries to enhance one of resources and policies relating to energy access, energy efficiency, we have no cost, expert policy assistance that I'll speak to in just a few minutes and we offer a forearm for peer-to-peer learning and training tool including this Webinar that you're attending today.

The Solutions Center has four primary goals. It serves as a clearinghouse of clean energy policy resources. It also serves to share policy best practices, and data and analysis tools that are very specific to Clean Energy policies and program. We deliver dynamic services that enable expert assistance, learning and peer-to-peer sharing of experiences. And lastly, the Sandra Foster style of an emerging policy issue and innovation occurring around the globe. As far as our audiences, our primary audience is Energy policy maker and analyst from government. what… we also work with technical organizations in our country and we start to engage the private sector, NGOs and civil society. Next slide please.

Now, I would like to talk just a little about our marquee feature that the Solutions Center provide which is our Expert policy assistance. We called the service as an expert and it's a very valuable service that is offered through the Solutions Center. Healey have established a very broad team

of over 30 experts from around the globe who were available to provide remote policy advice and analysis to all countries at no cost. For example, in area of building and their fee, we have Cesar Trevino who's President of the Mexico Green Building Council and Jens Laustsen who's the Technical Director at the Global Building Performance Network. And these two are on our team of experts offering building efficiency expertise to those who request it. So, if you have a need for policy assistance on building efficiency or any other Clean Energy sector, we welcome and encourage you to use this very useful service. And again, this assist is provided free of charge to the requester. And if you want to request assistance, you may submit your request by registering through our Ask an Expert feature at cleanenergysolutions.org/expert. And we also invite you to spread the word about the service to those in your networks and organizations. And you can see here just some of the broad sectors covered by our experts which include energy efficiency, energy access, renewable and a range of other Clean Energy topic. Next slide.

So a couple ways if you want to know how you become involved with the Solutions Center, we welcome you again to request Expert assistance or tailored technical resources for your country or region, like you're doing today, participate in webinars and training activities and policy network. We welcome and encourage you to offer advice to suggest resources to share, to deepen our resource library that we have, and we also have a by-monthly newsletter and you are welcome and we encourage you to sign up for this newsletter. Next play.

So with that wrap up of the Solutions Center, I'd like to provide brief introduction of our very distinguished panelists today. First up, well actually, yes for a little be speaking in fact, but we do have Jesper Ditlefsen who is Head of Section at the Low Carbon Section Unit at the Danish Ministry of Climate, Energy and Building and he's also the lead author of the Danish Toolkit on Energy Efficiency and Buildings. Our first speaker will actually be Peter Larsen who is project manager of Danish Policy Toolkit and he's a member of the Low Carbon Transition Unit. And lastly but certainly not least is Poul Erik Kristensen who's the founder of the Malaysia-based IEN Consultants and he assisted on the development of the Toolkit. So with that, I'd like to turn the Webinar over to Peter. Peter, welcome.

Peter Thank you, Vickie. Hello all. I'm Peter Larsen. I'm the project manager, as Vickie said, I work on Energy Policy Toolkits. Now, we have part of the Low Carbon Transition unit which is under the Ministry of Climate, Energy and Buildings and based that the famous energy has agencies. Most of our work's all around providing technical assistance in the areas of renewable energy and energy efficiency. I'd like to give, first, a thanks to the Clean Energy Solutions Center for this opportunity to set our Toolkit and Energy Efficiency in New Buildings which I am a good colleague and lead, Jesper Ditlefsen, will present to you in just a little while. But before we get to work to use the… I would like to take just a

few minutes to let you know who we are, what we do, and why we do it. Next slide please.

These Low Carbon Transition Unit or just shorter just the LCTU is under today's climate financing and there's a continuation of these fast track financing knuckles that result got 15 trophy. The purpose of LCTU is to provide technical assistance to accredit the common use on multitude of issues that would make countries better equipped to rule out greenhouse gas production measures. It's all measures over the past sector and countrywide in relation to development strategies as such. In the LCTU, we work with issue across countries such as baselines, reduction potentials, policy toolkits and ions mechanisms. We assist Matthew Pelanka in greenhouse gas reduction measures and initiatives to involve and then arrange onto that for inputs and partnerships. And we take also a government to government approach in our lateral programs in Japan, South Africa, and in Mexico. In the bilateral programs, we are responding to highest demand locally and then tailor preference in lined with country-specific circumstances. Well, Mexico, as we've stressed the brokers will subject to final approval will improve silent South Africa, Vietnam on the way. The LCTU is just operated with first [inaudible][00:10:58] which is the reason why those delivered cupcake with a castle at the little right side of the slide just in case if you want to… whether we also hit at or something like that which will [inaudible][00:11:09]. But this is in portal to the same business of preliminary of work chores and pulling… wrap up this tool of much to one. So, please let us know if you see something that we can do better. Next slide please.

In this experience in Renewables and Energy Efficiency, we'll go 40 years back and we have greater chance could have been signified in two straight one, reduce consumption through energy efficiency and saving and to increase production of renewable energy. This is also a strategy for the future. And in meeting our main targets, I'll just share a few of our future targets with you. More than 35% of the renewable energy in our final energy consumption about 2020, 7.6% production in brass energy consumption by 2020 in relation to 2010, 34% reduction in greenhouse gas emissions by 2020 in relation to 1990. All electronic emitting from renewable energy by 2055, and 100% renewable energy and also interest by 2015. To us in the Low Carbon Transition Unit it is a mission accomplished when we're able to share our experiences and meet the demand with broad companies and in rebuilding countries. Next slide please.

These two are our first two toolkits in which we have developed. The one to the left is on the system integration. Along through Ryan is one who's going to present today, Energy Efficiency in New Buildings. We've chosen to set up on making those two kits available as they present significant areas within month has managed to develop an energy efficient systems that we feel has made a different underground. At the same time, if there is whether a significant and cost-efficient greenhouse gas

reduction potentials will apply. The two first toolkits represent just the Tuba Weisberg. We have quite a few altitudes get high burn pipeline all on wish list. The pipeline and wish list currently includes to… it's on the previous low emission development strategy process with "establishmental" work and climate commission and the later topic of 100% renewal energy in 2050. Another one on physical planning with Winpar which is going to be released very shortly. So, Botshky and financing between Par Energy Efficiency appliances and in business and industry, Energy and Efficiency in assisting buildings that's from union to translates a bit few buildings on the district heating and cook in ration of to adjust in heat, and also other toolkits that may seem to light up. They want at least a few… see strong demands from countries. So, if we find something, I'll update you. Next slide please.

And now, without further ado, I'm pleased to give the floor to my good colleague, Jesper Ditlefsen, who will give you a presentation of our Toolkit on Energy Efficiency in New Buildings.

Jesper

Hello, everybody. I'm speaker Jesper. I'm just a [inaudible][00:14:33]. I'm also a Nuclear [inaudible][00:14:36.3] Carbon Transition Unit in the Danish Ministry of Climate, Energy and Building. I should try to highlight some key points from basic experience with energy efficiency in new buildings. My first question, why would energy efficiency in new buildings be relevant? I'd be really glad we didn't know this already but let me just take you through some main points.

First, the effect that we'd become [inaudible][00:15:08] of energy consumption. In developed countries, it is often 35-40% which is actually more than any other sector and then there's a fact that existing margins in tonight's issue on saving something essential that's so called zero energy building already exists. They operate with supply of energy from sources outside the building itself. In other words, with technical saving potential the new buildings is 100%. This is a chance in virtually no other sector get a hold of the technology offers a possibility of such to even change. As you know, there is no such thing as a zero energy car, a zero energy in some implants or a zero energy commercial airline not even on an experimental basis. But as we said, zero energy buildings only exist. And if you don't want to mandate zero energy buildings right away, there's still a huge possibility to have a potential in simple and prudent technology.

As you will see a little later, consumption [inaudible][00:16:28] has been reduced by 80% since the 1960's simply because we have mandated the use of solutions that were already available. It's not rocket science and there's Poul next he'll show you something similar can be drawn in a tropical climate which is completely different from the Danish one. Much of this is cost-effective not only because it saves energy cost but also because it's mainly for costing power failure just likely and render investment in the extra generation capacity unnecessarily.

Several studies show that investment needed to reduce power demand in new buildings is significantly lower than the cost of building a new supply capacity of the same size. Another important fact is that low construction industries is local. For example, Denmark does not produce cars, foreign alignments or even washing machines. So when you need these kind of products, you simply have to buy or call in the companies who made it. But because buildings are produced locally, even a small country like Denmark has been able to set its own bandwidths. Cost is also needed for that Energy Efficiency in new buildings that tends to create the work of employment and there's no hassle. Most of widget of technology's necessary part is fairly straightforward. So, as soon as it's been marked, local production will be possible. And one more thing that makes Energy Efficiency in New Buildings a bio engine is a fact that most buildings have a long life-time, therefore, poor energy efficiency tends to walk consumption at a new aversely high level for many years. And without [inaudible][00:18:36] can cause [inaudible][00:18:39] Energy Efficiency is more complicated and much easier in getting at the time of construction.

Now, let me take you back 40 years to the winter of 1973 and'74. As you all know, this was the time when the oil price sore and made the world's economy suffer from many units. Denmark, in particular, found itself in a very uncomfortable position but 99% of the energy that tend to come through and running was reduced from imported fossil fuels. So, we dealt [inaudible][00:19:22] immediate concern with the shortage of supply but the shock also caught a severe economic crisis and high on employment. What you see in the picture is one of the most spectacular and immediate responses to the crisis, private cars was banned from driving on Sundays during the first winter after we tried to get… the car that you see in the picture is no ordinary car, it's the police on the lookout for offenders but as the saying goes "Never waste a good practice"… The event 40 years ago started on a path to much reduced fossil fuel. I'd repeat that this is the key to more renewable energy and energy efficiency. It would be more than less. As I suppose you might see the van I'm driving on Sundays which is not very much like the being less and less.

The slide shows how they used energy and boost energy consumption has evolved since 1990. And as you can see, the Denmark's economy has grown quite reasonably while energy consumption and emissions has been reduced. If you would allow me to brag a little, Denmark has the world's highest year of renewable energy in the existing generation that is 41% from [inaudible][00:20:49]. We also have the lowest energy consumption for GDP in all of the year. Importantly, this has not happened at the expense of the economic growth. In fact, Denmark has pulled ahead on major European countries like Germany, France or UK. Now, how can we do that? I think it was also mentioned by Peter for some [inaudible][00:21:20] renewable energy but can you taste the effects of energy efficiency doing more or less as I said before is just as important. Much of what we've seen so far was to do this and then we're also

planning to go on the past towards the immediate target which has been mentioned in the introduction and one area in particular has been all important for Danish [inaudible][00:21:51] as a title that was not suggested.

As you can see from the slide, the maximum allowed energy demand from the new Danish building has been reduced quite dramatically since the first circulation was introduced in 1951. In the 1960's the typical new Danish single family house consumed 350 kilowatts [inaudible][00:22:19] per year and per square meter of [inaudible][00:22:25]. As the latest major revision of the building code which has been enforced in 2010, this has now has been reduced to 63.5 kilowatts with an equivalent of 6.5 meters of [inaudible][00:22:45]. The requirement applies to energy for heating, cooling, ventilation and domestic hot water and what that means is that energy demand has been reduced by more than 80% since the 1980's. After having seen such a significant reduction already, we would like to think that it would be difficult to build a new product not only from technical point of view but also in terms of political, feasibility and public acceptance. But in fact in 2008, a big majority in the Danish parliament decided that the maximum limit must be lowered again in 2015 and 2020 as you can see on this slide.

Now, let's take a closer look at the 2015 and 2020 requirements. As you can see, we will once again be reducing energy demand quite significantly. In fact, by 2020, the consumption will reduce by another 68% quantitatively. As I said before, this is technically possible. Zero energy buildings has already did this and several has been completed and has been marked in other countries but what are the cost? Well, you may be surprised to learn that the cost is expected to be made. The building owners... the life-time cost of a new building is expected to decrease, not increase but decrease when a new regulation is implemented. Demand invested for the construction of needs highly energy efficient buildings is enough and is expected to increase if only by only a few percent but the return on this investment in the form of lower energy costs during operation would be sufficient to make it total life-time cost of these building to go down compared to present living.

In many cases, the life-time cost of operating buildings is five times higher than a construction process. So, of course, you need to get reduced operating process. This can often pay for a substantial increase in the construction process. This is attractive so some investors want to try it out already. And so, although this new regulation is not expected to take effect until 2020, there are already a number of new buildings which comply with the 2020 standard. The picture shows one example of such building. The kindergarten in one of Copenhagen's modern suburbs. And in fact, since 2006 when the daily imploratives began to announce future standards well before they will become mandatory, 10 to 20% of all new buildings have been built to future standard rather than community standard in depth at the time of the construction.

So, where do all these savings come from? Well, in Denmark we have a fairly long winter. It's not terribly cold, around 1 or 2ºC in average but in some areas, temperatures may go down to -10 or even -20ºC in particular in the night. Also, autumn and spring are quite cool so in traditional housing heating will required typically from late September to mid May. Therefore, heating has consumed most of the energy supply to the buildings. One answer to that, of course, is thermal insulation in the building. Requirements with regard to this were introduced already in 1961 and as you can see they were made much more trendy in 1979 after the [inaudible][00:27:24] and they have been amended several times that you can also see from the slides. In 1961, 18 millimeters of mineral wool will be required for example to comply with the requirement for room insulation whereas today 400 millimeters would be needed.

Another building component which is quite important is windows. They have also, as you can see, has been made much more energy efficient than they were in 1961. Already in 1961 we have problems glazing but since then improvements such as [inaudible][00:28:11] in fact didn't quite lessened the light, insulation of window frames, beds and ceiling or anything that can pull through. These things have gradually made windows much more energy efficient than they were back in 1960's.

Another important area is the air-tightness of the building has [inaudible][00:28:36] firmly insulation but simply the fact that the building was air-tight. This and the way we vented through the building so the pressure can go in a little so it didn't quite dramatically… The first major increase in consumption, you can see in 1979. This was simply because more and more thermal insulation updated the units and was needed also to let… the community will not get into ice insulation. So this vapor barrier improve the air-tightness of the building and therefore reduced energy consumption in that way. And later on, we'll see another big drop in 2006 and that is because heating probably became mandatory so much of the heat that was lost earlier simply by ventilating out was now being kept inside the building. In fact, heat probably was not been itself to be mandatory but the [] alone energy performance requirement of the new building has been tightened to the point where a heat recovery system was necessarily simply to comply with the old requirement.

The last thing that I'll show you, one of the last… one other source of savings is the heat source. You can see here what has happened with the… not the energy consumption but the energy wasted so you can use an old boiler, gas boiler, or a heat pump the efficiency of a boiled water is the most common way of heating homes in the 1960's. The efficiency was only about 70%. So, a lot of heat was lost simply there. This deficiency has been improved to the point where oil boiler and gas boilers had the efficiency around 100% now and the fact that [inaudible][00:30:49] which was more than we're using and we've had heat pumps which also has the efficiency of more than 100%. So, with the heat pumps you save energy so to speak.

So, as you've seen there is potential everywhere in the buildings. So the question, of course, is how do you return these potentials into actual savings. Well, as you probably all know, these promising instruments are [inaudible][00:31:22], financial instances and recreation and the last one regulation. In our experiments by far is the most powerful. When is regulation developers and builders need to decide how they can comply in the most cost-effective way but they can't opt out or ignore this issue. Another important feature is that regulation may overcome market figure that is if something is cost efficient it still may not happen for a number of barriers which may be rare and we call that market figures. And regulation, in fact, can overcome this. It can also make sure that the long-term cost-efficiency of investments in buildings is taken care of and this last thing is something which is nearly possible to achieve with other potential needs. And then there's one more part and that's regulation may in fact... we call it innovation. This may seem to counter intuitive but how can regulation and current innovation… but let me just give you one example from the very context on how this can happen. It is about windows that you might be… windows, of course, provide light which is wonderful in particular during a long dark winter. But traditionally, they have also caused significant re-process and that's as I said before space heating [inaudible][00:33:00] many year supply performance in Denmark.

So, an energy efficient window for this climate is one that minimizes heat loss and maximizes so that the gains that is the heat that you get for free and sunlight coming in through the window so you could see them. That's the background.

In 2009, the [inaudible][00:33:32] and Industry equipped on a new set of performance requirements which target this sign of heat losses and some gains quite expressively. As you may be able to see from the slide a new regulation set the limit on met heat loss at 33 kilowatt hours per square meter window from 2000 and onwards and this were dramatically reduced to 17… I mean, a loss of 17 by 2015 and then to zero by 2020. At that time, many in the industry expressed concern that it would be extremely difficult to achieve. But today, only four of it is latest. The best windows in the market are the ones that you can see up here. As you can see, they'll see the 2020 requirement by March. They actually has gained more than 25 kilowatt hours per year and then there is perhaps the most striking feature of this new generation of highly efficient window. They are growing marginally more expensive than other windows and these is more in compensation for private energy service in the market.

Now, we have already have seen a bit of technical information on energy saving and where that come from. Now, let me give you a quick overview of the history of efficiency regulation. The first one as I've mentioned has been in 1961 and that was only about certain information that was the first impression. And as I said before, at that time 18 millimeters mineral wool will be required for getting information. For example, now it's 400 millimeters. Already at 1961, they also have a requirement on insulation

of windows. The requirement is so called [inaudible][00:35:31]. In fact, this meant that double glazing was mandatory. From 1979, we had our first requirements on insulation, second is insulation… First on heating and then the insulation and then later also in lighting and cooling. And then on 2006, we had the first requirement on overall energy performance. Also, in 2006 we had the first requirement on air-tightness. As I said before, the vapor barrier in itself providing more air-tightness in 2006 which was specified directly into the building of what time the air-tightness would be expected from the new building.

Now, I would like to touch on a few key issues with regard to the experience we've had. First, the [inaudible][00:36:37] of the building's corridor energy efficient is somewhat contested there. They are trying to involve [inaudible][00:36:46] requires the one with a comprehensive setup even if the actual tech relations was performed by standard or any other software in Denmark and in other countries which has a similar setup. This capability has been built up over many years. The foundation of this is specifically [inaudible][00:37:10] with regard to building indoor and insulation switch as you have seen where you can dwell before the overall energy performance calculation. So, in following them, well implemented basically requirements… our three pre-requisite for central use of an overall performance approach. Even now with the overall performance in the daily course have not stand alone. We've been supplemented by detailed requirements on building envelope and on insulations. So, why would… performance approach invites innovation and possibly some solutions of detailed requirements ensure that no part of the building's energy performance is neglected. In particular, requirement on the building are important. First, while technical information may have a life-time of 20 years or so, the building envelope remains in place so much longer than that. And secondly, those sayings provide it to building envelope. They tend to be lowest [inaudible][00:38:25] and then there's a cost issue.

Developers and building developments tend to be concerned mostly with construction process. So, regulation is a way to ensure long term cost businesses. This assignment nearly has been an important for the circulation. Glazing alone was mandated the efficiency simply to kickback time significantly longer than what the market provided by itself. As you saw on the window sample, this can increase the basic innovation and bring all of efficiency sooner and also much cost than [inaudible][00:39:10] as we've seen this many times. Another way to boost innovation is to choose option extra hard performance level which reflect the standards. For lack of a better term, you might call this premium options that we got through regulations. Since 2006, the Danish Corp has been providing builders with a choice between three different performance levels that are mandatory. Minimum standard too pass through such premium options. This credibility from the notion that options with higher upfront costs are better and more usable and it actually

seek to inspire people to do more although as I said before, the Danish minimum standard is probably the world's most stringent. Since we reduced this premium option thing in 2006, 10 to 20% have been on construction projects have chosen one of the premium options and it doesn't seem to matter whether the project owner is a private individual, a company or a public institution that has been premium project [inaudible][00:40:27].

Now, the last thing is how the regulation would work. As I said before, that is simply what we can do and now we have mandated a solution that we're [inaudible][00:40:43]. We want to make sure that your regulation keeps up with the technical requirements. So, to sum up with potential for energy efficiency in new buildings is huge and is cost efficient. But as I also said, different kinds of market failures may mean that this potential is not converted into action [inaudible][00:41:15]. Regulation, in particular, regulation is a way to overcome this. And as you've seen, it may actually make some other innovation that makes energy savings come somewhere and to a large extent that you're not expecting. So, thank you. Now, my colleague Poul, will share his experience with energy efficiency in a complete plan. So, thank you.

Poul

Good morning to you all or good afternoon or good evening wherever you are in the world. It's nice to be with you all. I am Poul Kristensen. I have been working and living in Malaysia for the last 13 years. It was a long time and I've been in the group there where we have been developing energy efficiency and main building design of the new buildings and I want to share to you some of our experiences from this climate. The main building is energy efficient in the tropical. The climate is very much different from any other climate. It took me some years to understand that and the appropriate architecture's different and reducing energy consumption for cooling is always the main issue and basic heating is never an issue.

And here the energy performance in this slide… the energy performance of the three office buildings in Malaysia that we start with… they were built over the last 10 years to showcase that energy efficiency in new buildings is technically financially feasible. The energy index is here as what I just mentioned measured in kWh/m^2/year. And for the three buildings, the energy index is here compared with data that were collected for typical office buildings 41 in Malaysia and 95 in Singapore which Singapore having more or less the same climate as Malaysia and also having the same building traditions. We have a fortune that we were acknowledged by someone as a Malaysian host for the issue… a small series of steps in energy efficient buildings and this… we call this our Stand of Approval which you will see here. Let's go to the first building that I started my work with in Malaysia that's the Low Energy Office building [inaudible][00:44:13] technology and water. It has been the new state capital of Putrajaya outside Kuala Lumpur. This slide shows the important energy performance data for this first series as an energy

efficient building and this project as was mentioned receives support from Denmark through the so-called [inaudible][00:44:35] that developed an existence that supports to cover the export or consultant on energy efficiency working well with the Malaysian chief of art as mentioned in the subsequent presentation.

The four most important areas in energy efficiency in modern office building in the tropics are illustrated in here in the bar charts. And again, energy efficiency is measured in kWh/m^2/year and for each of four areas three performs standards as illustrated. First showing red is the worst one in the market which unfortunately is quite simple for the building square. Initially [inaudible][00:45:20] to the minimum by the developer. Next is Base in gray where the assigned [inaudible][00:45:29] that some basic configuration from energy efficiency has been made. And last, the green one which is the actual phase of the… the office building or the new building the actual performance of that building in Malaysia.

The first coverage area is fan energy often overlooked. The fans are always used to pump cool air into the building so we can both cool down and to humidify the building. And in the worst case, this consumes a lot of electricity, actually, up to around 70 kWh/m^2/year. However, with optimal cases we don't strain with a little building. Electricity full of fans has been reduced by down to 10% of the work phase. Small power is another important electricity consumer in the building although not directly connected to the building design obviously but small power is one of the few friendliest [inaudible][00:46:32]. It's very significant to today's office buildings where a person just have a computer and using the best computers such as laptops instead of desktops makes a big difference here. Okay next is lighting. Lighting is a major energy consumer in modern office buildings and I will illustrate later in more detail the use of daylight and that ideal energy efficient lighting can make a big difference in using the energy consumption to a low level [inaudible][00:47:06]. And last, we have the cooling load and the reduction with energy consumption is fast and slow power. Lighting also reduces electricity consumption only simply because it is consumed in the backyards because all electricity bouncing inside the building also end up as heat and is being thrown out by the cooling system [inaudible][00:47:37].

So, using the [inaudible][00:47:43] situation but we also reduce energy consumption. Now, in this case in Putrajaya, the capital where the new building is being built. Now we have our district cooling and each of the building does not have to pull out their own cooling fan. However, if we have also in this project we had to fulfill in to put in a very efficient chiller, energy consumption for cooling would have been reduced even further that's illustrated here and showing here and as shown and we assume that the rest should be updated.

Next slide, those are a little bit more on the energy efficiency for ventilation that is the electricity consumption for the fans of the ventilation

and the other systems in office buildings in the tropics. This is an area that is often… always even not considered. If you don't see it in the building [inaudible][00:48:47] units and this is slightly used so we can actually achieve this very significant reduction and consumption here in the actual building here in the new building. First, the size of the ducts have to be… we have to increase it so we reduce the pressure loss of the duct work and this is something that is very small in investments. But again, it [inaudible][00:49:16] both primer of the developer… they would reduce the size of the ducts.

And then further on, if we look on the electricity for the fans and motors, it is further reduced simply because by choosing the best of the best on the market that we now have used in many years we're getting very efficient fans and also very efficient motors. And this again, is not really an expensive investment but it's the first cost of the key parameter then this is not considered.

Finally, we have to look at the controls of the fans. We should operate the fans so that the pressure is delivered always at an expert level and what is needed to cool down the building. This illustration on the right actually shows the variable speed drivers. You will not understand but I can be operational. The fan that [inaudible][00:50:23] for controls. The illustration shows the operational frame in the new building from in the morning where 100% of fans are needed until late afternoon and only for a third couple hours would they need that in full power. Later on, the electronic controls that use the fan speed down particularly to around 40% and it gives each junction [inaudible][00:50:44] this part of creating the air pressure. In conjunction reduced even further down on the ranking.

This diagram illustrates the key object that features that use energy consumption in the second building [inaudible][00:51:03] office building… well, mainly on the office building of the new building. The aim of this returning project… it's really was more a research project… It wants to achieve a zero energy building the fact that [inaudible][00:51:18] previously in this building. And so, in order to achieve that, we have to make the building solar energy efficient that by covering this where the office PV on the roof then it would be a zero energy building. We really have to put our focus on the [inaudible][00:51:39] bring down the energy consumption for lighting over the building. So, in this building, this has been designed to be [inaudible][00:51:49] during daylight. This is one of the big advantage of finding the… [inaudible][00:51:57] including day time every day, every year not like here in Denmark while in Europe where it's very cold and dark after a few the years. So, you'll only have to bring the light into the building without bringing in the excessive [inaudible][00:52:13] longer and even… it's important with the tropical sky being always having a very high illumination level. We have to bring in the light without causing discomfort to those are working there. The very issue is when often we lose that. It's like almost always in the provinces. When they visit there is that the wind is our most powerful bind

and all the saving systems [inaudible][00:52:45] and therefore they always have to leave the lights on all the time.

This time, we'll design the windows so they're only through the North and South so we can see that we have a very small overhang. This means that we will never have [inaudible][00:52:58]. And then we take glasses [inaudible][00:53:01] which is much more safer in tropics and here we have added the [inaudible][00:53:10] which actually reflects between slides up into the ceiling and thereby it bounces further back into the room where… it's really why need the daylight. And also, these slides serves as a shade for the lower part of the window or the division window that [inaudible][00:53:29]. The fixed blinds you could see in front is mounted in front of the… On daylight, windows… the other ones are very crucial because they have an angle so that direct view of the clearest sky is put off 100% at the back of the room but still obviously around the building.

And in this building, I have to say we have achieved what we said up to do to make it [inaudible][00:53:54] during day time. The electricity consumption for lighting in this building is actually 98% down from [inaudible][00:54:03]. There's also a bit of an illustration here where you need thermal insulation in the walls in the room especially in the roof. Thermal insulation, we need that in the roof. So probably buildings with [inaudible][00:54:16] roofs get on but in [inaudible][00:54:20] that should not be involved because of the differences. It's not that thick compared to [inaudible][00:54:24] in Denmark.

The one… this is the illustration of a new type of glazing that is very suitable for any part of the world. The glazing that's… that's invincible light that reflects infrared and ultraviolet… the ultraviolet part of the light spectrum. So when you get the light into the building and will maintain [inaudible][00:54:53] because the glazing actually looks like… it looks clear to us but we do not have the heat part of it. Daylight reflection [inaudible][00:55:05]. This is a so-called Spectrally Selected Glazing or its more popular term Solar Control Glazing. It's important to understand that this is not the same as [inaudible][00:55:17] glazing although we made sure that we use in multiple fragments to achieve… to have a glazing that releases as little heat as possible to the outside. This glazing has an invincible… floating inside that's heat-block like unit and both has exactly these desired characteristics of reflecting the heat. The only part of the daylight spectrum [inaudible][00:55:43] but we know when to hit into it.

The challenge was only from solar glazing that is really not readily available in all parts but it's actually coming out equally. It's produced in China and in India and when the market is there [inaudible][00:56:00]Southeast Asia. In office buildings, glazing we often use one for [inaudible][00:56:11] energy consumption. Basically, electricity consumption can be reduced significantly by the use of modern energy efficient lighting. And in this diagram you can see the efficiency of various light sources, efficiency here is measured in watts of electricity

used per lumen of light delivered. So, the lower the better. Incandescent lighting and halogen lighting are the first to buzz. It had been used but I think is obviously is not very efficient and the last marked electricity consumption is consumed for very little light delivery.

Also again, all efficiency consumption end up with heat and that will promote the chillers to work harder so we really [inaudible][00:57:02] basic consumption of lighting. Now, as you can see the fluorescent lamps [inaudible][00:57:10] lamps, compact drawers are all normal. Tubes, they are a lot more efficient and actually now they are the [inaudible][00:57:19] by the LED lights that are coming out this way. But let's have a look at this light source that we have outside all the time at least in the tropics everyday all day. Daylight. And if we look at the thermal efficiency of daylight, we need to say how much we do get for how many lumen of light. Again, we don't want the heat. It's actually better than any electric light source. Here's by daylight is very efficient. So if you get light from a blue sky exactly the… it's a very cool daylight.

Now, I mentioned before this Spectrally Selected Glazing and the light… daylight will get through Spectrally Selected Glazing is without any heat and we can say that there's a thermal efficiency that is on parallel to the other light sources. Here, I've put in this diagram amongst the daylight sources. I put in the LED lights. This could be in coming years. LED lighting has gone through a very rapid development and the prediction is that in another 5 to 10 years we will have efficiency as shown here but… so, this is really intended to be a light source of the future but again daylight is obviously the way you go when you can do it with an option to rule something.

Now, here in the second last slide, I want to walk you through the Energy Optimisation of the first building we did the so-called Diamond Building. You will see on the illustration the Diamond and I will illustrate the important text regarding general consumption in the office building in the tropics. First, we look at the so-called passive design bleachers related to architecture including making the building more air tight. You will see that we used integration. It's coming in to the Day's building Health, a very important in the tropic because the air outside is always hot and humid and those are the tendency on the chiller to prevent too much hot and humid air inside the building. The next one is to use the heat days through [inaudible][00:60:00] and in particular the important thing here is to use the radiation through the window areas up here and we will change it to review these very efficient [inaudible] [01:00:18]. They don't have anything. It's simply to make the lighting without the heat and to make the lighting without glare, as I mentioned before. In this case, we're having a reduction of energy consumption for light from around 50 percent. In the diagram, you will see that it uses power in an index of 126.

Now, look at the same pictures. Now, we still have a light in those, 10% lower but if we would like the best of the best energy efficient lighting

here, we can get the one step further down. In this case, if we have restored the lighting – very efficient so-called T5 tubes and we will use the electricity consumption for lighting. We would further prepare to - normal tradition – traditional tubes. Energy-efficient as I mentioned before, another step down, as I mentioned before.

The step 4, reducing the fan load, it's not so great as it was before because I that brings me to the next reduction core cooling, where we're down to seven feet. With this statement, we have applied a new cooling system in the tropics, probably done once before, it was the research Project. As far as the cooling, we have installed the pipes in the concrete floor slab so we get the cool – let's say, the sensitive cool low followed by cooling rhythms from the floors and from the ceiling.

Since water is a much more efficient media to transfer the cooling [inaudible] [01:02:07] thereby we reduce electricity for consumption for pumping the coolants into the building significantly. So somehow it's much lower than to vent out the [inaudible] [01:02:22].

Then, having implemented the active design features, we then cover the roof with solar PD, making it to see on the slight east landing part of the roof. There is actually the light areas there, solar PD areas. Now, the reduction is there but again, it would illustrate the main feature about the use of energy consumption if they look - we have to look at the passive-active design. And once that [inaudible] [01:02:56], that we might want to apply renewable energy to that. Renewable energy is not merely solar PD. It shouldn't be your first option.

Now, we're down to 65, figure out it's right here. This is actually confirmed energy consumption of this building the design plan with active 85. So we will be quite happy if we manage to get even further down.

Now, this is also an additional cooling area so I think we have the opportunity to get the best of the best dealers and they are now becoming very good. We could have gone either further down to around 50 which means that we will have to use 75 percent down from a normal building.

Then, I want to focus the last but not the least on energy management, because you can bring your [inaudible] [01:03:46] further down but normally, the latter end of that means that something's working much higher. We saw that from the new building, the first building we've been with, when that building was put into use. We decided that the index was a hundred but we actually decided to have an index of 160, to make it higher.

Energy management then – we are concerned about the actual fine-tuning and commissioning of the building, we brought it down to a level where it's now 100. But we'll be done building here, the penalty for no energy management it's sort of low or it could be significantly higher. So, energy

management is important, very important. There's no reason to have an energy-efficient building [inaudible] [01:04:41] because then you lose it all. Obviously the key features on energy management, lighting, fans, cooling,[inaudible] [01:04:47] every management [inaudible] [01:04:53].

This brings me to the last slide of my presentation and I want to give an overview of the actual economic feasibility of inefficient buildings [inaudible] [01:05:10] Malaysia and also some from Singapore, Thailand. Based on these three buildings we have here, the low-energy office building, the first building for the ministry, 50% savings and actually only [inaudible] [01:05:25]. The [inaudible] [01:05:26], the experimental building where we were very ambitious, in fact, savings at 25 percent the extra cost, so, we're not saying that this is all cost-effective now but that building has given us a lot of very interesting results and some of them are being implemented in real buildings now, for instance, the very successful [inaudible] [01:05:46].

The diamond building at [inaudible] [01:05:50] 65% savings and only 4% extra costs. You always [inaudible] [01:05:57]. Okay, in Malaysia, we're talking about [inaudible] [01:06:05] about three, four, five years. Now, I want to show you just one example,. It's a very new, fresh example. It's a new corner office, it's an international company that is being built in Kuala Lumpur. High rise building as you can see, it's part of a larger development plan of a Kuala Lumpur agency. The data here tells you that we were not able to improve them in the toolkit, but they are very interesting.

They will illustrate one – see, you need [inaudible] [01:06:41] energy efficient causing the problems but also anywhere else. So that's the reason why we chose to take Malaysia. Now, this building is also interesting because this building is the – actually, an office tower and it will later on be used by the city council. So it's – it's interesting because in Kuala Lumpur City, they will then be in a very energy-efficient and very green building. And the index is 105, 50% down from critical and we are going to focus on this that here, we have quite a lot of glazing in this building and the extra cost for the dollar, solar-controlled gauging, the best we could get on the market. This really US $1.2 million, excellent compared to [inaudible] [01:07:40].

However, because we managed to optimize this thing from the beginning, we – the computer monitoring, we evaluated how much can we save on the investment cost for the chiller now we have learned [inaudible] [01:08:02]. We do not need to install such a big chiller, and the actual savings just on the chiller is 0.58 or almost 50 percent of the extra investments integrated. So, that is a crucial conclusion on when you want to make energy-efficient buildings that are also cost-effective, you really have to optimize both the architecture and the engineering part in an intervening process.

So, the conclusion here is, integrating new design with [inaudible] [01:08:37] is extra costs and it improves economic feasibility. And I'll finish off with saying that, the challenge is not so much the technical challenge here. We've shown that this can be done. This is technically, economically feasible but the challenge is to turn a deeply conservative building sector around us like turning around a huge tanker takes time but if it can be done, that's where we need to go. Now, I'll finish off my part and I will turn it off – turn back to Mr. [inaudible] [01:09:14] who will give some final remarks on the experiences with the [inaudible] [01:09:22].

Male Speaker 2 Hello?

Female Speaker 1 Hello? Are we turning over to [inaudible] [01:09:42] again? I'm sorry.

Male Speaker 2 No.

Female Speaker 1 Thank you.

Male Speaker 3 Hi, this is [inaudible] [01:10:04]. I think we're ready for the Q&A so now, let's [inaudible] [01:10:08].

Male Speaker 1 Yes, [inaudible] [01:10:19].

Female Speaker 1 Okay, we're ready for Q&A. Heather, I believe – is that right?

Female Speaker 2 Sounds like it. Go on ahead. Thank you.

Female Speaker 1 Okay, great. First of all, we're received several really good questions from the audience but I'd like to remind those of you who do have questions, if you didn't hear my introductory remarks, if you do have a question you'd like to submit, there is a questions box or questions pane located on the right hand side of your screens. So feel free to present your questions through that mode and I'll make sure we get those questions over to our panelists. A real quick question – thank you, all of you, just Jester and Peter and Paul for those great presentations, they're very informative.

Again, I have several questions and I'll just start with the first one that came in which is, how do you improve building thermal insulation?

Male Speaker 2 I think – can you hear me?

Female Speaker 1 Yes, we can hear you. Thank you.

Male Speaker 2 Okay. Well, how do you improve building thermal insulation there? There are several ways –the simplest way is to fill in more of it and that is what we have been doing for so some extent, as I said, 18 millimeters of mineral [inaudible] [01:12:10] enough to comply with the 1961 requirements. And today, you would be informed the details that you wouldn't have typically.

Also, of course, at the same time, there had to be improvements in the integration with materials. You can now get polyurethane insulation which gives more insulation for this thickness than for example [inaudible] [01:12:45] or EPS polystyrene. But I think that the biggest difference say 20 or 40 years ago, thinking back, the thickness is bigger today than it was then.

Female Speaker 1 Okay, great. Thank you for that answer. This next question is pretty basic and simple but I think it's a good one. Does the term "tool kit" refer to the set of energy reduction strategies that have been identified and proven effective?

Male speaker 1 [Inaudible] [01:13:31]. Well, the tool kit is [inaudible] [01:13:40].

Female Speaker 1 We're having a difficult time hearing you. Can you speak a little -

Male Speaker 1 Can you -

Female Speaker 1 Yeah, we can hear you now. Thank you.

Male Speaker 1 Perfect. I was [inaudible] [01:13:58] the one we use and is designed for this experience, [inaudible] [01:14:10]. So, we use it as a term to communicate our [inaudible] [01:14:19] and our recommendations and the reservations that we would like to pass on, building on our [inaudible] [01:14:27] experience in this area. We have actually some positive experience which we would like to speak about first and foremost, and we've also had a complete [inaudible] [01:14:42] challenges which are [inaudible] [01:14:49].

Female Speaker 1 Okay. And we did have a little bit of difficulty hearing you so I may, if that's alright with you, return this question to – if you could answer it to me by email, I'll make sure it gets to the person who asked the question – to make sure we picked up everything that you were saying so, anyway – but based on that, I'll move on to the next question which, I think, is very interesting. And this person who is asking the question is in Dubai where the summers are very, very hot and the average temperature in the day time is around 48 degrees Celsius. And the question is, can we use the same technology from extreme cold and transfer that over to extreme hot climates where cooling and air conditioning is a critical matter.

Male Speaker 3 Okay, Poul here, maybe I should try and answer that question. Actually, the – my experience on what we call a hot and humid climate doesn't get so hot as it does in Dubai, we only get up to 35 degrees during summer – not only summertime but every day. But I would say, no, you cannot use the same technologies. Obviously, the focus in Dubai will be only on cooling whereas the focus in Denmark is primarily on heating. However, a good performance of the building envelope is still of the same value and thermal exploration in Dubai will be very important because you can have

48 degrees outside and you have 23 or 24 degrees inside. Those are big differences.

So, thermal insulation in both walls and roofs are even more important because it tends to have higher temperatures. So, the building envelope, yes. Also, glazing, high performance glazing, glazing that would either [inaudible] [01:17:12] reduces heat that comes through transmission through the windows. Yes, that would also be very efficient. In Dubai, it would be very important if you are placing that only the – let's say, the lights and not the heat.

And again, here you can use a trick of trying to focus your window area if possible on north and south because it's easier to shade [inaudible] [01:17:40]. I hope that feedback was useful.

Female Speaker 1 Great. Okay, thank you so much, Paul. And by the way, I just want to pass along a personal compliment regarding the buildings that you illustrated in your presentation. Not only are they incredibly efficient but they're also very beautiful pieces of architecture and I just wanted to compliment on that.

Male Speaker 3 Thanks very much but I cannot take credit for that because I was just trying to hold hands with the architects while they designed the building. I'm not the architect.

Female Speaker 1 All the same they're very beautiful buildings so – and nice hand holding there! Next question, where might we find some examples of the policies or policy options offered to developers, especially those incentives that motivate developers to address long-term operating costs.

Male Speaker 1 I'll try to answer that one.

Female Speaker 1 Okay.

Male Speaker 1 As I said in my presentation, my own experience [inaudible] [01:18:53] experience with this is you have – how do you get people to do what you want them to do is these regulations that means it's a law, so to speak, that says we'll have to do that. If you don't do it, you're not getting their construction license. Of course, you'll have to take these steps moving up overnight, change the [inaudible] [01:19:18] on it. You have to do another thing that you were not doing yesterday. You would have to face this thing gradually. But of course, the biggest steps you take, the sooner you will have the energy efficiency you're looking for but of course it's the steps are too big, so they are not taking that and your computation cannot follow this and it's too big to comply you might end up in the situation. Now, you do have the regulations but nothing happens on the ground.

So, regulation is essential for the cost if it doesn't get implemented or it gets partly implemented. It's not so valuable. So, these two things are

important. Of course, as I mentioned, there are also other instruments and we have used them in their market as well, [inaudible] [01:20:17] capping and financial incentives.

Well, I would say, as it also transpired I think from my presentation, regulation is the number one instrument, and then you can - this can be assisted by financial incentives. I can say in Denmark, we have one financial incentive which is, so to speak, a negative one because you don't get any extra funding if you could make an energy-efficient building. But our energy costs are quite high because we tax energy. Energy is being taxed quite a lot. So, that's an extra incentive to build or do everything in an energy-efficient way because energy is very expensive.

So, that is quite an efficient instrument to text in people and know them [inaudible] [01:21:12] and move into the opposite that you'll actually subsidize and you consult a number of other reasons [inaudible] [01:21:22] and then of course, people need to know about these, some kind of information and awareness campaigns and creating an environment where energy efficiency is something that is being studied in schools of architecture and engineering, et cetera, also really important.

But one [inaudible] [01:21:50] is specifically the mandate of this resolution, [inaudible] [01:21:56] and then we can start from that. I don't know if this answered the question.

Female Speaker 1 Okay, thank you very much. This next question, I think it's kind of interesting and the question is, does Danish energy suggest building construction materials which are green and save energy and can be used in hot climate, keeping in mind that the indoor air quality is an issue, for example press wood may emit formaldehyde which is a known carcinogen. So, do you have any recommendations on types of building materials that again are green save energy and address the concerns of indoor air quality and those hot climates?

Male Speaker 1 Okay, for me over here, yes, some of the [inaudible] [01:23:03], some of it for instance some insulation that we used [inaudible] [01:23:18]. Then issues like pumps and fans, energy-efficient [inaudible] [01:23:31]. So, that's useful as well. But I'll say with [inaudible] [01:23:45] quality. It's a very relevant issue mentioned here because [inaudible] [01:23:56] energy-efficient buildings with the expense of technology.

If people are not happy, they're not healthy. You can [inaudible] [01:24:03] and then you will lose so much more money than you lost on [inaudible] [01:24:11] energy efficiency. But the issue here is to have adequate ventilation, that's one. But the issue is also not to bring contaminants into the building via this building [inaudible] [01:24:26] we use, very important.

So, you have to have let's say [inaudible] [01:24:33] for the walls and the floor finishes, the carpets, the bathrooms and so on. If you really make sure that they not [inaudible] [01:24:45] air quality, then you just need to bring in fresh air for them [inaudible] [01:24:51] are impacted. So, we're focused on building materials to have better quality and a good ventilation system. Is that good?

Female Speaker 1 That's great. Thank you so much. And gentlemen, just one quick question, we're down to about five minutes remaining on our schedule of time and there are several other questions that have come in. Would it be okay with you if I sent you emails of the remaining questions for you to address and respond to the requestors?

Male Speaker 2 Yes.

Male Speaker 3 Absolutely. Please go ahead and do that and we'll be happy to [inaudible] [01:25:38].

Female Speaker 1 Oh, terrific. Thank you. And so, those of you attending, we will definitely be sending out. I apologize first of all for running out of time and not being able to present all of your questions but we'll make sure to get answers for you all through email.

So, I would just really like to thank our panelists for the outstanding presentations. I'd like to thank the audience for all of the great questions that have come in and I would also just - we have a little survey for you to take, but before we do that, I just like to offer our panelists a minute or two to provide any closing remarks that they might like to make before we close out the webinar.

Male Speaker 2 I would just like to thank you for giving us this opportunity to share our experiences and to all who have been listening to our presentations, please feel free to contact us if you have any questions concerning our toolkit or some of the other works which [inaudible] [01:26:54]. We'll be happy to engage with you and also to perhaps go more to the specific questions which you may experience in your own countries. So, thanks for this opportunity and it was a pleasure, thank you.

Female Speaker 1 Well, it's a pleasure having you. And I'd also like to pass on yet another complement for doing such a terrific job on putting together this toolkit. I think it's going to be very useful for people across the globe when they're looking at developing policies and such for energy efficiency and building. So, job well done. I just want to pass on that complement.

And so, with that, we'll move on to our little survey and I appreciate those of you still in attendance if you could just take a couple of minutes to answer the following three short questions. Your feedback is really important to us and it helps us make improvements and change up our webinars to make it more valuable to you.

So, the first question is, the webinar content provided me with useful information and insight. We'll give you a few seconds to provide your answers before moving on to the next question. Okay, great. Thank you everyone for your responses. We're going to move on to question number 2, which is, the webinar's presenters were effective. Right, thank you very much and we'll go to the third and final question, which is, overall, the webinar met my expectation.

Great. Thank you so much and we really again just want to really thank you very much. We appreciate your feedback. So, thank you for taking the time to do that. So, with that on behalf of the Clean Energy Solutions Center, I'd like to extend a very hearty thank you to all of our expert panelists today, Peter, Jester and Paul, great job and also thank our attendees for participating in today's webinar. You've been a great audience and we very much appreciate your time, your questions and your feedback.

I invite all of our attendees to check the Solutions Center website over the next few weeks if you would like to view the slides and also we will be providing an audio recording of today's presentation and not just these slides that listen, and we also have previously recorded webinars that you can look through and if there is anything of interest, feel free to watch and view those as well.

Additionally on this site, you'll find information on our upcoming webinars, as well as other training events that we collaborate with on our partner. And we also invite you to inform your colleagues and those in your network about the Solutions Center, our resources and services, including the no-cost policy support that we provide.

So with that, I wish you all a great rest of your day and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.