Danish Toolkit on Energy Efficiency in New Buildings

—Transcript of a webinar offered by the Clean Energy Solutions Center on 11 June 2013—
For more information, see the clean energy policy trainings offered by the Solutions Center.

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Vickie

As we begin, I'll quickly go over some of the webinar features. For audio, you'll have two options. You can either listen through your computer or you can listen over your telephone. And if you choose to listen through your computer, please select the mic and speakers' option, then audio pane. By doing this, you can eliminate the possibility of feedback and echo. And if you select the telephone option, a box on the right side will display a telephone number and an audio pin that you should use to dial in. And just a gentle reminder to our panelists, we ask that you please mute your audio devices while you're not presenting, and again this is to present any feedback or background noise. Then one other thing, if you're having technical difficulties with this webinar, there is a phone number you can contact to get to the go to webinar's help desk which is 888-259-3826, and they will be happy to assist you.

Ah, next slide, and I think someone, one of our panelists, they need to mute themselves right now, we're getting some background noise. Okay, so if you, ah, I'd like to go through over just a couple of housekeeping items, and the first is if you'd like to ask a question, we ask, we ask that you use the questions pane, which is located again on the right hand side of your screen, and there you'll be able to type in your question. And if you're having any difficulty viewing the materials through the webinar portal we've placed PDF copies of the presentation like CleanEnergiesSolutions.org/training and you can go there, download the slides and follow along as our speakers present. I'd also like to let you know that a recording and a video of the presentations will be posted to the Solutions Center training page within a few weeks.

And next slide please.

We have a really terrific agenda for you today, that again is focused on Denmark's knowledge and experience on how to improve energy efficiency of new buildings, addressing barriers and the subsequent toolkit that was developed by the Danish low carbon transition unit. As you can see, we have a very impressive group of panelists presenting on this topic.

And before our speakers begin their presentations, however, I will provide a very short informative overview of the Clean Energy Solutions Center initiative. And following the presentations, we'll have a question and answer session, a short survey just to get feedback from all of you attending on the effectiveness of the webinar and then we'll wrap up with a discussion and a few closing remarks.

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This next slide provides a bit of background in terms on how the Solutions Center actually came to be. And so the Solutions Center is an initiative of the Clean Energy Ministerial and is supported through a partnership with UN-Energy. We've launched in April, 2011 and primarily lead by Australia, the United States and as well as other, ah, CEM countries and partners. An outcome of this unit partnership includes support on developing countries through enhancement of resources, policies relating to energy access, no-cost expert policy assistance and peer to peer learning and training tools, such as the webinar that you're attending today.

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Ah, this next slide, ah, basically describes the Solutions Center's goals and audience. And we have four primary goals. First, being that we service as a clearinghouse of clean energy policy resources. Ah, we also share policy best practices, data, analysis tools specific to Clean Energy policies and programs. The Solutions Center delivers dynamic services and enables expert assistance learning and peer to peer sharing of experiences. And lastly, the Solutions Center foster dialogue on emerging policy issues and innovation occurring around the globe.

Our primary audience is, energy policymakers and also analysts from governments and technical organizations in all countries but we also try very hard to engage with the private sector, NGO's and Civil society.

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This next slide speaks to our marquee feature that the Solutions Center provides which is our expert policy assistance. We call this services ask an expert and it really is a very viable service that is offered through the Solutions Center. We have established a broad team of over 30 experts from around the globe who are available to provide remote policy advice and analysis and this is the – This is offered to all countries and we provide this service at no cost to the requester.

So for example, in the area of buildings efficiency, we have Cesar Trevino who's president of the Mexico Green Building Council and Jens Lausten who is the technical director at the Global Buildings Performance Network they are on our team of experts. So if you have a need for policy assistance

from buildings efficiency or any other clean energy sectors, we welcome you and encourage you to use this uh, very viable service. And again, this assistance is provided free of charge, and ask – or to submit a request, you can submit your request by registering through the Solution Centers like, through our Ask an Expert feature at CleanEnergySolutions.org/expert.

And we also welcome and invite you to spread the word about the service to those in your network and organizations. And just to give you an idea of the broad sectors covered by our experts, you know, we have experts covering energy access, efficiency, renewables, smart grids, microgrids, clean transportation, and also regulations and utilities, electricity market regulations and utility regulations.

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I just want to give you a few suggestions on how you can become involved with the Solutions Center. We encourage you to explore and take advantage of our resources and services including the expert policy assistance that I just mentioned. You can subscribed to our newsletter and also continue to participate in webinars like the one today.

Next slide please.

And now I'm going to do a brief introduction of our very distinguished panelists. First up, we have Jesper Ditlefsen who's the head of section of Low Carbon Transition Unit at the Danish Ministry of Climate, Energy and Buildings. And he's also the author of the Danish Toolkit on Energy Efficiency in new buildings.

Next slide we got – Okay, we got Peter Larsen who is project manager of the Danish Policy Toolkit and also is a member of the Low Carbon Transition Unit. And I think we have the slides, just out of order here. We showed Peter's first and Jesper's second.

Next slide please.

And apology for that. And finally, we have Poul Erik, excuse me, Poul Erik Kristensen who's the founder of the Malaysia based IEN Consultants and assisted on the development of this toolkit. And with that, I would like to turn the webinar over to Peter. Peter, welcome. Thank you.

Peter Thanks Vickie. Can you hear me?

Vickie Yes. We can hear you. Thank you.

Peter Thanks. Hello everybody. I'm Peter Larsen as Vickie said. And I'm the manager of our work here, and I've assisted with the toolkits as part of the Danish Low Carbon Transition Unit under the Danish Ministry of

Climate, Energy and Buildings, and based on the Danish Energy Agency. As part of the hard work, we've also been providing technical assistance in the areas of renewable energy and energy efficiency.

I would like to give official thanks to Vickie also the Clean Energy Solutions Center for this opportunity to present this toolkit on energy efficiency on new buildings which my colleague and, ah, legal [VSL] [00:09:01] will present to you in a little while. But before that, I would like to take just a few minutes to let you all know who we are, what we do, and why we do it.

Next slide please.

The Danish Low Carbon Transition Unit or in short just DLCTU is funded under the Danish Climate Financing and is a continuation of the Danish [Abstract] [00:09:24] Financing that was the result of the top 15 in Copenhagen. The purpose of DLCTU is to provide the technical assistance to growth communities and a multitude of issues that our country have well equipped to deal with the gas reduction issues, that will be the small measure of if it were on countrywide, we're in a mission on development to as such.

In DLCTU, we work with issues across the country such as baselines, the practice in the reduction potentials, all sorts of it, such as this one, and the financing mechanisms. We have systematic underpinning of gas reduction measures and initiatives through involvement in multilateral networks and partnerships, some of them are listed on this slide. And we take the government's approach in our bilateral programs in Vietnam, South Africa, and Mexico. In these bilateral programs, we're responding to [voice demand liquidity] [00:10:22] and we have tailored programs in line with countries on specific circumstances. In Mexico, actually the program is still subject to final approval as well as with South Africa, and get them all underway.

DLCTU has just celebrated its first year, first year on Thursday, and so also to say that this is kind of a new area of work to us although we've put much to it. So if you find anything that we could learn or should know, please let us know so we could get better on some areas.

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The biggest experience in renewables and energy efficiency goes 12 years back and the approach has been a [huge response] [00:11:10]. First, we try to reduce consumption through energy efficiency and saving. And second, increase production of the renewable energy. This is also a strategy for the future and in meeting our main targets for the future.

Here, you'll see just a few, a few of the targets. More than 35% renewable energy in the final energy consumption by 2020 and this is all in the political targets. And 7.6% reduction in gross energy consumption in 2020 in relation to 2010. And 34% reduction in our green gas, greenhouse gas emission by 2020 in relation to 1990. Ah, in addition to this, all the electricity and heating will be from renewable energy by 2035, and our long term goal is 100% renewable energy in in all sectors by 2050.

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Just in the low carbon transition unit, it is a mission accomplished when we're able to share our experiences and meet demands in for about 11 countries.

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Our first two toolkits as you see here are on system integration of wind power and energy efficiency in new buildings. And we have just started out on making these toolkits available as we present significant areas, but likewise manage to develop and implement efficient systems that will be able to make a difference on the ground and has made a difference on the ground, and then at the same time with these areas we're requiring a very significant and cost efficient greenhouse gas reduction potentials worldwide.

And the two first toolkits represent just the tip of the iceberg. We have quite a few other toolkits either on the pipeline or on other issues, the pipeline initiatives is currently [inaudible] [00:13:03] on the Danish Low Emission development strategy process which is establishment on work at the time the commission related to the developmental target of 100% renewable energy by 2050. Uhm, basically the planning of wind power, supposed fees and financing of wind power, both wind power and areas where we do have the expertise, and in the areas of energy efficiency. We will move on to targets on energy efficiency in appliances and energy efficiency in industry. Also, energy efficiency in system buildings where this is – in new buildings. District heating and direct generation of just heat will also be one area. And also other toolkits in these may also be lined up on it and obviously we see a strong demand on countries. So please let us know if you can give anything in particular that we should uh, [delve into] [00:13:53]

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You'll find more information on who we are and what we do and in this link here on this webpage. But for now, I'm pleased to give the floor to my good colleague Jesper Ditlefsen. He will present the bulk of our work about energy efficiency and what we do.

Jesper

Hello. Hello, everybody. As Peter just said, I am Jesper Ditlefsen and I'm also from the Low Carbon Transition Unit in the Danish Ministry of Climate, Energy and Building. I would try to highlight some key points of the Danish experience in energy efficiency in buildings. And you might ask why, why would this be relevant. I believe that many of you would know this already but let me just take you through the main points. First, it's a fact that buildings account for last of total energy consumption, in developed countries, it is often 35 to 40% which is more than any other sector. The two other biggest being industry and transport. And then, it's a fact that existing technology provides a huge savings potential, so called zero energy building already exist. They operated with no need of supply of energy from sources outside the building itself. In other words, the technical savings potential in these buildings is 100%. This is exceptional and virtually in no other sector does off the shelf technology offer the possibility of such a significant change. As you know very well, there is no such thing as a zero energy car, a zero energy cement plot or a zero energy commercial airliner, not even on an international basis.

And if you don't want to mandate zero energy buildings right away, there's still a huge and cost effective savings potential in simple and prudent technologies. As you will see a little later, consumption in new Danish buildings 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 thus all the next panelists will show you something similar can be done in a tropical climate which is of course completely different from Danish. Much of this is cost effective, not only because it saves energy costs but also it may make costly power failures less likely and render big investments in extra generation capacity unnecessary. In fact, several studies show that the investment needed reduce power demand in new buildings is significantly lower than the cost of building new supply capacity of the same size.

Another important fact is that most construction industries, local, for example, Denmark does not produce cars or airliners or even washing machines, so when we need these kinds of products, we simply have to buy what foreign countries make. But because buildings are produced locally, even a small country like Denmark has been able to set its own standards. Of course, this also means that energy efficiency in buildings tend to create local employment and local know how. Most of the necessary technologies are fairly straight forward so as soon as there's demand, local production will be possible.

One more thing that makes energy efficiency in buildings highly relevant is the fact that most buildings have a long lifetime. Therefore, poor energy efficiency tends to lock consumption in a needlessly high level for many years, it will lock in a series of costs because retrofit energy efficiency is complicated and much costly than getting it right at the time of

construction. Now, let me take you back 40 years to our winter of 1973, ’74 and you’ll know this was the time when the oil price soar and made the world economy suffer for many years. Denmark in particular found itself in a very uncomfortable position because 99% of the energy that kept the country running was produced from imported fossil fuels. So we felt the full impact of the price shock. The immediate concern was security of supply but the shock also caused a severe economic crisis and a high unemployment.

What you see in the picture is one of the more spectacular and immediate response to the crisis. Private cars were banned from driving on Sundays during the first winter after the crisis hit. So the car in the picture is not an ordinary car, it’s a police on the lookout for offenders. But as the saying goes, never waste a good crisis. The events 40 years ago started Denmark on a path towards much reduced dependence on fossil fuels. As Peter mentioned, this has been achieved through more renewable energy and through energy efficiency doing more with less as opposed to banning on driving on Sundays which felt more like doing less with less.

The slide shows how Danish GDP and gross energy consumption has evolved through 1990. As you can see, the Danish economy has grown quite reasonably while energy consumption and CO2 emissions has reduced. If you will allow me to brag a little, Denmark has today the world’s highest share of new renewables in electricity generation that is 41% from wind by much in 2011. We also have the lowest energy consumption per GDP unit in all of EU. Quite importantly I think, this has not happened at the expense of economic growth. In fact, Denmark has pulled ahead of major European economies like Germany, France or the UK. Now, how did we do that? For some, the chief ingredient in green versus renewable energy, but if you change perspective, energy efficiency, doing more with less as I said before is just as important. Much of what Denmark has achieved so far is due to improve energy efficiency. And this will also play a major role on the paths towards the ambitious targets which Peter talked about in his introduction.

One area in particular has been all important in the Danish success in this field. And that is of course buildings as the title of the webinar suggests. As you can see from this slide, the maximum energy demand from a new Danish building has been reduced quite dramatically since the first regulation was introduced in 1961. In the 1960’s a typical new Danish single family house will consume 350 kilowatt hours or equivalent of 35 liters of fuel oil per year and per square meter of heated floor space. As of the latest major revision of the Danish building code, that what you see here, ah, which has been enforced since 2010, the maximum limit on energy demand from a similar residential building has been reduced to 63.5 kilowatt hour or equivalent of 6.4 liters of fuel oil. This requirement applies to heating, cooling, ventilation and domestic hot water. And what

it means is that energy demand from a new residential building has been reduced by more than 80% since the 1960's.

After having seen such a significant reduction, you might think that it might be difficult to go any further, not only from the 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 have decided that the maximum limit must be lowered again in 2015 and 2020 as you can see from this one here.

Now, let's take a closer look from the 2015, 2020 requirements. As you can see, we will once again be reducing energy demands quite significantly. In fact, by 2020, energy consumption in a new building will be reduced by another 68% from today's level. Or to put it in another way, by 2020, consumption will be only 6% of what it was in the 1960's. Already, this is technically possible. Several of such buildings have already being completed in Denmark and as I said earlier, zero energy buildings already exist. But what does that cost? Well, you may be surprised to learn that the cost of these further reductions is expected to be negative that it means it's not a cost, it's an income. The building of this, the lifetime cost of a new building is expected to decrees, not increase when the new regulation is implemented.

You've now invested for the construction of such highly energy efficient buildings is expected to increase, it will only be by a few percent. But the return of this investment in the form of lower energy costs during operation will be sufficient to make the total lifetime cost of such building go down compared to the present level. In many cases, the lifetime cost of operating a building is five times higher than the construction cost so of course if you can reduce operating cost, this can often pay for the substantial increase on construction costs. In this case, the increase in construction cost in investment is only a few percent of the present level.

Some investors want to try this out already now and so although this 2020 regulation is not expected to take effect until 7 years from now, there are already a number of Danish buildings which comply with the standards. The picture shows one example, it's the kindergarten in one of Copenhagen's northern suburbs and in fact since 2006 when the Danish authorities began to term out future standards well before they will be commanded to, 10 to 20% of all new buildings have been built to future standards rather than to the one in effect at the time of construction.

Now, where do all these savings come from? In Denmark, we have a fairly long winter as you may know, it's not terribly cold, around 1 or 2 degrees Celsius on average but on some periods, temperatures may go down to minus 10 or even minus 20 degrees Celsius in a particular night. Also, autumn and spring are quite cruel so in traditional houses, heating

has been required typically from late September to mid-May. Therefore, of course, space heating will consume most of the energy supply to buildings.

On the first graph here which you see here, you will see, ah, how we have, ah, reduced the heat loses through a building envelop simply through thermal insulation. You can see how high it was in the 1960's and it's been reduced quite dramatically since then. What you see here is an example of how energy has – where energy consumption has been reduced in Danish residential buildings. As you can see also, the regulation on thermal insulation started in the 1960's which has been much more stringent, in particular, there's a big step here in 1979 just after the world price shock. It has been reduced quite a bit more since then.

Another area where the heat losses has kind of been reduced is the windows, you probably know, the glass types, probably joints, better insulated window frames and things like that has made it possible to reduce the heat losses from buildings also quite significantly there. And then, there is the area of air tightness and the way you ventilate the building. Here, you see one step down in 1979 that was simply a result of the requirement of more insulation which lead to a bigger area becoming necessary. And this increased the air tightness of the buildings quite a bit already. And then there's another bit here in 2006 where one reason is that we had a requirement in the air tightness on building regulations. But also, the overall, the requirement on energy consumption was reduced to a point where it became necessary to have heat recovery on the ventilation that actually accounted for quite a bit drop on the energy consumption.

And on the last line here, the last, the heat source. In the 1960's, almost all buildings would have an oil boiler as a source of heating which at that time had quite big losses. They have reduced it gradually so that the losses running the oil boilers [inaudible] [00:00:30:12]. And you can see, the gas boilers are even better than that and we'll also see the heat pumps which actually do not have losses but actually gains heat from the exterior.

So, these are some of the main reasons why we've been able to reduce energy consumptions. Now, as you've seen, there's a huge potential, you can save a lot of energy but how you turn this potential into actual savings? Well, the traditional – all these instruments are awareness campaigns, financial incentives and then regulation. And the last one, regulation, in our experience, by far the most powerful, mandatory minimum standards is the way to go forward if you want this to improve. With this regulation, developers and builders may decide how they can comply in the most cost effective way but then cannot opt out or ignore the issue. Another important issue is that regulation may overcome what we call market failures quite often affecting the success.

Although, a particular may be economically attractive, a person by itself, the market does not provide this quite so, it needs to be pushed somehow and this is what regulation could do. It can also quite importantly target long term cost efficiency. That means the lifetime cost of the building rather than just the construction cost and that is something which is nearly impossible due to other policy instruments.

And then, regulation is important also because it encourages innovation. This may be countering innovation. How can stringent regulation encourage innovation? But let me give you just one example from the Danish context on this. It's about windows as you may be able to see. Of course, windows provide light which is wonderful in particular during a long and dark Danish winter. But traditionally, they have also caused significant heat losses as you could see from the slide before. And as I said, space heating has been chewing most of the energy supplies. So an energy efficient window for the Danish climate is one that minimizes heat loss and maximizes solar gains, that is the heating you get for free from sunlight coming into the window during the heating season.

As a background, in 2009, authorities and industry agreed on a new set of performance requirements which target some of heat losses and solar gains expressly. As you may be able to see from the slide, the new regulation set the limit, you can see this thing here, it set the limit on net heat loss at 33 kilowatt hours per square meter of window from 2010 onwards and was then to be reduced to 17 kilowatt hours of heat loss and then zero in 2020. At the time when this was agreed, many angry construction industries expressed concerns that this would be very difficult to achieve and it will become very, very expensive. But in fact, the opposite has happened. Total, only four years later, the best windows on the market which are the ones you can see here, they exceed the 2020 requirements by a large margin. As you can see, they actually have a net heat gain of more than 25 kilowatt hours per year. And then there is perhaps the most striking feature of this new generation of windows. They were only marginally more expensive than other windows and this is more than compensated for by the energy savings it provided.

Now, we have already seen a bit of technical information on where the savings in Danish buildings comes from. Now, let me give you a quick overview of the history of our regulation. The very first was in 1961 as I think I've said before and it was only about thermal insulation of the building envelop. For example, to comply with the requirement at that time, 80 millimeters of mineral would be required whereas now you will need 400 millimeters to comply with the present regulation.

Already at that time, there was also a requirement of window, it was on the so called U-value but in practice, this meant that double plating became mandatory to new buildings in 1961. From 1979, new

requirements on installations were introduced, first on heating and ventilation and then later on lighting and cooling. And then, in 2006, we had the first requirements on overall energy performance and also in 2006, our first requirement of air tight on the new building as a whole.

I would like to touch on a few keys issues with regard to this regulation. As I said in 2006, we had the first requirement in overall energy performance. The calculation of this is somewhat complex at best in particular because it involves a significant amount of input data. So connecting this data and making sure they are valid requires a rather comprehensive set up even if the actual regulation is performed by a standard computer software. So the calculation in itself is not the most complicated thing, it's getting the data that is complicated.

In Denmark, as in other countries which has a similar set up, these capabilities have been built up over many years. The foundation is the specific requirements regarding the building envelop and the installation which were as you've seen implemented well before the overall energy performance calculation became mandatory. So in our view, well implemented basic requirements are a prerequisite for successful use of an overall performance approach. Even now, the overall performance requirement in the Danish building code does not stand alone. It is supplemented by requirements on the building envelop and the installations.

So while the performance approach invites innovation and cost efficient solutions, the detailed requirements ensure that no part of the building's energy performance is neglected. And this in particular is important with regard to requirements on the building envelop. First, because while technical installations may have a lifetime of 20 years of so, the building envelop usually remains in place for much longer than that. And secondly, because savings which are provided by the building envelop tend to be robust because they do not depend on regular maintenance.

And then there's a cost issue as I mentioned briefly before, developers and building owners tend to be concerned most with upfront construction costs so regulation may be required to ensure long term cost efficiency. This has been an important motive for Danish regulations, we regularly mandate efficiency measures with a single payback time significantly longer than what the market will provide by itself. As you saw in the window example, this can increase the pace of innovation and bring more efficiency sooner and at a lower cost than predicted and we've seen this many times.

Another way to boost innovation is to introduce optional extra high performance labels which reflect future standards. For lack of a better term, we might call these premium options. As I said earlier, since 2006,

the Danish building code has been providing builders with a choice between three different performance levels, the mandatory minimum standard plus two such premium options. This gives credibility to the notion that options with higher upfront costs are better and more future proof. And it seems to inspire people to do more. Although the Danish minimum standard is probably the world's most stringent since 2006. As I said before, 10 to 20% of Danish construction profits have chosen one of premium options and it does not seem to matter whether the project owner is a private individual, a company or a public institution. There have been premium projects in all categories.

And then one last thing, update regulation regularly as I've said before, what we have done in Denmark is simply to mandate solutions that were already available so as I've said, it's not rocket-science.

So to sum up, the potential of energy efficiency in new buildings is big, huge, and in realization is cost efficient in many cases. But you should not do anything, market failures for example, a consensus between the tenants and the building owners meaning that many new buildings are with poor energy performance or at least not as good as it could easily be. So regulation and effective implementation is crucial and it may well spur innovation as you saw in the example, we're doing those.

Now thank you. And I will now turn you over to Poul, my colleague, who will share you the experience for energy efficiency in a complete different climate zone.

Poul

Thank you very much and good morning. Good afternoon, good evening to every one of you around the world. I'm very happy to join my colleagues here at this web seminar. And I'm a Dane that has been working in Malaysia for – in a hot and humid climate for 12 years implementing energy efficiency integration projects.

And now, I will share my experiences from this climate, experiences that has been used for buildings [inaudible] [00:42:13] for the warmer parts of the world. Making energy efficient buildings in a tropical climate is very different from any other climate because apart from being Danish, the [inaudible] [00:42:28] is different and reducing – reduce the consumption for cooling is always the main issue and the spacing is not an issue at all.

Here, in this diagram, uhm, oops, sorry, sorry, sorry. Here, in this diagram, it says, you see that, the energy forms of the first three office buildings that we implemented in Malaysia, those are the buildings implemented over the last 10 years that showcase energy efficiency in buildings, showcase it technically and economically feasible. The energy index is a measure throughout the year and here we compare with data that we collected for 41 office buildings in Malaysia and 95 office buildings in

neighboring Singapore which has the same climate and same building traditions. You will see that the typical energy consumption we have here is around – between 150 and 220 kilowatt hour each day of the year. And you can see that we don't get below 100 and even in some days we get up to 400.

The three buildings have been compared among these buildings in Malaysia which showcase energy efficiency improvement and even we got them [inaudible] [00:43:50] Malaysia being implemented. They sent out a series of [both marks and amps] [00:43:46] for the building in total and they are actually showcasing these in their buildings. So I'll come to the slide but unfortunately [I showed this] [00:44:09]. This slide shows the – what are the issues on energy efficient buildings. Let's talk about that as we progress, the issues of any buildings. And the building that is next shown here and the we start with the so called passive design features that is related to the architecture of the building including making the building more air tight, to avoid having the uh, air get in to the building and thereby by decreasing the [turmoil] [00:44:40].

Secondly, we reduced the [loopings] [00:44:42] through the façade , and this is primarily about reducing the solar radiation through the windows. And in this project, this particular project, we call it Diamond Building uh, the façade is inclined uh, inward uh, like an inverted pyramid so that we have no direct solar radiation entering the building from both the South and earn a little bit light – solar radiation from West. Uhm, so this design is that we actually uh, need no external overshading and also that we could get away with using [inaudible] [00:45:15] integrating, where as long as we use the [inaudible] [00:45:18]. Uhm, thirdly, on the Passive Design uh, daylight harvesting contribute to reducing electricity consumption for lighting, and this building uh, is harvesting 50% of the light, as well to invade effective lighting daylight design. And, the uh, the energy efficient fans now were coming to the so-called active design features are controlled according to the need for ventilation, the openings in here. And however, in this building, most of the cooling [00:45:54], the floors and the ceiling but was integrated, unified to the floors and the ceiling. And we've done that because uh, more of this – more efficient as in – in the [carrier] [00:46:08] than here, so electricity consumption for circulating the heat is much low and versus electrical procedure [inaudible] [00:46:16]. We now reduce the actual energy consumption of the building to – down to almost uh, 72 kilowatt hour per meter square per year.

On the roof, we have a solar PV system integrated uh, you maybe see it on this [inaudible] [00:46:36] on top of uh, Diamond uhm, which show electricity [inaudible] [00:46:42] system is reduces and never need some [inaudible] [00:46:44]. And this is actually the – in the index they provide [inaudible] [00:46:51] each every year, that is the energy consumption of the businesses today. Also, you will know that uh, the contribution from

the new [inaudible] [00:47:03] is quite limited, just on the lines [inaudible] [00:47:06]. You should always start with energy efficiency before starting [inaudible] [00:47:10]. And this building is connected to the district cooling [motor] [00:47:16]. However, if the building, you can perhaps take an advantage of having the energy efficiency uh, chiller, we could act with a reduced energy consumption around it if we want. And uhm, if we – when, if you apply furthermore under the management, you could have uh, uh, reduced it a little bit more, but you could probably wasted [inaudible] [00:47:47] enhance new buildings uh, is very crucial [inaudible] [00:47:54] energy efficiency of the building that was built. Uhm, and in the – the LEO office building, the first building I showed before, we actually have an energy index that was 60% higher than just – compared to design. But when – when [inaudible] [00:48:09] introduced very effective and [inaudible] [00:49:13] could take it down to 100 and 60 level today.

And this last part integrates how much energy performance can be compromised due to the effort. [00:48:22] this situation is important with eight floor. Many buildings where they will not [inaudible] [00:47:30] with the management. So, [inflows] [00:48:35] on energy efficient uh, ventilation, very important uh, and this illustrates how we can achieve very significant savings on ventilation. First, the size of the ducts and the – work the size of the ducts uh, after the, increase the [normal] [00:48:54] space for economic reasons, investments uh, with savings here. Next, we have applied energy efficient fans and motors, we can get even further down, just applying what the best it is on the market today. And thirdly, the applied variable speed for [building plumbing] [00:49:13] controls on the fans uh, so that there are only one speed that – the uh – that which is needed. From the first, the LEO building, we have VSD ones that uh, join uh, the beginning of the day of 7 to 8 or 9 in the morning, then would be 100 uh, times speed, but then, due to the electronic controls when there was no need for excessive ventilation to cool down the building as we put about to 40% and we – the electricity consumption for the fans would go a little lower. So we can see that actually, a reduction of 90% was achieved here.

Another important part of designing, energy efficient building from the tropics goes to neutralization have a [inaudible] [00:50:04] that I just showed before from the – the [inaudible] this light and reflects into that ultraviolet [00:50:08]. We get the day light into the building and we maintain it on the floor to the building – to the surroundings of the building. [inaudible] [00:50:20] with human light, the so-called spectrally selective glazing go on. In more popular terms uh, solar control glazing uh, is what we call it and it is not the same as Diamond selective glazing or [diamond] [00:50:35] glazing, which is uh, very popular in [inaudible] [00:50:38] to the outside as mentioned by Jesper before. This glazing has an [inaudible] [00:50:49] as exactly as this [inaudible] [00:50:53] of

reflecting heat path [inaudible] [00:50:55] building in the tropics. Now, I want to turn to energy efficient lighting and uh, it start off with electric lighting, [inaudible] [00:51:14]. Uhm, basic electricity consumption can be reduced [inaudible] [00:51:21] model efficient lighting. And in the diagram, we see efficiency of various light also is secured. Uh, efficiency metric in watts of electricity used for the [inaudible] [00:51:33] lights in halogen light is has shown very inefficient as we know. Uh, and last, electricity consumption for LED light [inaudible] [00:51:44].

Also, all electrical light will [inaudible] [00:51:45] using energy efficient lighting has the advantage, further advantage of the use – uh, sorry, the use of the [inaudible] [00:52:00]. However, daylight is even more uh, efficient measure is little low for [medium] [00:52:15] of light, as shown in this diagram. Some lights is then – but then the electric lights, also daylight from a clear, clear sky is even better of 130. The reason for that, that sunlight is simpler because uh, when it enters a building, the amount of light provided uh, is often many times higher than what we need [inaudible] [00:52:43] with excessive overheating. [inaudible] [00:52:48], therefore, the building should be designed to [inaudible] [00:52:55] which we could light only as incoming the coverage area. Again uh, daylight enters the building through uh, solar control glazing during the fall uhm, [inaudible] [00:53:07]. But then we achieved what we actually called cool daylight and this is illustrated from the same diagram here. Uh, so, we get a lot of the light we have charged, but we'll get very little heat. Uh, just to finish off, this one here to looking to there is electric lighting uh, [inaudible] [00:53:50]. Uh, this is where we expect LED lighting to be implement is time for now. Very efficient with uh, very low electric consumption and therefore, also emitting very little heat. But again uh, the best light source is daylight and in the tropics is out there all the time the whole day.

This is how we used uh, daylight to the maximum and we so-called uhm, [inaudible] [00:54:02] office building [inaudible] [00:54:08]. We want just —zero energy consumption in this building and we almost got it up there. Uhm, I just want to highlight the uh, the architecture designing in particularly this day at this time. Office building is designed to be 100 of daylights when office hour from 8 a.m. to 6 p.m. And uh, as I mentioned, [inaudible] [00:54:36] is that daylight is also out there. Uh, only we have to bring it into the building [inaudible] [00:54:44] in the tropics, we have to bring it in with uh, abundant sky, that is almost always has a higher lamination. So we have to bring it in the outdoors and [inaudible] [00:55:01] in top of the buildings, you see that uhm, the windows are [inaudible] [00:55:06] shading systems and electric [inaudible] [00:55:09] what we setup to do in this building. It's uh, much – 100% daily during daytime, but actually [inaudible] [00:56:06] at its 98% daily during daytime.

So now, I will come to my last slide, which were the – economic feasibility of energy efficiency in buildings, which is also too very important for this to be popular, and also, very important for this to be uh, something that you can implement in the building code and make it mandatory. The case for this uh, this showcases are very important, uh, very competent in the building industry that we can actually go for energy efficiency [inaudible] [00:56:42] and, the buildings we have implemented in Malaysia had greater crucial role. Uhm, so, this last slide uh, I just summarized the uh, economic feasibility of the energy efficiency in buildings in – in Malaysia. Uh, so the only – the office building that use the energy efficiency technology [inaudible] [00:57:04]. This is very new data but important data to underline the uh, efficiency of uh, inefficient design and in the waste cost. This is a building for the office tower 3 in the development [inaudible] [00:58:19] and we have here achieved what was in savings, but only 3% of extra costs. Uhm, and I want to show you one of the key features that we think we could achieve this.

This building actually being the new uh, in goal for uh, [inaudible] [00:58:33]. Uhm, this building has an energy index – design index of 105, which is 50% down from technically 210. And here's the cost for very efficient double solar control glazing, the best we can get on the market uh, in the facades, US$1.2 million, whereas the consequential energy savings on the chiller investment would be now [inaudible] [00:59:12] US$0.58 million or 50% of the extra cost for the savings [inaudible] [00:59:21], the same uh – I'm sorry, 50% of the extra cost for the glazing is [inaudible] [00:59:26] on the chiller. So that underlies a very important points in optimizing energy efficient buildings, not just in the tropics but anywhere. That is what we call integrated energy design uh, which would uses the extra costs and improves, you know, feasibility. So we have to design a building, not just the architecture, but also mechanical, the electrical systems. Consider that from that the beginning and then you can make these very important uh, trade – tradeoffs.

So, that's uhm, mainly to the end of – of this presentation. Uh, hope you found it useful and I will now turn it over to the Q&A section.

Vickie

All right. Thank you, gentlemen. Peter, Jesper and Poul. That was very outstanding presentations with terrific information, and thank you so much for providing the presentation. We now, will move to the asking the question section. Well now, you've – much of the rest of the time for some questions from the audience. And again, if you have questions, you can type them into the questions box and I will read them up to the presenters to answer for you. So, just to start off. Peter, this question, it's for you, and the question is, why are the Danish Energy Policy Toolkits relevant when there are already other similar toolkits available?

Peter Larsen Okay. Thanks for the question Vickie. Regarding this, the relevant question on the many others, uh, other countries or institutions around the world that use the similar types of the – of the work on the informing, and that just use the [inaudible] [01:02:02]. For instance, it's carrying out the little work on toolkits, such as the one we do. We feel that, that our trademark here is, is a big years of experience, in Denmark in – in this area. So, the things that we have done well and, perhaps the things that we have learned from, are relevant to, to going forward to our countries. But also that this has been uh, stepwise development that we have begun from a very simple starting point that developed from that. So we have the experience from very [inaudible] [01:02:59] days back uh, when this -- when we began this work, and up until now, where we've been more advanced. So that become I think that we uh, fairly competent in giving advice and informing other countries that yield with the – this issue and the challenges which are associated with it. Also invitation to England practitioners or among the officials from [inaudible] [01:03:33] that we're happy to go into the specific countries, circumstances and challenges that actually gives specific advice uh, in that regard. Thank you.

Vickie All right. Thank you. The second question has come in speaking, I believe, Poul, this might be for you, but I believe you may have something to contribute to this one. And basically the requester is stating that these are very interesting ideas, and how can such innovations be mainstreamed into new buildings in developing country?

Were you able to hear me?

Poul Erik Kristensen I.

Vickie I'm sorry.

Poul Erik Kristensen I totally can hear.

Vickie Okay.

Poul Erik Kristensen I think that uh, basically.

Vickie Okay.

Poul Erik Kristensen Is how important to me in [inaudible] [01:04:31].

Vickie Yes.

Poul Erik Kristensen I wouldn't say developing country, because Malaysia is not a developing country. It's past developing country but definitely, in a very different climate. Well, typically the answer to the question is how can this be implemented in the developing country is trying to emulate what we've been doing in Denmark for many years, starting this, a – we control it a

very simple but effective [inaudible] [01:05:01] is what we have been developed over the years and uh, raising the ladder uh, raising the steps year by year or maybe five year by five year. For those whose to say that we cannot start with a [inaudible] [01:05:16] from scale 12:1, you have to have the examples, you have to have the case studies, you have to show the – goes to the government, the officials, but especially, your offer to the [inaudible] [01:05:28] that this can be done and this can be done in a way that is cost-effective. So for that, at least, helping things, raising projects, the case studies before implementing [inaudible] [01:05:37] are crucial. They will support the implementation, they will support the confidence, and they will also help to do training and the one trading in the building industry. So, yes, it can be done someone has to go. The billing cost has to go hand to the [search and demonstration parties] [01:05:57] and case studies.

And what we proposing from based on our Danish experiences, having a pro-active [billing growth] [01:06:05] that will always put forward to the next [billing growth] and the next [billing growth] where someone will always start to implement that one uh, even though it's not [01:06:17] can be helpful for the [inaudible].

Vickie Okay, thank you. Next question comes in. And this I believe will be for Peter and Jesper. And the question is, does the policy toolkit provide solutions for the tenant landlord split incentive such as the fact that gains in operation are not paid to the one who pays the higher upfront investment cost?

Peter Larsen I'll just answer that.

Vickie Okay.

Peter Larsen I think this tenant owner, there's also the [01:07:11] which is known under the name split incentive, and I think as I mentioned in my presentation that uh, regulation is one way to overcome this. If you have energy efficiency requirements in the building code, this means of course that, unless you comply with the requirements, you will not have your construction and we cannot build the building. So that is a way to make sure that that building's comply with a certain minimum standard. And then, of course what the owner will need to do to recoup his cost to just simply make the rent a bit higher corresponding to the effect that the tenants will pay, lest energy cost supported, to living in the building or the offer space on the manufacturing space or whatever is in the building that uh, operate and cost of the building will be in terms of energy cost will be your end. And this can be reflected in the – in a slightly higher rent. But the point to start may will be regulation to make sure it happens in the first place, and then the market will [inaudible] [01:08:31] the rest.

Vickie Okay, great. Thank you so much. Our next question is uh, related to uh, access to capital. And the question is, how important do you see access to capital in order to overcome the higher upfront investment cost? And the second part to this question is what policies have worked best in Denmark and what do you think might work in uh, in uh, a poor country?

Jesper Ditlefsen Uh, I'll – I'll try to answer that one [inaudible] [01:09:15].

Vickie Okay.

Jesper Ditlefsen As Poul mentioned then and I also said, the extra investment needed to make energy efficient building is only a percent of the total construction costs and the latest example that Poul shared. It was only 3% of the construction costs. So access to capital, I mean, if you can find the money to build the building usually it would not be an insurmountable variant to find these extra 3 or 4% to make it energy efficient. I can say from the Danish example, we have hardly ever used subsidies for promoting this. That the main, if I can say, if there is a financial incentive in Denmark it is, it was or the other way around, because we have very high taxes on energy consumption. And this means that of course if you make an energy efficient building will save not only the cost of the energy but also the taxes which are put on energy.

I know that this is somewhat different from what happens in many developing countries where you actually – the government actually subsidizes energy and subsidize these fossil fuels. And this of course will be another good uh, place to start to, stop the subsidies to fossil fuels and eventually start with some kind of minimum regulation on buildings. And at least in the Danish experience, access to capital has not really been [inaudible] [01:11:19] and, as I said, since it's only a few percent of the total construction cost. Uh, [inaudible] [01:11:27] maybe the government would be able to offer some kind of extra loaner something, but it should be a loan because uh, it's would – where you recoup [inaudible] [01:11:42]. That would be my answer to that. Almost to something in this.

Poul Erik Kristensen Yes uh, thank you, Jesper. Just a quick comment on this based on our experiences from Southeast Asia. The extra cost, I mean the efficiency is [inaudible] [01:12:01]barrier, and for that reason, it's also a real barrier in that cumulative expect that energy efficiency is very expensive. But once, you have demonstrate it this is not the case, then that barrier is gone because the 3 or 4 or 5% extra in giving for the building, you could also afford energy efficiency and we have actually experienced it in Southeast Asia. Uh, from Malaysia, there was another building where there was a [inaudible] [01:12:31] for an office building for the [inaudible] [01:12:33] department building. And actually, those [inaudible] [01:12:35] the ones that put – provide energy efficiency, this as [inaudible] [00:12:42]. So, the real barrier as much, for new building is not economy. The real barrier is

awareness, knowledge in the building industry. Whereas, when we talk about energy efficiency needs to exist in buildings, then we suggest the case because they will open up a new extra investments or real investments as requirements, but that's a knowledge sort.

Vickie — Okay. Thank you so much for that. Our next question is, actually, coming in from someone who is in India interning with [UNDP] [01:13:23]. There's a little background before the question. It's all just we've got for you as well. For developing countries such as India, social issues like poverty, health care and education hold much more important than climate change. However, various incentives are being provided by the government to promote energy efficiency. The energy efficient buildings are more costly, however, no incentives are provided to the developer. The cost benefit would be borne by the tenant and, that brings us to the question of, are there any immediate incentives to be offered to the developer in contracting, a green building?

Jesper Ditlefsen — I'll try to answer that one. I think it's somewhat similar to the previous question as of course, you can imagine some kind of incentive from the government. I know this happened in some countries where, for example, the government would offer loan for the extra cost at the low interest rate or would offer the guarantee for such of them and of course, these kind of things would be possible. But as Poul said earlier this barrier of extra investment is, is more of a perceived barrier than an incurring real barrier. And as I also said before, the issue about tenants at taking advantage of the extra energy efficiency, this is of course can be solved very easily by assessing the landlord at the rate that reflects this reasonable energy cost and as I also said before, getting the whole thing started might simply need some kind of regulation that makes sure that people – that buildings cannot be built unless than comply with such a minimum requirements. I think that's much more effective than – than starting some kind of [subsidy scheme] [01:15:48]. [01:15:50].

Poul Erik Kristensen — Yeah, just a quick comment on [inaudible] [01:15:59] to what Jesper mentioned. I think in many countries, also in developed – especially in developing countries. Once you've asked around this so – developing [inaudible] [01:16:08] themselves. Can we afford to continue to build uh, non-efficient buildings, because the burden of the energy consumption of these buildings would follow us at like 20, 30, 50, or 100 years and is really investing in the future and the investment is going small. So it's just a question of how you as quickly as possible can get to the point where you can manage your building cost with minimum requirements, because uh, that is really from a microeconomic point of view the best thing to do. Uh, it's really a win-win situation.

Vickie — Okay. Thank you so much. Next question regarding tools. And the question is, what tools can be used to assess energy consumption for buildings as well as energy efficiency analysis?

Poul Erik Kristensen — I just want to answer that question. It's a very good question. And when – I mean, specialized companies like the company I had in Malaysia uh, which [inaudible] [01:17:24]. We use advance [inaudible] [01:17:28] and others. Such tools are too complicated for normal practitioners of architects 100 of years. So, you need to have something that is – that is more accessible and uh, in various countries, now seems have been developed typical [Excel based] [01:17:49] tools that would be developed. So where you can input uh, you can input the important design data as I mentioned earlier on the architecture of the [eminent resistant] [01:18:00]. And then you will get a pretty accurate prediction on what is the [inaudible] [01:18:04]. You can play around with the design, we get immediate uh, answers. These tools have been developed on a very complicated and sophisticated tools, but they are commonly around. Uhm, they are being developed in Malaysia. They will be develop most likely in Vietnam. They will also be developed in Indonesia. So they are coming off but they are also very important for the implication of business code and the understanding of the uh, in the industry to take off five years.

Now, I'll hand it back to Jesper with a further comment.

Jesper Ditlefsen — Yes, I would just like to something that – what Poul just said. Because there is a lot of knowledge available already where the examples uh, as Poul mentioned there are examples from Malaysia, there are examples from many other countries from the world. There are examples from buildings that have already been built. And as I said, this is not rocket science, one thing that Poul mentioned is that we need to shape uh, window so that the direct sunlight gets in. This is not very complicated. It is a very simple measure that we could mandate rather easily. There is such a simple thing as making sure that window in the tropic space, South and North, in [inaudible] [01:19:33] there are also quite a number of existing technology that – that uh, that are already in there. Poul mentioned this solar control base there are similar – special kinds of glazing for uh, avoiding uh, heat losses in [inaudible] [01:19:53].

So much of this is well-known of course, you may need to make some adaptations to some particular country, but there are other countries uh, where this has happened already. So, there's so much that you can simply from what uh, exist already, so you do not need necessarily to make complicated uh, simulation on each and every building you built. You might simply have some rules and some guidelines which will uh, make sure that you harvest a lot of these low-hanging fruits, in very simple ways. But of course, I think rather the big barrier is uh, is to make sure that to move the construction industry to take off these changes and to

start doing it. And, and as Poul said uh, some demonstration firms, which will show that this is possible. This is not very complicated to do and this is – this makes very good economic sense. Uh, I think that's – that's the way to make sure that these kinds of things happened. Thank you.

Vickie Well, thank you. That's a great answer and very interesting and nice thinking about, especially new buildings and major innovation projects about how to incorporate passive designs to, you know, offset energy loads and such. So, thank you for that. I think we have time for maybe two more questions. So the final two questions. The first one is, and this is related to how did Danish government procurement procedure have influenced change in the direction of efficient buildings those for new and uh, refurbishing or perhaps major construction? So, how is the Danish government procurement procedure influence that direction of change within Denmark?

Jesper Ditlefsen Uh, I'll try to answer that one. I think it will be uh, fair to say that Danish government uh, procurement policies have not been very important. These have been – these changes have happened on the very general scale. The [Opleit] buildings as I said in my presentation, they have not been made particularly energy efficient. In fact, many private companies were private individuals have been the first to have thought this uh, higher standard. And, as soon a court – as soon a standard becomes – a minimum standard becomes managerial in the [billing code] [01:22:43], everybody must do it. It has not uh, these in the fulfillment of energy efficiency in buildings, the government procurement policy has not, it has not been a very important issue. It's more the regulation and the – and the taxes in the [inaudible] [01:23:04] the regulation that has let this. Thank you.

Vickie Thank you. One final quick question and this question is, in Denmark, regulation had played a key role, and Poul, I think this would be for you actually. For the Malaysian cases mentioned, have there been any changes in regulation, and are there any changes in regulations predicted or projected?

Poul Erik Kristensen Yes, thanks very much. Poul here. Malaysia has as of now, they have a volunteer rate called the [01:23:54] energy efficiency in buildings uh, that actually based back to 2001. It was revised in 2007 and is being revised now as we speak. And the revisions are very much influenced by active experiences, especially in the later revision. In 2015, we're expecting to have another revision in [01:24:22] and by the same time, we're expecting to have – that billing code where or that code of act of energy efficiency in buildings will [01:24:30] bring this to the [01:24:32] billing code in Malaysia. And we're expecting to see a billing code that will – that use energy consumption of new buildings of [01:24:42] of 50% compared to normal practice and that would not have been possible without these demonstration projects. So, she've mentioned also that there is a

Malaysian out a [01:24:56] from the project about energy efficiency and the means. And one of the key objectives of that project is actually to promote energy efficiency in buildings uh, is become [01:25:10] and also to promote further case studies of all.

Vickie

Thank you so much. So with that you know, great answers to some really great questions. So thank you all for uh, presenting the questions and also to our great panelist for providing terrific answers. So with that, I think we'll just move real quickly to the little survey I mentioned earlier uh, in the agenda. We just really like to get the feedback from our audience, so that we know areas where we might improve or, you know, and also things that we're doing well. So with that, Andrew, could you please post the first survey question? And I will read this out real quickly uh, give you a few seconds to answer. The first question is the webinar content provided me with useful information and insight. And, we'll just take a few seconds to let you answer those questions.

Okay, great. Very good. Thank you. Next question please. Excuse me. The second question is, the webinar's presenters were effective.

And, thank you so much. Uh, we'll move now to our third and final question. And, the final question is, overall, the webinar met my expectations.

Very good. Thank you so much. We really do appreciate your feedback. So thank you to all who participated in our survey. So with that we'll move to our final slide. And I just really want to say on behalf of the Clean Energy Solutions Center. I'd like to send a very hearty thank you to Peter, Jesper and Poul for this great presentation. And, to all of you in our audience and who attended and participated in our webinar today. You've been a great audience. You've provided us with great questions. We very much appreciated your time. And we invite all of you, our attendees, to check the Solution Center website over the next few weeks to view the slides and also listen to an audio recording that will be posted of today's presentation. And you can look through there and uh, find previously held webinars on a range of topics related to clean energy policy. We'd also invite you to inform your colleagues and those in your networks about the Solution Center, resources and services that we provide, particularly the no-cost policy support that we have available. So with that, I just like to wish all of you a great rest of your day, and again, we hope to see you again at future Clean Energy Solutions Center event. And with that, this concludes our webinar.