CLEAN ENERGY SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

Accelerating Adoption of Energy-Efficient Lighting, Appliances and Equipment: An Introduction to Proven Technology and Policy Solutions

—Transcript of a webinar offered by the Clean Energy Solutions Center on 25 July 2017—
For more information, see the clean energy policy trainings offered by the Solutions Center.

Webinar Panelists

Paul Kellett	UN Environment
Rolf Smeets	Philips Lighting
David Manrique	mabe
Nathan Mouw	Whirlpool Corporation
Ajit Advani	International Copper Association
Angelo Baggini	University of Bergamo

This Transcript — Because this transcript was created using transcription software, the content it contains might not represent precisely the audio content of the webinar. If you have questions about the content of the transcript, please contact us or refer to the actual webinar recording.

Stephanie — Hello, everyone. I'm Stephanie Hernandez with the Clean Energy Solutions Center, and welcome to today's webinar, which is hosted by the Solutions Center in partnership with UN Environment. Today's webinar is focused on Accelerating Adoption of Energy-Efficient Lighting, Appliances, and Equipment: An Introduction to Proven Technology and Policy Solutions. Before we begin, I'll quickly go over some of the webinar's features for audio. You have two options.

You may either listen through your computer or over your telephone. If you choose to listen over your computer, please select the "Mic and Speakers" option in the Audio pane. If you choose to dial in by phone, please select the "Telephone" option, and a box on the right side will display the phone number and audio PIN you should use to dial in. If anyone is having any technical difficulties with the webinar, you can contact GoToWebinar's Help Desk at 888-259-3826 for assistance—and the number's there on the screen. If you would like to ask a question—and we encourage that you do—please use the "Questions" pane on the toolbar.

If you're having any difficulty viewing the materials through the webinar portal, you will find PDF copies of the presentations at cleanenergysolutions.org/training, and you can follow along as our speakers present. Also, the audio recording and presentations will be posted on the Solutions Center training page within a few days of the broadcast, and they'll also be added to the Solutions Center YouTube channel, where you will find other webinars, as well as video interviews, with thought leaders on clean energy policy topics. Finally, one important note of mention before we begin our presentation is that the Clean Energy Solutions Center does not endorse or recommend specific products or services. Information provided in this webinar is featured in the Solutions Center's resource library as one of many best practices resources reviewed and selected by technical experts. Today's webinar agenda is centered around the presentations from our guest panelists Paul Kellet, Rolf Smeets, Nathan Mouw, David Manrique, Ajit Advani, and Angelo Baggini, who joined us to discuss the findings of six new policy guides developed by United for Efficiency initiative.

Before we jump into the presentations, I'll provide a quick overview of the Clean Energy Solutions Center, and following the presentations, we will have a question and answer session moderated by Julia D'angellini of UNEP, where the panelists will address questions submitted by the audience. And, at the end of the webinar, you'll be automatically prompted to fill out a brief survey as well, so, thank you again in advance for taking a moment too respond. The Solutions Center was launched in 2011 under the Clean Energy Ministerial. The Clean Energy Ministerial is a high level global forum to promote policies and programs that advance clean energy technology to share lessons learned and best practices, and to encourage the transition to a global clean energy economy. 24 countries and the European Commission are members covering 90 percent of clean energy investment, and 75 percent of global greenhouse gas emissions.

This webinar is provided by the Clean Energy Solutions Center, which focuses on helping government policy makers design and adopt policies and programs that support the deployment of clean energy technologies. This is accomplished through support in crafting and implementing policies related to energy access, no-cost expert policy assistance, and peer-to-peer learning and training tools such as this webinar. The Clean Energy Solutions Center is co-sponsored by the governments of Australia, Sweden, and the United States, with in kind support from the governments of Canada and Mexico. The Solutions Center provides several clean energy policy programs and services, including a team of over 60 global experts that can provide remote and in-person technical assistance to governments and government supported institutions, no-cost virtual webinar trainings on a variety of clean energy policy topics, partnership building with development agencies and regional and global organizations to deliver support, and an online library containing over 5500 clean energy policy related publications, tools, videos, and other resources. Our primary audience is made up of energy policy makers and analysts from government organizations in all countries, but we also strive to engage with the private sector, NGOs, and civil society.

The Solutions Center is an international initiative that works with more than 35 international partners across its suite of different programs. Several of the partners are listed above including research organizations like IRENA and IEA, and programs like SEforAll, and regionally focused entities such as the ECOWAS Center for Renewable Energy and Energy Efficiency. A marquee feature that the Solutions Center provides is a no-cost expert policy assistance, known as Ask an Expert. The Ask an Expert service matches policy makers with one of more than 60 global experts selected as leaders on specific clean energy finance and policy topics. For example—in the area of appliances and equipment, we are very pleased to have Christine Egan, of Class, serving as one of our experts.

So, if you have a need for policy assistance in appliances and equipment, or any other clean energy sector, we encourage you to use this valuable service. Again, the assistance is provided free of charge, and if you have a question for our experts, please submit it through our simple, online form at cleanenergysolutions.org/expert. We invite you to spread word about the service to those in your networks and organizations as well. Now, before we begin our presentations, I'd like to provide a brief introduction of today's panelists. First up today is Paul Kellett.

Paul manages UN environment's United for Efficiency program, and has been involved in energy efficiency and renewable energy activities for over the past 20 years. Following Paul, we will hear from Rolf Smeets, who has over 25 years of experience in several branches of the lighting industry, and is currently the director of global public and government affairs at Phillips Lighting. Next, we'll hear from Nathan Mouw, the senior director of global product safety and regulatory affairs at Whirlpool Corporation, which is the world's largest home appliance manufacturer. After Nate, we will hear from David Manrique, who currently leads sustainability efforts at Mabe, a leading appliance company in Mexico and Latin America. Following David, we'll hear from Ajit Advani, who's an advisor to the International Copper Association on topics related to energy efficiency, renewable energy, and energy access.

And our final presenter today is Angelo Baggini, who's an aggregate professor of electrical engineering at the University of Bergamo, and an international consultant on energy efficiency transformers, power quality, and renewables. And with those introductions, we would like to welcome Paul to the webinar.

Paul

Thank you very much indeed, Stephanie, and a very warm welcome to everyone joining our webinar today. I'm very happy to introduce United for Efficiency and to give a short overview of the initiative's activities. United for Efficiency—or U4E for short—is a global initiative managed by UN Environment which is working with developing in emerging economies to help them get the most out of their electricity, improve the security of their energy supply, and to strengthen their economies by accelerating the adoption of energy efficient lighting, appliances, and equipment. And the overall aim is to cut global electricity consumption by 10 percent by 2030 with proven more

efficient technology and successful policy solutions. And that started back with lighting in 2010, helping countries to phase out incandescent lighting and to leapfrog to high performance lighting alternatives like LED lighting.

So, policymakers around the world have been intrigued by the opportunity and the results of the program, so the initiative expanded in 2015 to include the next high-impact savings opportunities, which you can see at the bottom of the slide. We have lighting, residential refrigerators, air conditioners, electric motors, and distribution transformers. The United for Efficiency initiative is currently supporting 36 countries. It's funded primarily by the Global Environment Facility—GEF—and is supported by more than 30 global companies and organizations, including some of the world's leading manufacturers and environmental organizations. Next slide, please.

So, there are tremendous economic, social, and environmental benefits to be gained from energy efficiency. As you can see on the screen, savings on electricity bills increases purchasing power. Energy efficiency frees up power generation capacity for development. It reduces CO2 emissions and air pollution, and accelerates economic development. Essentially, energy efficiency is the first fuel.

Efficient products accelerate economic development and higher standards of living for everybody, and it is a truly global opportunity. It's available in every single country. Our recently completed country savings assessments show a 5 to 10 percent electricity saving available in every country from straightforward energy efficiency measures. Next slide, please. Over half the world's electricity is consumed by the five products that are targeted by United for Efficiency.

And you can see the products—room air conditioners, indoor and outdoor lighting, electric motor systems, residential refrigerators, and distribution transformers. Most all products that are in use and some of the new ones that are sold today waste a lot of electricity. This leaves less money for residents, businesses, and governments to spend on other priorities, and these products can be in service for 10 years or more. And consumers in developing countries are buying much more of them. For example—the number of air conditioners and refrigerators in developing and emerging economies will double in the next 15 years, adding an extra 1 billion refrigerators and 1 billion air conditioners to the global stock.

So, now is the time to ensure that high performance products take over the market to avoiding locking in inefficient and outdated products that waste large amounts of electricity. Next slide, please. So, our experience from around the world has shown the success of applying a five-step, integrated policy approach, and this integrated policy approach transforms markets. And, as you can see, the five steps on the screen—Standards and Regulations, Supporting Policies—which include labeling and communications programs—Finance and Delivery Mechanisms—including incentives—Monitoring Verification and Enforcement, and Environmentally Sound Management and Health. So, United for Efficiency emphasizes setting mandatory performance standards as a cornerstone for all other activities.

So, no single policy or program alone will suffice. For example, setting mandatory standards or requiring product labels without testing creates an opening for banned products to enter the market. Consumers lose out on products that perform poorly. Utilities and financial institutions are forced to invest in building costly new generation capacity unnecessarily. Manufactures of compliant products may lose market share to competitors who dodge the rules to cut costs.

So, monitoring verification and enforcement measures are a key component of the integrated policy approach, and they cannot be separated, really, from mandatory standards. Next slide, please. So, U4E works together with more than 30 project partners. There are manufacturers and industry associations, technical organizations and initiatives, funder and implementing agencies, as you can see from the slide. It takes a wide range of stakeholders to help set the right policies to successfully transform a national or regional market.

UN Environment leads United for Efficiency, which brings together this impressive array of leading global manufacturers, as well as energy and environmental organizations to help implement the initiatives at all levels. And each partner brings unique resources and expertise to bear in the countries and regions where we work, and we'll hear more later. Next slide, please. So, United for Efficiency offers a steady progression of support for policy makers to help them transform their markets to energy efficient, high quality products. We have three levels of support.

Our first level of support includes analysis and guidance to highlight the significant benefits of improving product efficiency. We also note global best practices and offer case studies. And the main focus of today is our new U4E policy guides on the five products. And we have a lot more information and resources available freely from our website. On the second level—the second level of support is when we tailored this analysis and guidance for use at the regional level.

For example—we worked with regional stakeholders to jointly asses their markets to identify which products are being sold and by whom, how much is imported or manufactured domestically, how they are distributed, the perform of the products, the impact on the electricity grid—such as peak demand—and which energy efficiency policies are currently in place and how are they enforced. So, with this information, we jointly develop a road map that identifies effective policies and opportunities for countries to collaborate on a regional level—for example—setting the same standards regionally, using the same product labels regionally, sharing testing facilities, and monitoring and verification activities. Our third level of support is the most in-depth. We work with national governments and local stakeholders to adopt, implement, and enforce strategic, sustainable energy policies, and these are full market transformation programs at the country level, taking between three and five years to complete. But they succeed in high market penetration levels for high quality, energy efficient products.

Next slide, please. So, you can see an example of one of our country savings' assessments. We've completed 150 country saving assessments and they show a considerable monitoring environmental savings that are available for countries that pursue a market transformation program. They are short, three-page assessments, and they show the energy, climate, and financial benefits of switching to energy efficient and climate friendly products. Savings of between 5 and 20 percent for a country are readily available.

The example shown here is from Nigeria, where over 10 percent of electricity can be saved, resulting in $500 million US saving for Nigerian consumers annually. So, there are very significant savings available and the opportunities are clearly identified on the three-page country saving assessments. And the assessments are available from our website. Next slide, please. So, the map shows our growing portfolio of regional United for Efficiency projects in different parts of the world.

The regional activity is shown in green, and we are active in West Africa, Central and Southern Africa, in the 10 countries of the Southeast Asia region—the Asian countries—and in Central America and the Caribbean. Next slide, please. United for Efficiency also currently has national projects in more than 14 countries, which you can see stretching across the different regions. These involve implementation of our full integrated policy approach, minimum energy performance standards, effective labels, monitoring verification and enforcement, financing and incentives, and environmentally sound management. We find that policy makers often start—as is the case, you can see, in Chile for example—with one product, such as lighting, and expand to other electrical products once they understand how the integrated policy approach works and how it can benefit them considerably.

So, energy efficient lighting has progressed the most as we've been working on that since the start of the initiative seven years ago, and we are steadily adding appliances and equipment to countries for [Break in Audio] transformation programs. With our regional country projects, United for Efficiency is currently working with 36 countries to transform their markets to much more energy efficient products. Next slide, please. So, just to say in conclusion, please consider joining us in Bonn in Germany on November 15th at the COP. We will be talking about all of these issues and more during a dedicated daylong event on energy efficient appliances, lighting and equipment, and registration will be opening soon.

Just e-mail us if you want to receive further updates. Our U4E video on YouTube also provides a good introduction to our work, and the link is shown on the slide. And I would now like to hand over to our United for Efficiency partner, Rolf Smeets of Phillips lighting, who would introduce the first of our U4E policy guides—Accelerating the Global Adoption of Efficient Lighting—followed by our other distinguished speakers from United for Efficiency's task forces on appliances and equipment. And please contact us for more information to learn more about our upcoming full day event, as I've mentioned, and how to join our transformational partnership to save 10 percent of global electricity. Thank you.

Rolf Thank you, Paul. Can I have the next slide, please? Okay, so in the section—we're going to focus on lighting. As Paul already mentioned, lighting was the first technology to have a policy guide issued under the banner of the Enlighten partnership program. So, lighting was the trailblazer in this process of creating policy guides.

Considering the rapid evolution of LED technology, the guide was fully updated in 2016. The previous guide was focusing very much on progressive lighting; the new guide is now entirely focusing on LED lighting. Not only does LED outperform the previously common fluorescent lens, it also becomes much more affordable, thanks to ongoing innovations and to improve economies of scale. You might wonder if the conversion towards energy efficiency lighting towards LED lighting well under way—well, as a matter of fact, most counties have no—or have very limited measures in place—to incentivize or to regulated the adoption of energy efficient lighting—the so-called carrot and stick measures. So, lacking these measures continue to drive consumers towards the cheapest solution in terms of purchase price, which are far more expensive in terms of their energy consumption.

Just to give you two examples, last year—2016—globally, more incandescent lamps were sold. The inefficient has a 25-year-old technology. More incandescent lamps were sold than LED lamps, and if we consider street lighting, globally, we estimated there are 300 million street lights, and only 10 percent of them is converted to LED, while LED can deliver 40 percent of energy saving compared to conventional discharge lighting. So, with quality LED bulbs, quality LED lighting, there's significant potential, as Paul already mentioned, to improve the energy efficiency in a highly sustainable way while actually providing a better quality of light all along. From all energy efficiency measures, lighting is generally considered to bring the fastest return on investment in terms of savings and reduced carbon emissions.

Next slide, please. So, here you see an overview of all the technologies covered in the lighting policy guides. Actually, we cover all technologies from left to right, including incandescent, halogen, fluorescent, the so-called high-intensity discharge lamps, and now, halos, LED lamps. That means that in terms of application areas, the scope has also been extended from residential lighting only to now also include commercial and public buildings, as well as outdoor lighting. And, from the various light sources shown above, LED offers alternatives to each and every technology, as a matter of fact.

So, the most important different differentiator between technologies is shown in the first two rows, which is the efficacy and the lifetime. Efficacy in lighting is to measure for the energy efficiency of a light source—measured as the amount of light per the amount of energy being used. Just as an example, a very common 60-watt incandescent bulb today can be replaced by a typically 7-watt LED bulb, which previously, would be a 13-watt cut back fluorescency of lilamp. So, roughly, LED is 10 percent as efficient as incandescent, and double as efficient as CFL lilamps. And, _____ tubes—very common fluorescent tubes—a common 36-watt TA tube can typically be

replaced nowadays by a 14-watt LED tube, rendering, again, a savings of more than 50 percent.

Next slide, please. So, over the next two decades, we expect the amount of lighting to rise massively as a result of population growth, increasing urbanization, and more people being connected to the grid or to microgrids. As the previous example demonstrated, transition to energy efficient lighting could easily reduce the electricity demand for lighting by 40-60 percent in 2030, and getting this transition right would unlock multiple benefits not only in the savings, but also in terms of investment, in terms of security, generate new business, et cetera. This would require us to leapfrog towards the best available technology, which means towards LED. And while LED—and this is the graph shown at the very bottom—LED tend to have a higher initial cost, prices over the last years have fallen rapidly, and many economies, prices are on parity between LED and CFL-Li.

LED, compared to CFL-li, offer though many benefits, including longer lifetimes, they're less fragile, they give instant brightness, and contain no mercury. So, here you see an example of efficacy measures—minimum efficacy measures—that apply in the United States and in Europe for general purpose household lamps. On the horizontal axis, you see the light output; on the vertical axis, you see the minimum efficacy required in order to be allowed to the market. We encourage—as Paul already mentioned—we encourage countries to consider harmonizing with neighboring counties on a regional level, which would offer benefits to stakeholders, in terms of better prices and better choice of products, because manufacturers can achieve economies of scale, and countries and suppliers do not have to replicate test facilities and test results on a national level, because they can reuse test results across countries. Next slide, please.

This, the last slide, Paul already showed the integrated five-step approach. We definitely promote the integrated policy approach to transform market towards energy efficient quality lighting products. And "integrated" here means that the five elements are inseparable. So, regarding performance standards, we do recommend to focus on a limited set of requirements focusing on the minimum efficacy requirements, because this will enable effective enforcement. Paul already referred to free riders that might circumvent the regulation if the standards set is too complicated.

Supporting policies remain important to increase public awareness and to create the buy-in. Important also—adequate financing mechanisms to overcome this initial investment hurdle and to unlock the saving potential, which exceeds the investments by far. And finally, there also should be policy measures that ensure the sound processing of products that are being replaced, especially when they contain mercury in electronics. So, the policy guide for lighting includes ample examples of global best practices, and, as Paul already mentioned, the team—the U4E team—is very keen to support regional implementation projects and capacity building to pick the benefits of lower energy bills, lower greenhouse gas emissions, while stimulating the

economy with better lighting. With this, I'm happy to hand over to Nate Mouw to cover the technology of refrigerators. Thank you very much.

Nate

Okay. Thank you, Rolf. This is Nathan Mouw from Whirlpool, and we're thankful to have this opportunity to talk about the policy guides and this policy approach. Our _____ history of domestic appliances—particularly refrigerators—has made great progress on the journey of producing energy efficient climate friendly refrigerators for markets all around the world, and we're happy to discuss this topic and support the efforts here to move this along. As the title indicates, it's all about policy and it encourages producing and marketing refrigerators that are two things: number one—energy efficient; number two—climate friendly. A lot of effort has gone into this policy guide, and we really feel this approach can lead to great outcomes for consumers, for governments, and for industry, and I think you'll find that the recommendations made in the policy guides are very practical and very sensible.

Next slide, please. So, why focus on refrigerators? Well, refrigerators are one of the first items purchased when electricity becomes available. As a result, they're the most common appliance found in household, and unlike other appliances, refrigerators, once they're purchased and in the home, they're on all the time. In developing markets, they're typically unregulated.

As a result, whatever is cheapest is what sells, and, given the trends we see in developing countries and emerging economies, we expect the stock, as Paul mentioned, we expect the stock of refrigerators to double by 2030. Outdated ones, ones already on the market, consume up to three times of the energy of the best new models. Most of the time, these products last a decade or more, unfortunately locking in energy waste for those years. Once they're discarded—now, the refrigerants in these products are rarely captured for processing, and instead, escape to the atmosphere. The refrigerants that are used are very potent, often times having a global warming potential of more than 1,000 times that over CO2; others damage the ozone layer.

It's important that any policy that we consider address disposal of refrigerators as well as energy efficiency. So, now's the time to act, and this policy guide is a good start to that. The scope of this guide is what you see on the screen, and that's refrigerators, freezers, and fridge/freezers. All of these products, of course, have the purpose of storing and preserving food items just to keep fold cold or to freeze the food items for longer-term storage. In many of these economies, in many of these markets, this is the first time a family would have such a product, and are, of course, thrilled to be able to preserve and store food.

Some of these products also are designed and equipped with an ice maker that's built in, and they come in a variety of sizes around the world. Now, many—up to 50 percent of those—are smaller than 250 liters. And, of course, in other markets and other economies, they get bigger—roughly 21 percent of those are greater than 350 liters. Next slide, please. As I've mentioned, the energy efficiencies of refrigerators has improved tremendously over the years.

The things you see on the screen—insulation, compressors, and controls—these are things that manufacturers have looked to as tremendous gains for energy efficiency. It's improving the thickness of the insulation of the foam, improving the insulation factor of the foam, implementing compressors and products around the world with much greater efficiencies than those used in the past, and often times, with little cost impact to the product and to the consumer. Controls have been improved to implement variable speed compressors, and, as a result, again, the efficiency of products has gone from pre-regulation time of roughly 700 kilowatt hours per year down to a tremendously efficient 250-kilowatt hours per year. So, as we seek to implement energy efficiency policy for refrigerators, we should consider setting standards that arrive at the lowest life cycle cost, which is really the sum of the purchase price plus the operating cost for the product. Next slide, please.

So, as we talked about, energy efficiency's an important effort, but it's not the only one that this policy guide is designed to address. Refrigerators are unique in that they have the potential of having other significant climate impacts as well, especially older products that are on the market. We've come a long way in being able to reduce the direct emissions of refrigerants and foaming agents. You can see in the plot on the screen just a tremendous reduction in the emissions reductions by improving the foam blowing agents within the foam, as well as transitioning the refrigerants to more climate friendly refrigerants, as well as significantly increasing the efficiency of these products. On the left side of the slide, you can see the potential result or outcome that is out there if we take this seriously and we're successful with this project.

By 2030, we can expect, in the year 2030, to have an annual energy savings of around 150 terawatt hours, lower emissions to around 90 million tons, and lastly, save consumers money—save roughly $14 billion for consumers. Those are big numbers. Those are numbers that we should all strive for and hopefully, someday look back and feel real satisfied that we're able to get to that outcome. Next slide. So, lastly, again, the refrigerator guide—we recommend and proposed the integrated policy approach as Rolf described as well—five parts to that.

Rolf already covered a number of them in more detail, so I'll just touch on a couple of things. First of all, we need to adopt standards or MEPS that are tied to a specific test procedure. So, we recommend a test procedure that is on the slide that is IEC 62552. This test procedure is adaptable to the local climate and storage temperatures of these products that we used in, achieve good reproducibility, and more cost-effective testing, and is also less prone to cheating and circumvention than other methods of testing found around the world. So, along with that, of course, we need supporting policies—things like performance labels—that consumers can look at as they look to make a purchase decision.

As Rolf described as well on lighting and refrigerators, we need monitoring, we need verification, and we need enforcement to make sure that all players

that are importing or manufacturing products in a market are doing so under the rules that are in place. Like lighting as well, we need financial mechanisms in place. Often times, these products are very efficient and will save money over the long term, but often, customers see the initial cost of them—the higher cost—as a barrier in the financial mechanisms to get over that barrier. And lastly, as I've talked about for refrigerators in particular, we need to really focus on end of life disposal. I hope that as you take a further look at the policy guide that _____ _____ on refrigerators, you'll find that it's very sensible, very practical, and I think it's an approach that can be implemented in any market around the world.

And with that, I'll turn it over to air conditioners. Thank you.

David

Thank you, Nathan. Well, in my case, I will present air conditioners. Could you go to the next slide, please? Okay. So, just as refrigerators, air conditioners are often unregulated in some countries, but it is recommendable to regulate them because of the impact that they have.

As, was stated before, the global stock will double by 2030. And the impact of this kind of equipment is very large. For example, in some households, 20 percent of the energy is due to this kind of equipment. And, in the last years, the global warming potential of the refrigerants of this equipment is actually above 1,000 points. So, it is very recommendable, and this policy covers how to create regulation for this kind of equipment.

Could you go to the next one, please? So, this policy have the scope of basically, all the technologies that are around the world, and specifically to the ones that are more used right now that are the mini-split, but it is important to understand that this policy covers all these kind of technologies and it has been used around the world. Could you go to the next one, please? Okay. So, in order to create a policy, this policy guide give you an example of how different countries are using these kind of standards.

And the idea of this policy is to use international standards, just like many other countries has done already before. And for this specific technology, there have been many improved—just like refrigerators—and we know for each kind of improvement how much the efficiency has been leveled up. Just like, an example, using a different compressor has increased efficiency up to 18.7 percent or changing the variable speed of drives or those kind of things could have on this technology. This policy actually supports the idea of using better technology and creating incentives for all their manufacturers to have a better technology each time. So, it's, in that case, all the regulations should be made to do that kind of situation.

Can we go to the next one, please? Okay. Now, it is very important or this case that we understand that sometimes, that these kind of technologies, that when they're very, very efficient, seems to be very expensive, but if we see this in an approach seeing all the life of this equipment, we will actually see that the cost of this equipment is lower than our equipment that could be less expensive in the investment, but is more costly in the operational. As an example—for example—an air conditioner that use an EER of 3.2—that is

not very efficient—would cost, in all its life, almost $2,000.00. But, in the case for air conditioner that actually is more expensive as a technology, it will use only $1,900.00.

60 percent of that cost is the equipment, but only 40 percent of that cost is the operation. So, this will have a very big impact in savings of energy. For example—it's calculated that the energy saving would be for of 620-terawatt hour or actually, it will reduce the emission to 480 megatons of CO2. So, the improvements that these kind of technologies would do in the long run is what this is specific _____ is cost for. Now, could you go to the next one, please?

Okay. This energy guide—or this policy guide—is actually covers, as Paul said before, an integrated system. And, for example, in Mexico, we use these standards, but we use international standard just to see how this would work. We use the EER. It's a specific indicator for the energy efficiency of the product.

And it has been very convenient for us for many, many years. But we actually recommend—and it's very important to have a monitoring verification and enforcement system. Without these kind of systems, sometimes, the policies doesn't work. So, in Mexico, we actually have different institutions to handle all this part of the product, and all this part of the policy implementation.

And, finally, in Mexico, we have a very good experience in environmental sound management, but trying to destroy or dispose refrigerators and ACs, and it was very successful. And with this, we make sure that all the benefits that energy efficiency has and the destruction of the refrigerant are done properly. So, it's very important that this policy guide actually covers all that, and will make you see and help you to see all these kind of benefits. So, with that, I think that's all I have, so I will leave the room to the next presenter.

Ajit Thank you, David. My name is Ajit Advani, and I shall now provide an overview of the energy efficient electric motors and motor systems policy guide. Next slide, please. Electric motors are everywhere around us, either used for transporting people, such as in trains, electric _____, and elevators; for transporting materials, such as in baggage conveyers, or pumping water and other liquids, such as in domestic water pumps; or delivering air and gas, such as in electric fans and representative compressors. 53 percent of global electricity is consumed by electric motor systems.

Of this, the industry and building sectors account for over 92 percent. The energy efficiency of individual motor systems can be improved by up to 20 to 30 percent in many cases. The use of motors is going up as economies grow and populations increase. This demand will accelerate as more electric breakers are used for transportation, as oil fired buildings are replaced with electric heat pumps, and the use of domestic appliances increases. Next slide, please.

The policy guide focuses on the subset of motors with the most significant opportunity for overall energy savings. These are general purpose induction motors in the output range of 0.75 to 375 kilowatt. These comprise only 10 percent of the stock but account for 68 percent of the energy used by motors. A parallel area of focus is the overall motor system, which further includes the driven equipment, the power supply, controls, transmission, and other mechanical and process components. Next, please.

The energy efficiency of a motor is defined as a percentage of the input electrical energy that is converted into useable mechanical energy. The energy efficiency of a motor can be improved through several design and manufacturing process improvements. These include reducing energy losses in the magnetic core and the electrical conductors, using low friction bearings and an efficient cooling fan and so on. These solutions typically add to the initial price of the equipment, but they yield energy savings that lower utility bills and result in a lower overall lifetime cost of ownership. Next, please.

The International Electrotechnical Commission—or IEC—is an intergovernmental standards organization of 82-member countries. IEC has provided the basis for internationally harmonized minimum efficiency standards, or MEPS. The colors show the minimum efficiency level required for a given kilowatt size of motor for each efficiency class. These are for 4 pole 50 hertz motors. Similar colors exist for 2 and 6 pole motors, as well as for 60 hertz motors.

As you can see, the efficiency classes are defined from IE1 to IE5, with IE1 representing standard efficiency and IE5 representing ultra-premium efficiency. A large number of motors around the world do not even meet the standard efficiency 1E1. This is either because the country does not regulate and enforce motor standards, or because it's an old motor that was purchased many years ago. At the other end, while IE4 super premium efficiency motors are commercially available, the ultra-premium efficiency class IE5 is currently aspirational, and it shall be defined in detail in a future edition of the standard. IE5 is expected to define an improvement of around 20 percent relative to IE4.

Next, please. To start the market transformation, it is recommended that developing in emerging economies set mandatory minimum energy performance standards—or MEPS—for motors. Just like 41 countries which account for 81 percent of global electricity use in motor systems have done so far. Not to do so risks locking in inefficiency for decades, as motors have a long life, at times, of more than 20 years. The economy also risks becoming a destination for inefficient motors not acceptable as well.

IE3—or premium efficiency—is the current policy best practice for MEPS, with most countries having either adopted it or set a target date for its adoption. Next, please. Much higher energy savings can be achieved by improving the performance of the overall motor system, but it also more complex. This is an example of a pumping system to deliver a certain volume of fluid at a given pressure. The conventional design shown in the upper

figure requires an input power of 100 to deliver an output power of 31, thus giving a system energy efficiency of 31 percent.

The lower figure shows a redesigned system for delivering the same fluid flow and pressure. A variable speed drive, rather than a mechanical throttle, varies the flow. The motor, the pump, the coupling, and the pipes have all be replaced with higher efficiency ones. So, in the energy efficient design, the input power required reduces to less than half—from 100 to 43. That is giving a system in energy efficiency of 72 percent.

Next, please. In accordance with the integrated policy approach of U4E, the motors' policy guide recommends setting MEPS at a minimum level of IE2 with a time table for graduating to IE3. For countries without domestic manufacturing, MEPS can be set directly at IE3. MEPS are to be accompanied by appropriate supporting policies. These include the adoption of IEC nameplates which show the IE efficiency class of the motor and the professionalization of motor repair practices.

Supporting policy should also encourage the improvement of the energy efficiency of overall motor systems. These are to be accompanied by a strong monitoring verification and enforcement framework, and appropriate financial delivery mechanisms. And finally, the policy guide emphasizes the safe disposal of motors at the end of life. This is facilitated by the fact that about 98 percent of a motor is recyclable and includes valuable metal scrap. I hope this brief overview will encourage you to look at the motors' policy guide in detail, as there are many more recommendations in it.

Thank you for your attention. I shall now hand over to Professor Angelo Baggini to cover the transformers policy guide.

Angelo

Thank you very much, Ajit. I'm Angelo—Angelo Baggini speaking, and I would like to introduce the policy guide dedicated to power transformers. First of all, let me speak about some basic details, because, lighting equipment, refrigerators and so on, are a variable in _____, while the transformer are very, very diffused, but usually, they are unknown except for the specialist. Transformer are a static equipment to transform electrical energy into electrical energy, adopting a voltage level to decreases losses in the network. Higher is the power, larger is the voltage needed, and then lower is the current.

Transformer, as a huge impact on energy because of a lot of reasons. Even if they are very, very performant equipment, their losses are not negligible at all, at least for too many reasons. The first is that the total amount of electrical energy is very large, and the second is that a large part—the major part of electrical energy is transformed—by transform more than once. The first time it's generation, then the transmission, and then at distribution at the medium voltage or low voltage network. So, even if a transformer has efficiency close to one, this effect produce a large amount of losses.

Globally, worldwide, transformer losses are equal to the electricity consumption of Japan—that is one and one terawatt hour. Next slide, please. One issue is also related to the increase of electrical consumption around the world, and then also, to the number of transformers around the world. For this reason, we have prepared a policy guide focused on transformers. The ways to classify transformers are very different around the world.

We can classify transformers in terms of voltages, in terms of related power, in terms of fashion, in terms of technology, in terms of number of phases. By the way, one of them is to divide them on the basis of voltage. A large power transformer over a 230 KV—typical liquid fill transformer—it is mainly liquid filler transformer; single or three phases—medium power transformer—between 36 and 230 KV, single or three phase liquid fill or dry type. Or medium voltage transformer for the distribution network—or should call it distribution transformer—less than 56 KV, single or three phases according to the practices around the world. Typically, liquid filler, but in the industry, quite often also dry type transformers.

Then, last, but not least—because of number of situations—low voltage transformer—less than 1 KV. The guide approaches all of this classes of transformer, even if, let me say, the most important categories is the one of medium power transformer because of number of units together with the leg of control. Let me explain better. For a large power transformers, a lot of specialist approach any commitment and any unit. Medium power transformers are important, but are usually both in the general market, also why [Inaudible].

Next slide, please. They ways to approach energy performances of transformers are different and let me say, I use the term "energy performers". It's not necessarily energy efficiency of energy transformers, because in transformers, we have losses as well as in any other equipment, and this affect losses. Losses in transformer are into the core, and they are called no-load losses, because they depend on the voltage and on the windings or load losses—depending on the load factor. This _____ of losses combined with the power delivered can be transformed, can be expressed in terms of transformer efficiency.

And the green _____ in this graph represent the transformer efficiency guide at least for these transformers. We can immediately see that we are the maximum. This is for when load losses equal to no-load losses. So, the problem is double. To select the most energy _____ transformers and to use the transformer in with the best load factor.

Indeed, this requires a lot of knowledge and is harder to be done. For this reason, _____ a different matrix to approach this issue for transformers—let me say, I would prefer the one of losses—the—I see one—the one used in Europe, because this automatically guaranteed the maximum level of losses, even if we can approach this is an issue—also with efficiency like in the United States, for example. Next slide, please. For this reasons, 13 world's largest economy already have some tool to manage market transformations in transformers, but a lot of other very important economy now don't have any

tool for doing this. The saving potential is very high—400-terawatt hour corresponding to 250 million of tonnes of CO2 in 2015.

The risk of a nation is important—very important—because transformer live for a long time—sometimes, 25 years or also, more. And let me say that we always mention CO2 emissions, but in the end, we look, first of all, on money. From the point of view of total cost and money, investment in efficient transformer is good business and is a very _____ business. Indeed, the cost of an energy performer transformer is higher than a big one, but, as the transformer process so much energy, the savings during the long life of the transformer are direct impacted also in terms of money. The next slide, please.

The next slide, please. Okay. Thank you. This are the efficiency queues represented in terms of IEC stand up at 50 percent upload of some economy around toward including my country that is Europe. This is for three-phase liquid filler transformers.

Some of them are more performant; some other are less performant. In my opinion, what is really important is to start this process in a way or in another way. Sometime, we say "Yes" in Europe for a low power. The requests—the _____ are very low.

This is true, but low power are not used in Europe. The next slide, please. This is the same for single phase transformer very used in some region around the world, and so, very important for energy savings. I show you only a liquid filler transformer queues. Indeed, there are also for dry type transformer.

Let me say, more in general, that liquid filler transformer are more performant than dry type. When needed, dry type are very okay, but quite often, the performances are confused on the market. The _____ is important and the good with the bad energy efficiency is usually low. The final slide, please. The next slide, please.

Okay. Perfect. So, some simple recommendation for policy makers. The first one is to have a check to the guide—much more detailed than my speech. But, in this guide, the main concept is to adopt minimum energy efficiency performance standards, preferably according with the _____ of the set-up set in the IEC 676—that is the most common around the world; to adopt supporting policies in terms, at least, of labels that are in terms of communication campaigns.

Indeed, humans are humans, so it's very important to implement monitoring verification and the enforcement program—initial legal framework—to try to really put in place the section about the financial mechanisms. Indeed, these are good and it's better to encourage to adopt them, to encourage the adoption of _____ and purchasing practices of energy efficient transformer. But, let me repeat that that is just matter of first cost, because an energy efficient transformer in the full life is a—as _____ said—itself would also, from the point of view of money. Last but not least, in the past, we installed around in the world, and we still have a lot of units containing PCB. PCB is not code at

all for _____ and the option to eliminate these units then substitute them with the energy efficiency new units is good also for PCB disposing.

Thank you. That's all from my side.

Stephanie Great. Thank you so much for those wonderful presentations. Now, we would like to open it up to the audience for questions. So, if you have a question, please type it in the "Question" pane on the GoToWebinar toolbar. And now, I will hand things over to Julia for the question and answer session.

Julie Yeah. Thank you, Stephanie. Hi, everybody. So, this is Julia, and we already actually got some questions from our _____. So, I will start with the first question addressed to Paul Kellett.

So, the bulk of products today are made in China. Are you trying to involve China's companies and institutions in the U4E partnership?

Paul Thank you, Julia. Yes. I believe it's something like 85 percent of lighting products are manufactured today in China, but we work very closely with UN environments collaborating center—the Global Efficient Lighting Center in Beijing in China, focusing on quality control. And the Global Efficient Lighting Center [Inaudible] United for Efficacy in training national laboratories and the staff in national laboratories to international standards so that they can independently test, monitor, and verify the standard of LED lighting. Currently, they're working in some four countries—Chile, Jordan, Pakistan, and Tunisia—and this is very important monitoring and verification enforcement activity.

We also regularly engage with the Global Efficient Lighting Forum—the last one was in 2014—to discuss the developments in the industry and to make sure that the quality control issues are covered. And the next Global Efficient Lighting Forum is expected in 2018.

Stephanie Hi, Julia? We can go to the next question, but it looks like your microphone might be muted. Okay.

Julia Okay. So, the next question is—actually addressed to all panelists—is how can we integrate renewable energy with energy efficiency policies to maximize climate benefits?

Ajit This is Ajit Advani. I'll take that question. Actually, energy efficiency and renewable energy complement one another completely. As Paul Kellett had said at the beginning of the presentation, energy efficiency's the first fuel. And, by using energy efficient appliances and equipment, as well as becoming more energy efficient in buildings, industry, and transportation and so on, we reduce the demand for energy in total—electric power, specifically.

And this, therefore, means that the limited investments that are available for renewable energy can cover a greater proportion of the energy demand. The International Energy Agency has an estimate in its world energy outlook that actually looks at the scenario going all the way up to 2030 and beyond, and

almost half of the savings in the carbon emissions will come from energy efficiency, and the renewable energy portion would complement that, but it's a much smaller proportion that will come through renewable energy. I hope that addresses your question.

Julia [Break in audio] or [Inaudible] can you answer this question?

Stephanie Julia, I believe your audio cut out a little bit. Could you please repeat the question you were asking?

Julia Okay. Let me repeat the question. So, this is a question for Nathan and David, our cooling experts. What is the difference between EER and SEER?

David Hi. This is David. Basically, the—well, in general terms, SEER considers seasoning and EER does not consider seasoning and only consider what is the power—the thermical power removed from the environment over the electrical power used to remove that. That's the basic relation. I don't know. Nathan, do you want to add something?

Nathan No, that was well done. Nothing to add.

Julia Let's move with the other question—how the registration system should be used in the MVE—in the Monitoring, Verification, and Investment process. This is a question addressed to all our panelists based on your experience. So, please, if you have any experience in this sector, answer to this question.

Angelo May I start? May I start?

Stephanie Of course. Go ahead.

Angelo Okay. Frankly, I don't have real experience on that in Europe, because the MVE has been set up, but let me say it does remain, therefore, transformer more theory than practice. So, my suggestion is to set up it in the simplest way and to finance from the beginning, because for sure for transformers, the number of issues in verifications are completely different and more difficult than for other, let me say, smaller [Inaudible].

Rolf Stephanie, if I may add—Rolf Smeets, Phillips Lighting speaking here. In lighting industry, we, of course, have already a long history of working with these registration schemes. As a matter of fact, my earlier plea was to keep the monitoring of verification and enforcements _____ as simple as possible, because we've indeed seen examples of a massive amount of requirements, which are then very, very difficult to maintain. It's like indeed, putting speed limits, but without control and indeed, the people that are malicious will violate these requirements at the cost of consumers that are living unsafe and—well, in this case—we're lighting other manufacturers would face an un-level playing field. Reputable manufacturers are investing a lot in quality control, and indeed, unfortunately, there are requirement supplies that are either not willing or absolutely won't comply.

Even with the registration schemes, we've seen phenomena of so-called "Golden Samples" where a good lens were tested, but then the actual supplies were of a completely different—and, I should say, lower quality—than the ones that were tested and registered. So, in a nutshell, the example we've seen in the states and in Europe where regulation has been adopted already for energy efficient lighting is keep it simple. Focus on minimum energy efficiency, which is very easy to control by consumer organizations, and, indeed the ones that are violating, their requirements will easily, in a very transparent way, be identified and be expelled from the market. So, keep it simple. And mandatory registration schemes—we do not have too many good examples of that, but indeed, voluntary adoption of a simple but stretching set of requirements has proven to be the most effective way of doing business. I hope this was clear.

Julia Thank you. So, let's go with another question on transformers. So, is PCB free liquid—is available now? Professor Baggini, maybe you can answer to this question.

Angelo Sure. Repeat me the question, because I didn't understood or hear.

Julia Okay. No problem. PCB free liquid is available now?

Angelo PCB. Unfortunately, PCB is still in a lot of transformer units around the world—in the most developed economy as well as in the other economies. This for simple reasons. Life of transformer is very, very long, and so transformer, from age when the effect of PCB were unknown are still in service. Sometimes, they also have been treated, but not in the proper way. So, in any case, PCB is to be taken into account still today.

Julia Okay. So, we go now for the last question. That is a question open to all our experts online. Finance mechanisms in place to support adoption of energy efficiency policies are available in our United for Efficiency program.

Rolf This is Rolf Smeets, Phillips Lighting. I think in the lighting guide, we have a number of examples of successful financing schemes. One of the examples that is often referred to is the way that the Indian government has turned a massive transformation program into practice using on bill financing—so, where consumers can, at a very acceptable, affordable price level, buy energy efficient LED bulbs and finance this through on-bill financing. So, that means that during 12 months or 10 months, they pay 10 rupees, which, after 10 months, then has paid for the light bulb that has costed 100 rupees. So, simply, they get a lower electricity bill, because they have instant savings from using the bulb, and through their electricity bill, they pay for the initial investment.

This, of course, is relatively small scale. This is not big amounts of money. But it's a way of, indeed, spreading the cost and basically overcoming the initial investment hurdle, which is a significant hurdle for everyday citizens in India, as you can imagine. So, the money was pre-financed through the World Bank. It was guaranteed from the Indian government, and this allowed them

to procure the lamps and then distribute them and get the financing back through the utilities.

Julia Thank you. Is anyone else of our expert want to respond to this question maybe on other products as cooling or transformers or models?

David Yes. This is David. In our case, there was a program in Mexico called "Change Your Old One for a New One" for refrigerators and air conditioners, and it was very good for the country. Actually, it managed to change almost two million equipment units during a four-year period and it was basically something financed by the World Bank and the Mexican government and it changed all refrigerators and all air conditioners around 10 years to a new one. So, the efficiency paid itself.

All the savings created by the energy efficiency was the one that actually managed to pay the loan to the World Bank. So, that's another example for how to finance this kind of projects.

Julia Okay. Thank you very much to all our panelists. We will try to respond to the questions we have received since the beginning of this webinar, and if you have any other questions, you can send it to our e-mail address—that will be in the presentation. That will be available as well at the end of the webinar. Thank you very much to all.

Stephanie Great. Thank you so much. On behalf of the Clean Energy Solutions Center, I'd like to thank our panelists and attendees for participating in today's webinar. We really appreciate your time and hope that you received some valuable insights to take back to your ministries, departments, and organizations. We'd like to invite you to inform your colleagues and those in your networks about the Solutions Center's resources and services, including no-cost policy support through Ask an Expert.

I invite you to check the Solutions Center's website if you would like to view slides and listen to a recording of today's presentation, as well as previously held webinars. Additionally, you'll find information on upcoming webinars and other training events, and we are now posting the webinar recordings to the Clean Energy Solutions Center YouTube channel. Please allow a few days for that to be posted. Finally, I would like to ask you to please take a minute to complete a short survey that will appear when we conclude the webinar, and with that, please enjoy the rest of your day, and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.