

Impact of “Phase-Out” Regulations on Lighting Markets

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Webinar Presenter

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Sean

Hello everyone. I’m Sean Esterly with the National Renewable Energy Laboratory, and welcome to today’s webinar, which is hosted by the Clean Energy Solutions Center in partnership with the International Energy Agency’s 4E Implementing Agreement. Today’s webinar is focused on the Impact of “Phase-Out” Regulations on Lighting Markets and the Associated Policy Implications.

One important note of mention before we begin our presentations 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.

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simply type it into the "Questions" pane and we can submit those to the panelists during the question and answer session. If you are having difficulty viewing the materials through the webinar portal, you will find PDF copies of the presentation at cleanenergysolutions.org/training and you may follow along as our speakers present. Also, an audio recording of the presentations will be posted to the Solutions Center training page within about a week of today's broadcast. We are also adding the recordings to the Solutions Center YouTube channel where you will find other informative webinars, as well as video interviews with thought leaders, on clean energy policy topics.

Today's webinar agenda is centered around the presentations from our guest panelist Stuart Jeffcott. Stuart has been kind enough to join us to discuss the impact of efforts to phase out inefficient lighting in several countries and regions around the world. Before our speaker begins his presentation, I will provide a short informative overview of the Clean Energy Solutions Center Initiative. Then, following the presentations, we will have a question and answer session where Stuart will address questions submitted by the audience, followed by closing remarks and then a brief survey.

This slide provides a bit of background in terms of how the Solutions Center came to be. The Solutions Center is one of 13 initiatives of the Clean Energy Ministerial that was launched in April of 2011 and is primarily led by Australia, the United States, and other CEM partners. Outcomes of this unique initiative include support of developing countries and emerging economies through enhancement of resources on policies relating to energy access, no-cost expert policy assistance, and peer to peer learning and training tools, such as the webinar you are attending today.

There are four goals for the Solutions Center. The first goal is to serve as a clearinghouse of clean energy policy resources. Second is to share policy best practices, data, and analysis tools specific to clean energy policies and programs. Third is to deliver dynamic services that enable expert assistance, learning, and peer to peer sharing of experiences. And then lastly, the Center fosters dialogue on emerging policy issues and innovation around the globe

Our primary audience is typically energy policymakers and analysts from governments and technical organizations in all countries, but the Solutions Center also strives to engage with the private sector, NGOs, and civil society.

This slide highlights one of the marquee features that the Solutions Center provides, which is the no-cost expert policy assistance known as "Ask-an-Expert". The Ask an Expert program has established a broad team of over 30 experts from around the globe who are each available to provide remote policy advice and analysis to all countries at no cost. For example, in the area of Lighting we are very pleased to have Gustau Mañez Gomis, the en.lighten Project Manager under the United Nations Environment Programme, serving as one of our experts. If you have a need for policy assistance in lighting, or any other clean energy sector, we do encourage you to take advantage of this service. Again, the assistance is provided to you free of charge. If you have a question for our experts please simply submit it through our simple online form at cleanenergysolutions.org/expert, or to find out how the Ask-an-Expert

service can benefit your work please contact me directly at sean.esterly@nrel.gov or at 303.384.7436. We also invite you to spread the word about this service to those in your networks and organizations.

Now, I'd like to provide a brief introduction for today's panelist. Mr. Stuart Jeffcott has been working in energy efficiency for over 25 years. Stuart is currently the lead contractor for the IEA 4E's mapping and benchmarking activities, which seek to inform policymakers of potential product policy pathways through the benchmark of the performance of energy consuming products across international borders. However, over the last 15 years, much of Stuart's focus has been on assisting policymakers in the Asia Pacific region develop product policy, particularly in the development and implementation of more efficient lighting.

And with that introduction, I would now like to welcome Stuart to the webinar.

Stuart

Thank you very much. Let's start by making sure you can see my slides. Alright, can you see those Sean?

Sean

Yep. They're up and all set.

Stuart Jeffcott

Thank you very much. Welcome too, everybody's who's joined. Thank you very much for making the time to hear about the outcome from our study. I'd like to start by thanking our host. That's the Clean Energy Solutions Center. They are very kindly allowing us to use their facilities to let us share our information with you and particularly Sean and another lady who is working in the background, which you probably won't hear from, a lady called Heather. They've both been wonderful.

One additional piece of logistics before we get started, which Sean did mention, as you can probably tell I'm a first language English speaker. I come from the UK, but I come from the north of the UK, so I have a slightly strange accent for some people. If you are a non-first language English speaker and having difficulty following me, if you'd just pipe into your chat box and tell Sean, he will try and sort me out.

Okay, within the part of the agenda I am talking about today, what am I going to cover? Firstly, I am going to give you a very brief overview of the IEA 4E and its mapping and benchmarking analyses and the processes we go to, mainly because lots of people are interested in hearing different things from their particular study and why so I want to give you that background and give you some idea of its independence. Then we'll get onto the main body of the report—the outcomes of the benchmarking study. Then, as Sean said, we'll go to a question and answer session. Hopefully I'll be able to answer anything you may raise.

Let's kick off with the first of those—an introduction to 4E mapping and benchmarking. Let's do it in three stages. It sits under the umbrella of the IEA. That's the International Energy Agency and it's an implementing agreement, which broadly speaking is a group of countries within the IEA that come together and agree to work together on a particular topic area. In

this case it's a bit of a mouthful—a Co-operating Programme on Energy Efficient End-Use Equipment, hence they just call it 4E. There are 12 countries involved and I'll show you those 12 in just a moment. All 12 members sit on this executive committee and they then in turn establish the bits at the bottom, which are called annexes. Think of these as sort of sub-clubs where people contribute money and resources to examine a particular area or a particular cross-sector issue that they are looking for as a group of national or international policymakers where they want some more information. Currently there're three. There is one looking at electric motor systems. There is one looking at solid-state lighting, so LEDs, and one looking at this burgeoning new area of connected devices and networks, so small products. The mapping and benchmarking activity used to be one of those annexes but we've now been absorbed into the central management committee because all the countries participate in mapping and benchmarking exercises, and then there's monitoring one-off projects. That's the broad picture of the umbrella we sit under.

These are the countries that participate—Australia, Austria, Canada, Denmark, France, Japan, The Netherlands, Republic of Korea, Sweden, Switzerland, United Kingdom, and the USA, so a broad overlap with the Solutions Center.

In addition to drawing information from those countries, and doing analysis on products that are available in those countries, we also try and find information from other trading blocks. In addition to our EU country members, we try to look at the EU as a whole. We look at China where we can, India, and sometimes South America. In this particular case, all the information relates to countries that are participants with the addition of the EU where there is product by product.

How do the mapping and benchmarking activities work? What are they trying to achieve? They're trying to analyze product performance between countries, so across national boundaries. Everybody does analysis when they make their own regulations, their own policy, on what products they have, what technologies are emerging. It helps policymakers if they can see an international picture of that kind of thing. We're trying to identify which countries have better performing products compared with others, why that might be, what are the policy drivers, what are the cultural issues, and some areas that policymakers may want to concentrate on, maybe may wish to shy away from, and some of the technology options they might be encouraging.

So far, there have been 14 products. Today you are going to hear about lighting, a cross of domestic appliances—refrigerators, washing machines, air conditioners, dishwashers, all the way up to some commercial and industrial refrigerating systems, distribution transformers. The process itself is a three-stage process and it's pretty much the same irrespective of product address, very slightly but not too much. The first stage is product definition. Everybody thinks we know what we mean by dishwasher or a lamp or a distribution transformer, however that understanding varies between countries—what performance characteristics are called, what products details are called, how the standards are established, what's a typical size. A

refrigerator in the US is about the size of a Swiss apartment. What we try to do with a product definition is try to create standardized language that all our participants can understand and a frame of reference for them all to work in. We define the performance parameters we are going to look at and the scope of the analysis. We're going to look at big ones, little ones, different sectors, or whatever.

The next stage is to create what is called the country mapping. This is a repository, a store, for all the information on a particular country that will be used in the analysis. It includes historical and current product performance, the regulatory framework, labeling, maps, other policy interactions in the market, and some cultural and other relevant influences on product performance.

That view is the basis for the benchmarking analysis, which comes in next. That takes all the data from individual mappings that's been produced in each country and brings them together to attempt to compare them and contrast the performance of products between countries. Now, obviously the data we have differs, both in terms of its source and its quality, but also the framework that it's in. Some countries will measure different performance criteria than elsewhere. They'll use different performance metrics. They'll use different test methodologies. We have to manipulate the data from the different sources and from the different countries to be able to compare it. That process that we generically refer to is normalization. We try to normalize all the data sources to one particular comparable basis. Our ability to do that varies between products, fortunately with lighting it was certainly on the easier end of the spectrum. That's the big picture of who we are and where we come from and how we do things.

Let's now have a look at the benchmarking report itself. In this particular case, rather than looking at individual products, one CFL in the US is better than another CFL in Australia. We're looking at groups of products and how they're rated in the market. I'll come to that in more detail in a moment. We are looking at the regulations that are trying to manage the least efficient lighting in the market and generally trying to remove that lighting and updating the report from 2011. I will occasionally refer to the 2011 report because it had some more detail on specific issues. In general, everything seen today will relate to the 2015 version.

What was the report trying to achieve? Firstly, we wanted to give our policymaker funders the ability to see the difference in the phase out regulations they have in place. Every thinks they have the perfect solution and in lots of cases they are to local circumstances, but there are some significant differences in approach and we wanted to highlight those to give them an understanding where theirs differ from elsewhere.

We wanted to look at the type of products entering each market. So, what is the proportion of sales LEDs, compared with CFLs, compared with maybe halogens, compared with incandescent lamps? How is that changing over time? That should give us a major indication of some of the policy outcomes in terms of what products are moving in and out of the market.

Looking at the longer-term efficiency improvements, i.e. what people have installed in their homes and in stock, we have an average efficiency of products entering the market. That's not a perfect metric. I'll come to why in a minute. It gives an indication of efficiency improvements in the home in the future. Finally, we try to draw out of that analysis some of the key issues for policymakers where they might consider modifying existing policy or add additional policy to react to what is actually happening in the market from their first engagements.

As I said earlier, it's not a direct comparison of this product is better than that product. It's looking at whole markets and impacts of the mix of products across markets. Excuse me. We have put this boundary on. We are looking at products that are applicable to the domestic sector. In general service, incandescent lamps are the traditional lamps, halogen, compact fluorescents, and LEDs. Obviously, those lamps are used in other sectors and some other lamp types are used in the domestic sector but they are the primary lamps that are used in the domestic sector so they were the focus of the study.

Data quality and quantity and availability—well, if we just have a look at this slide for a moment. The countries on the left are those that we have data. Across the top are the key chunks of data. We have a great deal of detail within these boxes but on a big picture we have information on the policy, so regulation, labeling and that kind of thing. We have information on the sales over time of the different amount of products in those markets and there are derivations of the overall efficiency of those products entering the market.

We have developed, within the market, a benchmarking process—a way of allocating reliability to that data. That's a combination of the source data itself and any manipulations we have to do to that. Obviously, the more we're playing with data the less reliable it becomes. So, in the graphics you'll see coming up you'll see robust data, which is pretty accurate. We're pretty sure it is representative of what we're displaying, indicative, that gives you a pretty good idea. It is reasonably accurate and it shows a good idea of the outcomes that are being presented. Illustrative? Now that's a dotted line. Be slightly cautious of illustrative dotted lines. I will take an example here. If you see half way down the table, you will see Denmark. Their policy information is the same as the EU so we know their policy is right. However, a lot of their data is based on modeling. Almost all of their data is actual sales data from the market. Danish data manipulations internally within Denmark and we have to do some too. Therefore, their data is a little less reliable and therefore it is included but it has this illustrative decoration associated with it.

One other thing to pick up here, US, we found it impossible to get dependable US data on sales. It is available in some forms for some products but quite often, it is often regional or doesn't address all product categories. Therefore, I'm afraid if you're interested in the US, you're going to have to use Canada, at least, as a proxy. From the information that we do have on the US, Canada is a reasonable representative mirror of the US. Canada was able to supply data. We could not get it from the US.

The process and a couple of cautions—we are looking at the efficiencies of lamps. We have a lot of detail about the inefficiencies of lamps in Canada compared with Australia, for example, with used international averages. Because the difference between a CFL and a halogen is infinitely different than the difference between a 10-watt CFL in Australia and a 10-watt CFL in Canada, we've taken a global average of this and we've adjusted that for the years included in the study to show changes in the efficiency over time. I talked about the normalization process to try to make things comparable while as a general statement CFLs and LEDs, because they have electronic controls, voltage differences and things like that that don't really make much difference. Similarly, the test methods are pretty much the same around the world. They're all based on CIE standards ultimately. So, there's no normalization of those lamps. Where we have had to make a normalization is for filament lamps, which are incandescent, or halogens, introducing incandescent or halogen lamps, and where we've done that we've used an internationally recognized approach, which is IEC 60064 and we've backed that up with some empirical data to make sure it gives a reasonably accurate conversion, which it does basically. There are a number of cautions presented in the benchmarking report. These are the most critical ones. As I said before, we're looking at markets as a whole. If you could imagine 100 lamps sold into Canada each year—20% of those might be incandescent, 50% might be halogens, 20% CFLs and 10% LEDs. We have that data by size, light up box, that wattage, so we can break that down by detail, but it is looking at instantaneous sales in a particular year. It is likely that efficiency of products in the store is changing at a faster rate. If sales are going up by say 5% efficiency improvement, stock is probably going up faster than that. It's related to the lifetime of the lamps and newer ones lasting longer than traditional lamps. Similarly, because of the metric we're using, sales across markets is not a perfectly true metric. Lamp sales are falling because lamps are lasting longer and the replacement cycle is longer. Direct comparison between years isn't perfect but it gives you a strong indication of what is happening.

Finally, we have not taken account of cultural factors in this case, at least to the greater degree we haven't. It's very difficult to quantify though. For example, in Asia light quality is less important than it is in maybe Europe or North America. The switch to CFLs happened faster. We haven't taken account of that in this analysis but bear it in mind as we go on. I will mention it, particularly in respect to Korea.

Let's start off by having a look at the regulations and tells. On a big picture of the graph, for a start...let me get my little highlighter up. The graph here shows lumen output, so how much light is emitted against how efficient something is—the efficacy requirement. These lines on the graph are the minimum performance requirements for the next level for all the countries listed on the right hand side, which includes the lamp light and when the regulations come into force. I'm not suggesting you look at this in detail. It's very hard to follow at a very detailed level. I would recommend you go to the report if you're interested in this in real detail because there are some important issues associated with this. Let's look at a big picture just for a start. As a general statement, irrespective of country, regulations don't ban a

technology. They set a minimum performance requirement for a broad range of lamps. So, it's not necessarily about abandoning incandescent or abandoning the halogen lamp. It's about setting a performance requirement that if you can build a lamp of any type this is the requirement here to meet.

Normally regulations are implemented in stages. Larger lamps go first. Normally there's a set of exclusions for lamps of a particular type or a particular function or under particular circumstances and generally speaking, there are some extra performance requirements to satisfy consumers. This is a regulator intervening in the market and they want to be sure that if they are making consumers change the product they traditionally wanted to buy the product that it is being replaced with is at least as good in the consumer's eyes. Those requirements might be about additional performance requirements related to color, related to lifetime. This kind of color performance has to last this long. It's got to get this kind of color rendering and sometimes there are extra requirements. In this case, I just pressed the button and those extra lines appeared at the top. There are additional requirements for things like CFLs in Europe and Australia and Korea. In the EU there is something called covered lights. That's anything that's not a point source light is required to meet a premium performance standard broadly in line with CFLs a few years ago.

Big picture wise, things are pretty similar but if you start looking in detail, you'll begin to see some of the things are very different. Let's start with the overall regulatory approach. Again, I'm going to use my highlighter. I apologize for my graphical ability. There are broadly three approaches to regulation. There's the curve. Let's look at this bottom brown one here. That's giving a continuous performance requirement across the lumen range but at the lower end the requirement is lower and as lamps get bigger they are required to be more efficient. That is typical across lamp sizes. They are more efficient the bigger they are. The shape of that curve can be varied to meet whatever the particular lamp type or requirement is as those lamps get bigger. That's used in most countries around the world—China, Australia, Europe. Most countries adopt that. Korea adopted a step approach. Korea in this graph is green. Here is one example of one of the Korean regulations from a few years ago. As you can see, I'm drawing this. It's a stepped line and it says that lamps from 200 to 700 lumens have to have efficiency requirements of 8 lumens per watt. Larger lamps, 10 lumens, and those from 1200 lumens upward, are required to meet 12 lumens. Again, we're sort of reproducing this step in. As lamps get bigger, efficiency requirements go up but a bit more of a clunky way and it doesn't necessarily capture all of the energy savings in between but it's very simple to understand.

Now the US and Canada, which is on this line. The US is always purple and Canada is always gold. Because they sit on top of each other, we had to make it dotted. They have this distorted arrangement. I'm trying to draw that now. Their regulations are created based on wattage. If, for example, a lamp is between 20 and 50 watts then it has a certain efficacy requirement. Then there is a step change between 50 and 100 watts and 100 and 150, whatever those boundaries are. However, the world has moved on now and because policymakers in general are trying to move people away from those

traditional 40 watt lamps, 60 watt lamps, 75 watt lamps, 100 watt lamps and trying to think in terms of light output, that's why we presented them in the same format based on light out but rather than those wattages. You can see it creates some anomalies. It's possible that the red, if you're here, you would be non-compliant if you were producing. That's something like a 40 watt traditional incandescent. What you could do is actually increase the light output power consumption up here and you suddenly become compliant. I'm not suggesting people would but it creates some potential anomalies and there are lots of other potential issues with that approach. So, the US and Korean approach is very straightforward, and Canada, but it does present some issues. So that's a big picture on the regulatory front so let's have a look at other issues.

Let's look down at this part of the graph just here. This is the bottom end of the spectrum. In old-fashioned incandescent terms this is sort of the 10, 20, 30 wattage lamps. As you can see Australia's regulations finish here. US and Canada's regulations finish here. Korea's regulations finish there. European level regulations come all the way down here. It's not quite clear why people have different put off points at the bottom. These lamps are the same everywhere. Everybody has the same requirement for low light output lamps. Now, the regulatory structure might drive that but it's just a bit odd. Similarly, up here you'll see the US rate went out at about 2,600 lumens. That's, broadly speaking, 60 or 70 watts of old fashioned incandescent lamps. The previous Korean regs are here. Again, why these differ is unclear. I'll clear those off.

The stringencies, so, what we're looking at is performance levels at these different steps. There are some differences. Some of these standard lamps. Some of them are clear. Some are covered. Some of them are reflective but a lot of them are similar lamp ties but there are huge variations in the efficacy departments between countries. Again, we're talking about the same lamps.

Products exempted in some countries—the products exempted are a very small group applying to specific applications or specific functions, elsewhere, broad sways of problems that are included. Again, the applications are the same everywhere. The features are the same. It's not quite clear why they're different. Similarly, the way the regulations are formulated and sometimes in terms of specific product outputs. Sometimes it's measured results. Sometimes it's rated results. They lead to different outputs and it's very very difficult for manufacturers to know those subtle differences between the markets. This makes compliance really quite difficult.

Let me just clear all my markings and move forward.

This summarizes it. Overall, they're pretty similar but the regulatory approaches differ. Some of them are sorters. Some of them move as curves. The levels are different. The range of light products, light outputs and products that are included within the regulations vary. Exempted products vary or have different performance requirements and how those regulations are applied varies between markets. Now, manufacturers and regulators talk all the time about harmonization of requirements but in this case, lamps are the most globally traded consumer durable. There is no bigger traded product

that's a durable in the world. If the political will exists, and manufacturers are keen, alignment of these efficiency requirements and scopes and exclusions is technically very simple. Such alignment is likely to result in substantial energy savings, be that through adopting the higher performance requirements that are there, or simply by making better compliance. That's the second item in the supplier understanding. At the moment ignoring a supplier in China, where most of people's lamps come from, it's very difficult to understand why Australia is certainly different from Europe, which is different from the US in what applies. What you do is make what you think and that means compliance bodies have to pay more. Consumers are less likely to be satisfied with the end results.

There's potential for cross-border enforcement. If I identify a product in my market that is substandard and we have the same regulations then I can tell you. You can go looking for the same product or similarly I can save you money by saying this one is okay. Don't waste your time looking elsewhere. So it has the potential to increase global trade and it's likely to reduce the cost to consumers but this isn't happening. If anything, there's a movement away from this. There have been some efforts under the same umbrella that mapping and benchmarking activities are happening. The 4A SSL Annex is trying to develop some performance requirements for LEDs and test method LEDs that are applicable globally. They're doing very well in that but uptake so far has been relatively limited on the regulator level. Australia and some of our member countries, supposedly Sweden, have attempted to put forward proposals to the IEC for performance requirements for things like CFLs, but they've met with stiff resistance and they have not been adopted. The reasons for those barriers are myriad but, if policymakers and manufacturers really are interested in harmonization, this is the product to start with. Maybe smart lamps, with this new generation of lamps that are coming on to the market, with potentially having enormous energy impact, that might be an area to start cooperating and find to come up with an international approach. It worked with a new generation of TVs, for example. It worked with power supplies. Maybe smart lamps is an area where there can be some international collaboration to show it works and then it can be expanded into these other lamp types where it should be used. That's the regulations and some of the big take aways for policymakers there.

What about the lamp sales? What impact does that have on the market to date? What does this graphic show? On the x-axis is time. It starts in 1999 and runs through to 2013. On the y-axis is percentage of sales of lamps that are incandescent. Let's take an example. As you'll see as we go through these slides countries are always the same color. I'm going to pick Austria now because they're the easiest to see. They're at the top. Austria is always this red color. If you're interested in a particular country, for instance Canada, Canada is always gold.

Let's look at Austria here for a moment and see what the graph means. In 2001, just here, of all the lamps sold in Austria in 2001, 90% of them were old-fashioned incandescent lamps. Over time that has gradually been decreasing and at the point where regulations began to come into force into various parts of the world, it had fallen to 75, 73 to 75% of sales with still

incandescent. So improving, but not great. Overall, there was this general trend to improve. Going from 80-90% of incandescents by 2008 typically 60 to 65% of individual markets for incandescent lamps. Two anomalies on this picture, one is Australia. As you can see, they had a sudden fall in incandescent sales in 2007-2008. Regulations weren't in force at that time but the announcement was made that Australia was going to phase out incandescent lamps. As it turned out indirectly, by technology, did it neatly, as others did, but basically, the announcement was made that it was going to change. It rode a big environmental wave that was happening in Australia at the time to phase out lamps. Naturally, people switched having heard the announcement. They're the only country where an announcement appears to have made a difference. Everywhere else nothing happened until the regulations came into force. Korea is this green bit at the bottom, another anomaly, but we'll come back to those in a short while.

What happened when regulations started to take effect? The first regulations were in Australia and the EU. Australia pretty much regulated everything in 2009. The EU did it phased in 2009 to 2012. As you can see, it's resulted in a precipitous fall in sales of incandescent lamps. This is what policymakers were hoping for. This is what they were expecting to happen. Looking at a couple of things in detail, Australia, they continued their fall from announcement to when regulations came in force. They carried on down. They've been the best performers. Overall, the EU, which is the brown one, has been falling in line with the regulations and the EU countries around it. Austria, the UK, and Denmark have been following a broadly similar path. This big fall in incandescent sales is the UK. The UK is a blue line that beelines down. That corresponded with an enormous push in CFL give aways from utilities and the utility program in the UK, which was brought to a halt in 2010. It went down very rapidly and back up again as soon as that give away finished. Then it reverted the type, like the rest of Europe. Austria is lagging very slightly up here and the bit at the top was a big consumer backlash against the regulations. There was press and public reaction was negative at the time when regulations came into force and there was a big stockpiling of incandescents but that's been offset over time and they are now again joining the rest of the EU in this precipitous fall. So good, where regulations have been in force for a while things have been happening. What else? So Korea, down here at the bottom, their most recent regulations came to force in 2008 and then again in 2012. They were the first country to regulate seriously in 2013, sorry 2003, not particularly ambitious at that point. It did not take any particular products out of the market but it signaled early on their intention and they have been the best performers overall, as you can see at the moment. They have the biggest uptake of CFLs. That's partly due to their Asian acceptance of light quality being different than elsewhere, but also this signals that the regulator is serious.

Elsewhere Canada, Canada is the gold one I told you about. They had a pretty big fall in incandescents, sorry, incandescents over time. That slide, that related to a big CFL push under something called "Switch and Save". That program pretty much ran its course in 2007, 8, 9. It's still ongoing. It still promotes LEDs on a much smaller scale. Incandescents slightly fall but it then levels. Since policy intervention has calmed down it's flattened out and

regulators are coming into force around about this data runs out but there is a little bit of indication it's going down but not a huge amount.

Finally Japan, let me clear the panel, this is Japan. Japan is the black line with the black cladding. There is some uncertainty about Japanese performance but Japan is unusual in being the only country with no regulation. It has a voluntary agreement within industry to stop using incandescents. Sorry, stop producing incandescents, but that's quite small impact because most of them are imported anyway. What really was a driver in Japan was that in 2011 there is this sudden downturn. They had their Tsunami and the disaster associated with that. It led to a national power shortage and a big change in the cultural perspective of the country and a big switch resulted in more efficient lighting. Then we've got some more recent data than this since the report was published and that line carries on going down. We can see where regulations are in effect. There's been a huge impact. In places, like Canada, where they're not there yet, there's no real step change. So good! The policy implementation appears to be working. It's taking the worst performing lamps out of the market.

We can see this clearly by looking at the EU. This is incandescent sales in the EU by year by lamp type. This is drawn from the EU mapping report where there is much more detail on individual countries. You can go and look at that. There are similar things for other countries. You can see the step down, firstly, from about half a billion incandescent lamps sold in 2007 to about 15 billion in 2013. So it's 10 times reduction in the amount of incandescents sold, which is a good thing and what the policymakers wanted. You can see the larger lamps have been removed from the markets first. 2013, after the point where most of these lamps should be removed there are still sales, partly that is to do with exempted lamps and partly it's due to legacy sales. If you have lamps in your store before the regulation, you're still allowed to sell them. That will continue going down but it will continue to flatten out. So good! We're getting rid of the worst performers in the market.

What's that mean in terms of improving efficiency? Well, looking at those countries where those regulations are enforced or where anticipated, typically there's been an improvement. In this area of the graph here we were looking at lamps. Average lamp sales across all lamp CFLs, LEDs, and incandescents, are efficiencies more in the 12 lumens per watt range before regulations took effect and that's now picked up and we're up here in the 17 to 20 lumen per watt range. There's a strange pick here in the UK to do with that CFL huge push, but in general it's reverted to tide. There is an improvement in the average efficiency of lamps sold but not a big step that most regulators were expecting. Incandescents have fallen down. We expected loads of CFLs and LEDs, which would have driven this up much further. CFLs and LEDs are in the 50, 60, 70 lumens per watt category. Why hasn't this graph been pulled up further? Other countries have managed a bit better, particularly Australia and Korea. Australia rode a bit of a wave in environmentalism in Australia. It's tailed off that but they engage very closely with their stakeholders. They did lots of work on the ground, which means they managed to get a better take up and are doing better. They doubled their efficacy. They went from 14 to 27 lumens per watt and Korea has continued its upward trend. It's doing

remarkably well compared with elsewhere. It's regulations have been very successful and then combined with cultural situations it's managed to drive efficacy levels to twice as good as Australia, which is the second best, and three times as good as the rest of the world.

A big fall in incandescent. In general, a slightly disappointing increase in efficiency. So, why is that? Where have all the lamp sales gone? Let's have a look at CFLs and LEDs. Again, this looks a bit cluttered but let's do it in stages. This is the same graph as we had for incandescents, but in this case it's CFLs. We have time along the bottom and then the percentage of all sales that are CFLs. Take that off. Again, to take an example, let's take Korea because it sticks out at the top and it's easy. In 2006 about 55% of all incandescents, sorry, all lamp sales in Korea were CFLs. That's risen a little bit of a stat but now that's 70%. What's happened elsewhere? There has been a pickup in sales but as a general statement it's been pretty disappointing. Australia has done pretty well. It's had this big jolt associated with the announcement. Then the regulations came into force in 2008 and it's managed to stay at broadly that level. It's managed to bring CFL sales up broadly to 30% of the market.

In Europe there was this pretty broad flat lining around 5%. Regulations came into force. As a general statement there was a peak up to 2010 but they've sort of fallen down. Individual countries vary a little bit. We've got this downturn in Austria where we had the negative impact and this bump in the UK, which was the big CFL push by utilities. In general it's followed the overall EU line with a bit of a bump and back down to 15%. Good. It's gone from 5% of the market to 15% of the market, but not the huge step change that regulators were expecting.

Have markets gone to LEDs rather than CFLs? This is LED sales. They have received lots of hype. They are certainly exploding on the market. Come 2008, where there were broadly no noticeable sales in the market, there's been a big big growth. In 2013 we're still only looking at 3%–15% of any market, in general much closer to the 5%–10%. So lots of hype but as of yet they have not penetrated the market.

What has been happening? This is the same graph but looking at halogen lamps. When we had this broad sway of pre-regulation markets were somewhere between 15%, 20% halogens down to 5%, 6%, 7%, 8% and then regulations started coming into force just about here. What's actually happened is rather than customers migrating to LEDs or CFLs, which is what regulators would have hoped, what's happened is this explosion in halogen sales. Now halogens are only slightly more effective, slightly more efficient, than incandescents in general. We're talking about a 10, 12, 13 lumens per watt move to a 14, 15, 16 lumens per watt in performance. What we've seen is halogens beginning to take a big share of most markets, and not the switch to CFLs and LEDs that we expected. You can see this much better if we combine incandescent sales and halogen sales together. In fact we've just taken CFL and LED sales from the market. What we see is those countries where regulations have come into force around 2007, 2008, there's been a small reduction in halogen and incandescent sales but broadly speaking it's only gone from 90, 95% down to 80, 85% and that explains why there's only

been a small uptake. A small uptick in the overall efficiency of lamps sold. There was a big fall in incandescent sales but there's really just been a migration to halogens.

The EU's stabilizing about 80% of the market. Canada regulations continue but it appears to be following the same path and this here was where they were pushing CFLs very hard, but what's happened is there has been a migration back to halogens and as far as we can see CFLs are now on the replacement track and it appears that Canada is going to join the EU and most countries where regulations are enforced, where halogens are going to be the default choice. Australia doing better than everybody else but nevertheless is beginning to flatten out with incandescents and halogens becoming the default choice. The big message for policymakers here—it needs to be a rather rapid policy intervention to maintain this improvement in the market and prevent halogen becoming the new default choice for consumers. Most countries faced some kind of political backlash from their regulatory introductions. If consumers get used to halogens as the default choice, you're going to face that again if you ever try to apply it to these new performance levels of CFLs and LEDs. That's going to be a challenge to overcome if regulations aren't addressed soon.

So, that's data on sales in the market. Impact is happening. Incandescents are reducing. It's not leading to improvements in efficiency regulators were hoping. Additional policy making may be required, a quick deviation into another outcome of the study. For us to do our job we need lots of data. I said at the start that sales were not a perfect metric for this. What they do is allow you to see trends in the market, whether a type of product is getting around regulations, and if new technologies come along. It's a useful thing for regulators to know about and I have to say there's limited market knowledge out there. Our partners put an enormous amount of effort to get the data represented. Some of it is new to policymakers. They did not have this data before we gave it to them. We're helping but it's worthwhile investing in that data and improved in-home application and usage patterns. Sales are useful for big picture trends. They don't tell you the whole story. If sales of CFLs and halogens or CFLs and LEDs are going up but they're being installed in cupboards and garages that use is very low. Impacts on consumption are going to be marginal. If the reverse is happening and they are being used in high use applications it's going to be significant, even if their sales are relatively small. Unfortunately very few people know that. Finding the information on in-home application is hard. Some regulators spend a lot of time doing it. California, for instance, has some really good information on this. Australia is invested and the UK is invested, but nevertheless they don't map the entire market. There is an opportunity for investors to invest in this and people who want to support regulators to support them in that investment and that would be really useful with improved future policy and compliance.

Key issues from the report as a whole. I have not managed to go into any level of detail but there are things to take away. There has been substantial reaction in the market product regulations. There's been a precipitous fall in sales of incandescents where the regulations kicked in. Canada appears to be following a similar path. The US we assume will be something similar. Alas,

there has not been a similar uptake in the efficacy as expected in most policymakers and in their projections of savings in the regulation because there has been a significant migration to halogens. Policymakers really want to consider urgently intervening in the market to stop those halogens becoming the default choice. The EU is not only do so; they're what they are calling the phase 6 regulations, which should come into force next year. They are currently under review. There is a suggestion they may be pushed back. The EU needs to think about that seriously. Similarly, the US has some planned regulations for 2020. They might want to consider bringing those forward so they don't come across quite such a big jump to consumers. The market momentum, the market change continues much more rapidly. Korea, although they have some unique cultural situations, did show us that regular revision of their performance requirement does lead to rapid market change.

Something that I highlighted all the way through, for instance, Canada drop...sorry, improvement in CFLs but then falls off. The UK has been pushed for CFL programs and then fall off. Non-regulatory interventions in the lighting market do seem to work but only in the short term. Very quickly after the intervention or support or policy or whatever it is ceases the market seems to revert to its original state relatively quickly. If policymakers are considering or currently implementing non-regulatory interventions, like Energy Star, if you want them to continue you have to continue that intervention. If you stop, the market returns relatively quickly.

This final thing that I went into a bit of a divergence about—better market and usage data is really important to help develop better policy, monitor the implementation of the policy, and do things like what we've just done but in terms of measurable impacts.

Okay, I think that takes me to the end. What I have here is a couple of websites. You can get the mapping and benchmarking reports, all our reports, from that second website of the agency. The address is rather long so maybe use the top one—<http://www.iea-4e.org>. That takes you to the 4E site. Click the mapping and benchmarking tab and then you will be able to download things from it. You can write to me. That's my email address at the bottom or I'm sure Sean or his colleagues will be happy to funnel through to me. Questions, so maybe I am back to you Sean?

Sean

Yes, thank you Stuart and thank you for the presentation. Just a reminder to the audience that if you do have any questions those can be submitted through the question pane on the GoToWebinar window and I can ask them to Stuart from there.

We'll move on now to the question session. The first question I have for you Stuart asks—it's in relation to slide 14. Do you have a similar breakdown of sales by product size for other products in the EU, such as CFLs and LEDs and for other countries?

Stuart

That's a pretty decent question. Would it be possible for you to just hand control back to me for a moment Sean?

Sean

Oh yes.

Stuart

I am moving it back to slide 14 and see what we're talking about so people know what we mean. This is slide 14. Somebody has picked up on incandescent sales and you can see how sales have changed over time for different product sizes. The simple answer to that question is yes. We have mirror data for this for CFLs and LEDs, and halogen lamps, and actually fluorescent cubes within the EU. While the information I have presented here for all the lamp types was a summation of this data, for all countries we have this data broken down by similar sizes, by similar time frames, so yes we have it for all the different product types within the EU and mirror information between countries. If I could switch to my browser view for a minute...let me go to the browser. Nope. This is the 4E website. This is the mapping and benchmarking website and you can see the different products. If I select domestic lighting you can see the publications. At the top here we have the benchmarking report we talked about today but down here we have the individual reports for each country. I showed you the EU one. That was an output from the EU. We have the same for Austria, Canada. Each country that appears in the report has a similar breakdown of products. So yes is the answer to the question. You can take control back Sean, or you can leave it with me.

Sean

We can leave it there for now in case another question is related to the slides. We had a few more come in from the audience. The first question I received—is part of the explanation of sales trends related to the price of lamps and will falling prices of LEDs change the picture absent additional regulations?

Stuart

There is certainly a linkage between price and sales. Absolutely. The falling LED price is going to be a big factor in that switch. We weren't able to track price. Simply because the range of lamps we're picking up information for was enormous and going back to that shortage of market knowledge, nobody actually knows it. There are some commercial reports that are available for some markets but as a general statement their coverage is pretty small and the price of products, particularly LEDs, is changing rapidly. The simple answer to the question is yes. LED prices falling are going to drive the market in that direction and it's going to encourage take-up of those products and help with the regulatory framework that's in place. To what degree, I don't think anybody knows and to what degree the prices will change. They are continually going down but at some point that is going to stop. There are very different pricing structures in different parts of the world. I currently live in France and I can buy a product in France and if I go to the UK and buy exactly the same product at half the price. In the US it may be half the price again. It depends partly on manufacturer's pricing strategy and partly how the effect of this global trade is in competition in allowing products into markets. I sort of skirted the question but prices are impacting the market. I am going to hold my hands up and say I don't know what degree. We couldn't look at that. I don't think anybody really knows. So yes, it is impacting. It will impact differently in different parts of the world. To the degree, we just don't know yet. Sean?

Sean

Great, thank you. Yeah, and moving on now to the next question it asks—should countries or do countries have technology specific regulations instead

of efficiency based benchmarks? What is the main driver for the shift to halogen? Is it price or preference in terms of its similar appearance to incandescent lamps?

Stuart

I'll do the first question first because it's easier. (laughter) Do any countries regulate by technologies? As a general statement, no. None of the countries that we looked at regulated explicitly by technology, per se. China is a bit of an exception. It wasn't included in the study but I work there a great deal. I helped with their phase-out. In effect, they regulated incandescent lamps specifically rather than all lamps across the market, but as far as I'm aware that's the only country that specifically sets their mix based on technology type. Having said that, there are increasing regulations that apply to specific technologies. If you look at the EU, if it's an LED it must comply with this performance requirement. If it's a CFL it must comply with this performance requirement. If it's a reflector lamp it must comply with this performance requirement. Generally speaking there is an efficacy requirement there but they are very much about making sure that the consumer is get the service that they're expecting from a particular light source as the market evolves. So, yes, some technology regulation but it is limited and quite focused.

Now on the second part of the question, much tougher. A bit like the question on price. We don't know for sure. Why are people going to halogens? Partly it's price related. Partly, I'll take my mum as a classic European consumer, a halogen lamp looks pretty much like the lamp she's always bought. It's sold in broadly the same way. I have a 60-watt lamp that's halogen it says. It's the same as a 60-watt lamp. It looks like a 60-watt lamp. It's a bit more expensive but it's not very much more. I'll buy that. So, partly perception, partly cultural preference, partly history, and partly price are all drivers. That mixture varies between countries but it's likely that's going to continue until there is some kind of regulatory imposition to change that. As I said, the 2016 European regs should, if they're not delayed, which is most likely, the Americans 2020 regulations with their backstop at 45 lumens per watt would do it but might be a bit lazy and might get quite a lot of political backlash in the US. Australia is looking at their regulations now but pretty certain without some kind of push the cultural price, traditional drivers are going to hold halogens. The balance varies between countries but I don't think it really matters. It applies everyone to some degree. Did that answer the two parts of the question appropriately Sean?

Sean

I believe so Stuart. Yeah, thank you.

Stuart

Just to be aware for you Sean, you're a bit quiet on my end. I think you may be for everybody else too.

Sean

Oh, sorry about that. I'll move the telephone a bit closer.

Stuart

That's better. That did help.

Sean

Next question for you Stuart points out that—In the US there was a political push back at the government eliminating incandescent lamps. Has there been similar push back in other countries that you're aware of?

Stuart

Absolutely, and absolutely everywhere. If you remember...oh, I still have my controller, that's right. I do. You remember this little bleep in Austria? Austria was a particular example. It happened in Germany. We have not got the data for Germany for all the years so it's not included on this graph, but large ways of Europe had a real push back, a populist uprising if you want to call it driven a lot by the media and to regulation. It happened here. To some extent it happened in Australia but they were able to ride it better. They also had the advantage that they engaged in their stakeholders much earlier. They got very close to them. They explained a lot to the markets so Australia fared better. England and China saw a little bit of bounce back. It appears the UK went in the opposite direction to Austria, which is true but it's due to this strange CFL intervention related to utilities. In terms of media coverage and political challenging, absolutely there was a push back. As a general statement that has waned significantly. Most regulators have managed to go through that sometimes short, sometimes long, push back period and consumers are just getting used to the new change in situation in the market. Yes, initially, almost everybody had push back, but if you stick with it you get through it. That's the key message coming from this. If the momentum of change that consumers are now expecting with this changes to halogens and LEDs coming in, if that momentum stops and halogens do become their new first choice it's likely that regulators are going to face exactly the same challenges again with their next round of regulations. Whereas, if they keep the momentum going and consumers are now attune to the fact that things are changing. I need to be looking for something else. They can do it now, keep the momentum going, or that backlash is going to happen again and probably worse next time around. We've done it once. Why are we doing it again? Why didn't you fix it the first time? Sean?

Sean

And the next question from the audience asks—how could "light systems" be regulated in the future, also with efficacy?

Stuart

It's a challenge. Everything you see today is related to the lamp itself. We are moving to a brave new world where the lamp and its control system may or may not be linked on an individual level. Lamps may or may not be linked together. On a household level they might be controlled at a distance by telephone. I don't know is the answer to that. It's quite simple. I don't think anybody knows yet. The EU has just commissioned...I say just, about 6 or 8 months ago, commissioned an organization called VETO to look exactly at this. How are they going to begin to regulate lighting systems? It's been done for a while at the commercial industrial level through building regulations. Now we've got these different lamp types in the market. The system is coming down to the home level and I don't think anybody knows. I would encourage you to look at what's happening in the EU. Certainly some of the more future looking governments around the world are national or local. For instance, California is looking at this issue. As yet there is no resolution. Nobody knows what the lamps will look like in 2 or 3 years. Will everything be controlled by a phone or will it still have a switch in the wall? Will they be talking to each other or will that just be a fad. Are we still with halogens or will there be this revolutionary moment where the refrigerator is controlling the light bulb? We don't know. It's a transitional period. It's one of the reasons why that market data is critically important over the coming period and

governments and NGOs need to be investing in that to find out what's happening to make sure technology doesn't run away. Again, I have not really answered your question. I don't know how they're going to regulate systems in the future. People are looking at it. Keep your eyes open. There will be an attempt to do it in the mix 1 to 2 years or at least to map out an approach to doing it, whether that's going to be effective we have to sit and wait and see I'm afraid.

Sean

Great, thank you Stuart. We have a couple questions left but we are running out of time so these might have to be a little briefer. The first question is—was the special purpose loophole in the EU regulation taken into consideration in this impact assessment? They give the example you can still buy 100 watt incandescent lamps sold as Heatball or Rough Service, etc. in the majority of EU countries.

Stuart

Was it taken into account? It was. We did not look at it separately. Where's our EU picture? This part's just here. Partly it's legacy lamps. Partly it's people getting around the regulations. It is happening. There are notable efforts to get around regulations everywhere. Canada did have a short period where modified spectrum lamps were appearing on the shelf in a format that made consumers believe they were just incandescent lamps. So, yes, everybody has some issues with, shall we call it, regulatory avoidance. That's why market monitoring is important. That's why some of these legacy sales in the EU are happening more in some countries than others. Australia in particular does quite well in keeping theirs down. They have a registry system that requires product registration. They do install monitoring and they do testing. It really depends on how robust your regulations are from the start and whether you continually monitor your markets, which may be something that the EU doesn't do particularly well.

Sean

Thank you Stuart. One of our attendees is wondering if you know whether or not India has similar regulations established.

Stuart

Um, that's a difficult question. India does have some. I don't remember all the details. India certainly has extensive regulation related to LEDs, some regulations related to CFLs, but I don't think it actually has a minimum performance requirement for all lamps across the market. So I don't think it has much, no. They certainly looked at it for a while but I don't think there is a requirement. I won't guarantee that but if you do contact the Indian lighting association, they're actually pretty good. They're able to get back to you but if you really want to know and can't get ahold of that just drop me an email and I'll find out the actual answer for you.

Sean

Great, thank you once again Stuart. That is the final question that I've received from the audience. At this point we'll move on quickly to our attendee survey. We just have three questions for our audience today that helps us evaluate how we did and helps us improve for future webinars. The first statement is—the webinar content provided me with useful information and insight. Just mark if you strongly agree, agree, not sure, disagree, or strongly disagree. The next question is—the webinar's presenters were effective. And then the final system—overall the webinar met my

expectations. Thank you very much for answering our survey. On behalf of the Clean Energy Solutions Center, I would once again like to thank you Stuart for your presentation today and for your time and also for our audience for participating in today's webinar. We very much appreciate everyone's time. I do invite our attendees to check the Solutions Center web site. If you would like to view the slides, and also download them, within about a week we'll have posted the recording of today's webinar to the website as well. Additionally, at the Clean Energy Solutions Center training page you will find additional information on upcoming webinars and other training events. Just a reminder we are also posting the webinar and our recordings to the Clean Energy Solutions Center's YouTube channel, which has several other videos, clean energy policy videos, as well. I encourage you to check that out. We also invite you to inform your colleagues and those in your networks about Solution Center resources and services, including no-cost policy support. With that I hope everyone has a great rest of your day and we hope to see you again at future Clean Energy Solutions Center events. This concludes our webinar.