

CCUS in Mexico for a Low Carbon Economy

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Webinar Panelists

Leonardo Beltrán	SENER (Mexico's Ministry of Energy)
Diego Arjona	National Institute for Electricity and Clean Energy
Guillermo Hernández	World Bank
Peter Warren	Energy and Industrial Strategy (UK Government)

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Katie Contos

Today's webinar is focused on carbon capture, utilization, and storage in Mexico for a low carbon economy. Before we begin, I'll quickly go over some of the webinar features. For audio, you have two options. You may either listen through your computer or over your telephone. If you choose to listen through 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 the box on the right side will display the telephone number and audio PIN you should use to dial in. If anyone's having any technical difficulties with the webinar, you may contact the GoToWebinar help desk at 888-259-3826 for assistance.

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Today's webinar agenda is centered around the presentations on the NIBSIM initiative on carbon capture, utilization, and storage. Before we launch into the presentations, I'll provide a quick introduction of today's panelists. Then following the panelists' presentations, we'll have a question and answer session where the panelists will address questions submitted by the audience.

Now I'd like to introduce our speakers. First up, we have Deputy Minister Leonardo Beltran, who is the deputy minister for planning and energy transition for Mexico's Ministry of Energy. Following the deputy minister, we'll hear from Dr. Diego Arjona, who is the executive director of the Mexico

CCUS Center, and director general of the National Institute for Electricity and Clean Energy.

Following Diego, we will hear from Guillermo Hernandez Gonzalez, who is the energy specialist at World Bank. And our final speaker today is Peter Warren. Peter is a senior policy advisor and senior climate investment lead at the Department for Business and Energy Industrial Strategy for the UK government. And with those brief introductions, I'd like to welcome the Deputy Ministry Beltran to the webinar.

Leonardo Beltran

Thanks very much, Katie. This is Leonardo Beltran. Good morning to all of you, and I have today the honor of presenting a little bit of what we are doing in Mexico regarding carbon capture, use, and storage. And I will start with a brief introduction.

Back in 2009, Mexico started to look at this technology as a way to reduce greenhouse gas emissions in the energy sector. At that point in time, there was a policy document that had to be approved by Congress called the National Energy Strategy. And within the National Energy Strategy in 2010, we started with the introduction of this technology, again, as a way to reduce greenhouse gas emissions across the board, and in particular, creating a sustainable energy sector for Mexico.

Then in 2012, we started discussions that resulted in the approval of the General Act on Climate Change. The General Act on Climate Change is the first piece of legislation that incorporates this technology, that incorporates the efforts of the energy sector and all the productive sectors into an act that is binding for the government, and that includes medium and long-term targets for greenhouse gas emissions. This is the result of the discussion that took place in Cancun back in 2010 with the COP16, the UNFCCC COP16.

Then in 2013, we started with the discussions of the energy reform that we engaged in the administration of Mr. President Pena Nieto, and today, we have included in the Energy Reform the sustainability as a principle. And as part of this principle, the inclusion of clean generation technologies in an Act that is called the Energy—the Electricity Industry Act.

So today, it not only is present into a General Act on Climate Change, binding for all the government, but in particular, for the energy sector, we have included this technology as part of the mandate and as part of the opportunity to take into account a technology that can reduce the environmental footprint of the energy sector.

Another piece of context for this technology in Mexico is besides the legal framework, we have now a few documents that state first what's the potential in terms of storage for Mexico in particular into two specific locations, in the coast of Mexico, near the Gulf of Mexico. That is the first document, the image that you see where it says Atlas.

Then we have collaborated with our colleagues from the United States and Canada to develop the North American Carbon Storage Atlas, the NACSA.

So that's the first exercise, trilateral exercise, that includes the quantification of the storage potential for the region. Then we decided to move on to a technology roadmap, where we can have different components, not only the legal framework, but technology, the incorporation of the academic sector, science in particular, research institutions and academic institutions to join and help develop the technology and help lay the ground to the uptake of this technology across the board.

And as part of this exercise, we are developing an innovation center on this technology with the participation of the private sector, academic sector, research institutions, and of course, the government across the board. This year, we published the update of what we have been doing since the publication of the technology roadmap, so today, we have a few updates that we would like to share with you that my colleague Diego Arjona will expand upon. But I would like also to give you piece of background.

As part of our international commitments reflected today into our domestic legal framework, we have some targets for this year, for 2024, and 2050. Today, we're about to reach the 25 percent clean generation target. If we continue in this path, we will be able to reach 35 percent by 2024, and half of our consumption will come from clean energies by 2050.

That translated into CO2 reduction means that by 2030, we will be reducing 22 percent of our greenhouse gas emissions, with the baseline of 2005, and by 2050, we will be able to reduce a little over one-third of every emission that Mexico has as part of the commitments that Mexico endorse under the UNFCCC agreement, the _____ agreement.

So, let me get back just to a little bit on the technology roadmap. As I was mentioning, we published this document that incorporates several items, if we are to continue into this road.

First, we have to have a legal framework, that it makes operational the inclusion of this technology as a clean technology. So, we have signed an agreement between three institutions and the Mexican Department of Energy, the Ministry of Environment, PEMEX, and our national oil company and Commission Federale Electricidad, another—a national utility. And the framework is to make sure that the energy sector, along with these large entities, with the help of the Ministry of Environment, work together towards undertaking the challenge of incorporating this technology into day to day operations of these companies.

Then the second item that we incorporated into the technology roadmap is the creation of an interdepartmental group that incorporates 18 national institutions, from the government, academia, and industry, to understand what's the baseline for this technology, what's the understanding in the private sector, in academic sector, and in regulation, and then develop some targets, let me say it like this, north, in which we see where to head for this technology.

The third component, besides having a robust legal framework and interdepartmental or inter-institutional agreement, CCUS working group team, we decided to do an analysis of the Mexican regulatory framework to make sure that it's not only classified as a clean technology, but it also includes specific technological or technology items that takes care of the environment.

And for this particular exercise, we have developed a Mexican Mandatory Standard on this technology, and we are in the process of taking part into the International Standards Organization standard for this technology.

And the fourth item under the technology roadmap is international collaboration. And we think that the international collaboration for this technology in particular, but in general for the energy sector, is key if we are to meet our goals in the mid and long term. We have developed international cooperation with the Carbon Sequestration Leadership Forum, the Global Carbon Capture and Storage Institution, Mission Innovation, the North American Energy Ministers Trilateral, which will be happening this week in Mexico, the Carbon Capture, Use, and Storage Initiative of the Clean Energy Ministerial, and bilateral and trilateral agreements with the United States and Canada, and of course, bilateral collaboration with the United Kingdom, Norway, Australia, and Saudi Arabia.

Now besides doing this technology roadmap that sets up—sets us up into this framework of an existing legal framework, technology collaboration, and international cooperation, we have set up a national carbon capture use and storage strategy, which basically assesses the potential of different fields for storing CO₂ permanently or using and storing the CO₂ in different parts of the country.

Basically, we started with the assessment of deep saline aquifers, and the second exercise that we conducted, or we are conducting, is the assessment of oil and gas fields for CO₂ _____ recovery. Next, we are assessing the opportunity in power plants, to make sure that we can translate this good use of CO₂ and reduce the environmental footprint of the power sector. And finally, we will explore these same opportunities, but in large CO₂ sources, mainly industrial activities.

And as part of this strategy, besides doing an assessment of the opportunities for use and storage, we have now developed two pilot projects that will be coming on stream later next year, and within the next 18 months, that we will have the opportunity there to learn a little bit more about the opportunity in a natural gas power plant, and the opportunity for using CO₂ in specific fields, oil and gas fields in Mexico.

In addition to this, we have developed some capacity building activities. First, we started with the development of a master's degree program, which is led by the National Autonomous University of Mexico, our top university, in collaboration with the University of California at Berkeley and the Lawrence Berkeley National Lab. With them, we also developed a specialized training program on carbon capture use and storage, more like an executive technical

diploma. And with these two capacity-building programs, we are aiming to translate this—the benefits of developing talent into interested stakeholders that will populate government, academic, and private sector institutions, to make sure that this is well understood, and the benefits of undertaking this technology are not set aside for—that this connection of the technical people from the benefits of the technology.

Here is a little bit more of the detail regarding the pilot projects and the Carbon Capture, Use, and Storage Innovation Center, but I will leave that to my colleague Diego Arjona to explain in detail. I will just say that we have invested in the order of \$80 to \$100 million for the creation of this Innovation Center, but we will touch upon this topic in the next presentation.

This particular slide will only show you the interest we have and the importance that we assign to international collaboration on this technology. We are, along with the United States, the United Kingdom, and Norway, the only four countries that collaborate on the Clean Energy Ministerial, the Oil and Gas Climate Initiative, Mission Innovation, the Global Carbon Capture and Storage Institute, the International Energy Agency, and the Carbon Sequestration Leadership Forum, as a way to advance knowledge, information sharing, and of course, the development of clean technologies.

And I also would like to mention that Mexico, now it's co-leading, along with Saudi Arabia and the United Kingdom, the Carbon Capture Use and Storage Initiative under the Clean Energy Ministerial. And with that, I really appreciate the time and the opportunity to share with you a little bit of what we are doing on carbon capture, use, and storage, and the floor goes to Diego.

Diego Arjona

Thank you very much, Leonardo. What I would like to do in the time that I have, and I will try to be brief, is talk a little bit about the National Institute for Electricity and Clean Energy, and then talk about the Mexican Center for Carbon Capture, Use, and Storage.

So, the National Institute for Electricity and Clean Energy was created in 1975, and then—as the Electricity Research Institute, and then two years ago it was changed, and it became the National Institute for Electricity and Clean Energy.

In this institute, we have working over 1,000 people, and what we do is work in all topics that relate to electricity and the generation of power in the country. We are running several of the—well, the Mexican government, the _____, our National Council for Science and Technology, and the Ministry of Energy, have created a policy to try to generate a collaborative work from institutions in Mexico, from various institutions in Mexico, and these are called the National Centers for Energy Innovation. Actually, it's an initiative that has been pushed by Leonardo, and it has been very successful in the last six years that they have been under implementation.

_____ running the Center for Wind Energy, the Center for Intelligent Smart Grids, for intelligent networks, and also, the Center for Carbon Capture, Use, and Storage, which is the one that we are going to talk about today.

The center has been awarded a grant in order to operate, and what we show in this presentation right now is the members of the center, how the conformation of the center has been established, and I will explain the projects that we are going to be running in a moment. But if you see the members, you will see that we have various institutions, both from Mexico and outside of the border of Mexico. This includes academic institutions, research centers, and even product companies, which are working on different topics which are relevant to carbon capture or to the use or storage.

Also, you will see that we have an advisory committee. The advisory committee is including some people who come from various institutions who have shown a leadership at the international level in terms of knowledge which become really important.

If you look at the lower part of this graph, you will see the description of pilot projects, and actually, the main objective of the—the research objective of the center is to generate infrastructure for research in two topics, which I will explain in a moment.

First, if we look at the issue of the structure and projects, research and development and innovation will be run on carbon capture processes, the use of CO₂ in enhanced oil recovery, which is a relevant topic for part of our industry. Of course, all uses of CO₂, how to transport CO₂, compression and transport, and of course, there's also the issue of _____ CO₂ is in order to be transported, and the cost of perhaps CO₂ of different quality. Of course, the issue of carbon storage is very relevant. And monitoring, measurement, verification, and integrity of storage.

As we talk about the infrastructure, the idea is to generate two very important projects in this sense. The first one will be a carbon capture pilot plant, and the second one, an enhanced oil recovery pilot plant. And both of them will help to support the National Laboratory of Carbon Capture and Use for CO₂.

If I could show you where the Carbon Capture Plant is going to be, if you're looking at the plant, you will see Poza Rica as the—both in the State of Veracruz, but you will Poza Rica to the north as the place for the Carbon Capture Plant. The National Utility _____ Commission has a facility in Poza Rica for generation, and in this facility is where we are going to establish the carbon capture facility.

And the idea is that we are going to capture carbon from a power plant that is using a natural gas at this moment to fuel. So there is a difference with some other facilities in the world which are using—which are taking it from generation of coal, so there is going to be a difference in the amounts of CO₂ that we're going to find, because as you probably know, if you go into a coal powered plant, the flue gas that you are going to find is usually flue gas that goes into the 11 to 13 percent range, while in natural gas, you're going to find 4 percent, 3 percent, 5 percent, depending on the how the flue gas is developed. So, there is going to be a change in the amount of air that we're going to use in order to capture the same amount of CO₂.

But then the interesting point, the interesting point about this is that in this facility we're also going to try to examine the use of renewable energy in order to support this. So, one of the issues is to generate a solar collector in order to generate feed for the use of the facility.

What we're going to do with this facility is to generate a way to do solvents. So, we're going to try at least with three solvents, but of course, once we have the facility established, what we're going to do is generate the capacity and have an open space for other solvents that could be used in order to do this. But also, if you consider what we're going to do is that we will have a place where we have the full system in order to take flue gas from the power plant, and in turn, that will allow us to try other techniques that may be used for carbon separation, like nanomolecular membranes or the different options that might come in the future from this.

And in the second facility that you see in the lower part, which is the Brillante Oil Field, what we are going to have is the technology to place CO₂ on the ramp. We are going to experiment in that place with the idea of using it for enhanced oil recovery, but we are also going to use it for the idea of leaving it as geological sequestration _____ place.

So, if you look at the next graph, we have _____ this graph describing both projects that we are planning at the moment. The Carbon Capture Pilot Plant, as you can see, the idea is a post-combustion CO₂ capture, so it will be quite interesting, and probably in the future we'll try to do things with oxy-combustion or with pre-combustion in order to capture CO₂. But at this moment, the facility as it's going to be designed to begin with is going to be designed as a post-combustion CO₂ capture site.

The idea is to capture about 20 tons of CO₂ per day. That will be the capacity. But actually, the main idea, as I was mentioning, is not so much for the production of CO₂, which is not what we are aiming with this facility, but to try all different techniques and all different materials that can be used in order to perform this, and to understand very well the cost that might be associated with the different options.

Also, we are going to learn a lot about the power plant and how it will relate to the fact that we are going to take the CO₂ out of it, as we'll try to force the _____ so that we can see what happens to the different parts of the power plant as we are doing.

Of course, as we go into the enhanced oil recovery, the pilot, this is going to be done in a site that is owned by the Mexican oil company, PEMEX, because were we to do _____ test of _____, and of course, the idea of the injection wells.

So with these two projects, we believe that we are going to have a lot of information in order to take decisions in the future, to be able to advise the Ministry of Energy or the Mexican Oil Company or the other companies that are going to be participating in the oil market in Mexico, or the _____ Commission, or all the other companies that are going to be participating in

the power sector in Mexico, into the different options that we have to reduce CO2 from this facility.

So, we're working at this moment with the—with the National Council for Science and Technology and the Hydrocarbon Funds, which is operated by the Ministry of Energy, but we're also working with the World Bank. And the idea is to have the World Bank involved not only because of the economics part, which is obviously quite appreciated, but also because of the technical expertise that they can bring into the table, and the support that they can provide in order to determine the different aspects of the project.

And with that—I'm trying not to abuse my time—I will give the space to Guillermo. Thank you.

Guillermo Gonzalez Thank you very much, Secretary Beltran and Dr. Diego. Good morning, everyone. My name is Guillermo Hernandez, and I'm here to share with you the engagement that the World Bank has had with the government of Mexico on CCUS in the recent years.

First, I would like to mention that CCUS is part of the long-term engagement that the World Bank has had with the Mexican government in support of Mexico's ambitious targets on clean energy and greenhouse gas emissions reduction, which is aligned with the World Bank goals of eliminating extreme poverty and boosting shared prosperity in a sustainable manner.

Just a quick—a few examples of engagement that we have had in the recent years. We have supported a number of projects in residential and municipal energy efficiency, rural electrification with renewable energy and solar—wind and solar thermopower at the utility scale.

So, moving on to CCUS, let me start by saying that the World Bank is supporting CCUS through the implementation of a trust fund. We're supporting a number of countries through the World Bank CCUS Trust Fund, which was established in December 2009, with the main objectives of—the main objectives are to support strengthening capacity and knowledge building, to create opportunities for developing countries to explore CCS potential, and to facilitate inclusion of CCS options into develop country low-carbon growth strategies and policies.

I would take this opportunity to thank our donors, our CCS Trust Fund donors, the UK government, the Norway government, and the Global CCU Institute, which in recent—in recent months is in the process of withdrawing from this initiative. But its support was a decisive one for the first stage, which I'm about to explain in the next slides.

So total funds allocation to date is US \$50—almost US \$56 million across two different phases.

Let me talk a little bit about the two phases that we have supported with this trust fund. Phase number one was completed in 2015, with a small allocation. It was almost \$8 million US. And we supported nine countries and regions,

and it was mostly analytical work, where we provided capacity building and understood desktop CCUS studies and analysis. At the right-hand side of the slide you can see the countries and regions that we supported. It was Botswana, South Africa, China, Mexico, Indonesia, Kosovo, Egypt, Jordan, and the Maghreb region in Africa.

Now based on and building upon those analytical studies and analytical work, we moved on to phase two of this World Bank CCS Trust Fund, which started in 2014, with allocated funds of almost \$48 million US. And we're focusing on South Africa and Mexico for the construction of actual pilot projects. Two of them are capture projects and two of them are storage projects.

So, this is a quick summary of the phase one World Bank support in Mexico. It had a budget of \$1.3 million US and comprised the completion of five studies. A pre-feasibility study for a capture pilot plant a natural gas-fired power station, which is the foundation for the pilot project at Poza Rica that Dr. Arjona mentioned. Second study was the assessment of monitoring and regulatory requirements for converting enhanced oil recovery sites into permanent CO₂ storage sites, which is the foundation of the storage project that we are pursuing in Mexico. And we also provided support for this study to establish and legal and regulatory framework for CCUS in the country.

Fourth, studies developing a public engagement strategy. We started that in phase one, and we are aiming to complete that in phase two, as well as a number of initiatives to support capacity-building efforts wherever opportunities arise. So, based on this—using this fifth line for our engagement, we have been able to provide support for study tours for a number of government officials from the utility, from the oil company, from the government, from the Ministry of Energy and Ministry of Environmental Natural Resources, to Canada and to other countries, so that they could learn from those who have already built—successfully built pilot projects elsewhere in the world. This phase one was completed in 2015.

And then let me just briefly summarize phase two. Mr. Beltran and Mr. Arjona already mentioned about this. The phase two World Bank support for CCUS in Mexico will be led by SENER and by the National Institute of Electricity and Clean Energy, INEEL. It'll be supported by PEMEX and CFE and the Mexican Center for CCUS. And the total project budget will come from—it's a shared effort, US \$12.5 million from the Mexican Hydrocarbon Fund, and \$20.5 million from the World Bank CCS Trust Fund.

It will have two components, the capture pilot project in Poza Rica, and the CO₂ storage and enhanced oil recovery monitoring project in PEMEX oil field.

This is a quick snapshot of the capture pilot project. I won't say too much. Already, Dr. Arjona mentioned the key features of this capture pilot project. It'll be hosted in Poza Rica, Veracruz. It will be a post-combustion capture on a natural gas combined cycle power plant.

Now this is important to mention, that this is one of the first initiatives for a natural gas combined cycle power plant. In the past, there have been efforts, and the technology has already been proved in coal-fired power plants. So, this is, again, another example of leadership from the Mexican government on pursuing innovative solutions for tackling climate change issues.

The size is 2.4 megawatts, and it will capture about 20 tons of carbon dioxide per day. It will be a generic, flexible design to allow testing of a range of advanced amine technologies. So, we—our support—we are supporting project preparation, and we will support construction and operation, and the total budget is \$27.5 million US.

Then the Mexican CO₂ storage and EOR monitoring pilot project will be hosted by PEMEX at the Brillante oil facility in Veracruz. It will comprise a one-week CO₂ huff-and-puff test, and if, as everyone expects, this test is successful, we will proceed on a two-month CO₂ injection test.

Our support will be in the amount of \$1 million US, and we will be providing CO₂ storage and EOR injection and monitoring technical advice and support.

A quick summary of phase one World Bank support for CCS in South Africa. The budget was similar to the one in Mexico, \$1.35 million. It comprised five studies, regulatory review to enable the implementation of the pilot CO₂ storage project, techno-economic assessment of deployment of CCS technology in South Africa, capacity building for CCS in South Africa, and the National and Local Public Engagement Plan for the pilot CO₂ storage project. It was completed in 2015.

And in phase two, we are planning to support the CO₂ capture pilot project and the CO₂ storage project. This project is led by SANEDI and is supported by the Department of Energy, Council for Geosciences, and Petroleum Agency of South Africa, and also by Eskom. The total project budget here is \$15 million from the South African Department of Energy and \$27.4 million from the World Bank CCS Trust Fund.

A quick note on the potential future CCS Trust Fund activity. It will be the consideration of the role of CCUS in industrial decarbonization, CCUS use in different industrial sectors, such as high purity sources, cement, iron and steel, and refineries, and the CCUS use with different industrial fuels, such as natural gas and biomass.

We might be also interested in developing an emerging economic potential for CCUS in industry, and to develop country case studies and lessons learned from CCUS in the industry. Of course, we are partnering with other institutions, such as IEA and the ADB.

As a final note, I would like to say that we are proud to partner with the government of Mexico and with the donors to promote the full-scale development of this technology, and to be part of the implementation of Mexico's CCUS roadmap, and I would like to take this opportunity to thank Mr. Beltran on behalf of the World Bank energy team, and his team, for his

leadership, and for his decisive support throughout the past years. And we remain committed towards maintaining a strong collaboration with the government of Mexico, and we look forward to the collaboration with INEEL for the implementation of the second phase of the Mexico CCUS engagement. Thank you so much.

Katie Contos

Wonderful. Thank you so much, Guillermo, for that presentation. Next up, we will be joined by Peter Warren. Peter, are you on the line?

Peter Warren

Hi, Katie. Can you hear me okay?

Katie Contos

Yes. Wonderful. We have your slides up, and we're ready to present.

Peter Warren

Okay. Great. Well, thanks very much for this opportunity to present. And, I have the final slot now, which I'll be speaking about international collaboration as a driver to accelerate CCUS globally, in particular what the UK is doing to enable international collaboration to achieve that.

So, on my first slide, slide 34, I've got a map there which just shows the current deployment of large scale CCUS globally, and I thought it'd be useful to put the content behind where we are the moment on CCUS.

We recently completed an evidence review which shows that _____ absolutely crucial, and we need to make up 12 to 14 percent of global decarbonization efforts if we are to meet the two degrees Paris Agreement targets. If we don't do this, it will be at least more than 40 percent more expensive to meet these targets without CCUS.

And one of the primary reasons for this figure is that CCUS is not just about coal power. It has very wide applications for decarbonizing heavy industry, such as iron and steel, petrochemicals, etcetera, as well as forming a way to produce clean hydrogen, as well as decarbonizing the full gas chain, so gas production, gas processing, gas power. And that's why we're really interested to be supporting Mexico on the Poza Rica gas power plant to demonstrate carbon capture technology for gas power applications.

So, on my next slide, I just briefly wanted to talk about the benefits of knowledge share and international collaboration. So, I think it's really crucial that as many countries as possible engage with some of the existing initiatives, such as Carbon Sequestration Leadership Forum, Mission Innovation CCUS Challenge, which Mexico, UK, and Saudi Arabia are co-leads of, as well as the IEA for their greenhouse gas R&D program.

But it's not just about the existing initiatives. I think it's important that countries share lessons learned from previous experiences with developing both pilot scale and large scale CCUS plants across different sectors, as well as establishing new initiatives, whether it's bilaterally or multilaterally, and also encouraging where possible more donors beyond the UK, the Global CCUS Institute, and Norway to provide that support and finance to emerging economies, such as Mexico, South Africa, and others, to develop and deploy CCUS globally.

And it's not just about learning I think from the successes, but also the failures, where pilot projects haven't worked. We can use those as a way to move forward.

So, on my next slide, I just thought I'd give a couple of examples. I've already alluded to them before, and also previous presenters have mentioned these. Like Mexico, UK is part of the CCUS Initiative and the Clean Energy Ministerial, as well as the Oil and Gas Climate Initiative. And I think maybe ones that I didn't mention in the previous slide. But as I said, we're really keen to work closely with other countries to push CCUS forward.

On my next slide, which should be slide 37, one example of this is that the UK is cohosting an International CCUS Summit with the International Energy Agency in November, on the 28th of November, in Edinburgh. What this will do is it will have both a summit and a conference. The summit will bring together energy ministers from around the world to look at how we can scale up CCUS globally and will also involve CEOs of industry as well.

Alongside this, we'll be having a CCUS conference to bring together policy makers and experts from industry and academia to do deep dives into particular topics within CCUS, again, as to how we can accelerate the deployment globally.

So, on the next slide, I thought I'd mention another form of international collaboration, which is to do with the use of Official Development Assistance. We have in the UK international climate finance, which is covering climate change mitigation in emerging economies and developing countries. Our current spend profile is 5.85 billion over 2016 to 2021, which the UK's share of the \$100 billion per year by 2020 climate finance commitment under the Paris Agreement.

Now on the next slide, which is slide 39, a chunk of this goes towards CCUS, and this is one of our long-running programs, which has been running since 2012. We joined the World Bank CCUS Trust Fund in 2012. We also have a similar amount of money in the Asian Development Bank CCUS Fund.

So as alluded to previously, the work through the World Bank is primarily supporting Mexico and South Africa. We're also keen to see as many countries supported as possible under this, and we're also looking to scale up our activities with current countries. So, for example, we recently extended our World Bank funding by 10 million, with an extra 5 million pounds going towards the Mexico pilot projects, particularly the Poza Rica gas power plant and the enhanced oil recovery projects that were alluded to before.

The sorts of work that our funding goes towards is primarily technical assistance, so for example, we're setting up CCUS centers of excellence, undertaking training and knowledge sharing events, capacity building workshops, with one of the primary aims of that type of workshop is to help to develop the policy and regulatory framework, for example, for CO2 storage or CO2 capture for particular industries, to enable CCUS to move forward.

On the next slide, the only thing I wanted to sort of mention on this slide, which is slide 40, is that we have an annual review that we publish every year, which assesses the landscape of _____ internationally and what's going well, what's not going so well, lessons learned, where we can improve. And, I think if anyone wants to understand our program in more detail, in one document, that's a good one to look at, and I've included the link there.

So, on the next slide, which is slide 41, I'll probably be brief on this, because all of this has actually been covered in the previous speakers' presentations. But as I said, we're primarily supporting the technical assistance aspects of the work in Mexico, so I think those feasibility studies and developing regulatory frameworks, so a lot of this was under phase one, and under phase two, it's more looking at how we can start to build the pilot projects, like the capture pilot that was mentioned, the storage pilot. But also, we're looking to see how we can further support Mexico going forward.

So, my final slide is slide 42. So, on this one, I thought it'd be useful to talk about very briefly what the UK is doing itself. So apart from all the work we're doing internationally with other countries, it might be interesting to know what we're doing.

We recently published our Clean Growth Strategy, which looks at how to decarbonize the UK economy across all the different sectors. And within that, we published our new approach to CCUS policy. So, we have an ambition to deploy CCUS at scale in the UK during the 2030s, and we'll be publishing a deployment pathway to achieve this by the end of this year.

We see the role of innovation and innovation funding crucial. So, some of the key barriers to CCUS that are experienced globally are things like cost and how to reduce the costs, and through innovative technologies and processes, we've seen companies such as Carbon Clean Solutions, who have developed technologies that manage to reduce the cost to less than \$40.00 a ton for things like industrial carbon capture and utilization. So, we're interested to look at these commercial models and how they stack up.

So, we've to date already provided 130 million pounds invested in CCUS RD&D to look at these issues, and we also have _____ 100 million pounds to CCUS in industry, as well as the 70-million-pound Official Development Assistance Fund that I mentioned before. But we're looking to work more closely through international initiatives, and I'd be happy to speak to others after, if you want to contact me to talk about what the UK is doing internationally to support other countries further.

I just want to take this opportunity to thank everyone for this opportunity to present, and I will hand back over to Katie. Thank you.

Katie Contos

Wonderful. Thank you to each of our panelists for those outstanding presentations. As we shift to the question and answer session, I just would like to remind our attendees to please submit the questions pane at any time. And for the questions that we don't have an opportunity to get to today, we'll

connect with those attendees offline after the webinar, since we only have a few minutes remaining.

We've had some great questions from the audience that we'll use the remaining time to answer and discuss, and I'll direct each of the questions to one of the panelists, but please feel free to—for everyone else to jump in and add your comments as well. Our first question is for Mr. Beltran. This attendee would like to know, can you expand upon the Mexican mandatory CCUS standard? Will it include other large emitting industries beyond energy?

Leonardo Beltran

Thanks very much, Katie. Yes, regarding the legal framework, in our energy reform, there was the enactment of an electric power industry law, in which we classified this technology as a clean technology. So, with that in mind, for the participants of the electricity market, they are able to qualify their CCS projects as clean, and with that, they would be able to receive clean energy certificates. So that's the first item to promote this technology for the power sector.

Regarding the mandatory standards, the Ministry of Environment, our Mexican environmental protection agency, has developed these mandatory standards in which they have to comply with certain regulations regarding—respecting the baseline in terms of what it's—in the location of the project, what's the fauna, what's the flora, what's the different settings for the ecosystem there, that it's not affected in case of a leakage. And there is a prescription on how to develop redundancies to reduce the potential environmental footprint of these technologies in case of accidents.

And there is a voluntary standard to try to incorporate this technology in industrial processes, and in general terms, in industrial processes, today, it's just a voluntary standard, but eventually, once we are implementing—let me take that back.

In 2020, we are going to set up the carbon market, with collaboration and interaction with North America, and once this carbon market is implemented, most probably these voluntary standards will become mandatory standards, to comply with the opportunities and the obligations of the carbon market that is being set up in North America.

And of course, if there is a need to carry on with the conversation, you can share with the participants our emails, and we can have a private conversation.

Katie Contos

Wonderful. Thank you so much. I think we may have time for one more question. This question is for Diego. Diego, can you provide us with a timeline of the projects to be executed by the Mexican Center?

Diego Arjona

Sure. I will _____ time on how we are starting to do this, because the _____ CCUS, as we call it, was—where it was in the month of—three months ago, of June, and at this moment, we are in the process of signing and formalizing with the National Center for—with the National Commission for Science and

Technology, which will be done probably in October. And also, at this moment we are working with the World Bank in order to find all the resources and to make the changes involved and requests to the Ministry of Finance, Ministry of _____ of Mexico, on all of these issues.

So, the idea is to start very relevant work in 2019. Of course, the Center as a whole, with the money that has been allowed for it for research on all the topics, is expected to work for four years of development. The exact times on which we will have the pilot projects operational will be before that. But I will not venture a date today, because all the elements that we need order to be able to start.

Katie Contos

Wonderful. Thank you so much. Again, for all the questions that we didn't get to, we will follow up with those attendees offline, after the webinar. And I'd like to extend a thank you to our expert panelists today, and to all of our attendees, for participating in today's webinar. We very much appreciate your time, and hope in return that you have some valuable insights that you can take back to your ministries, departments, or organizations. Please enjoy the rest of your day, and we hope to see you again at future CCUS events. This concludes our webinar.