CLEAN ENERGY SOLUTIONS CENTER
ASSISTING COUNTRIES WITH CLEAN ENERGY POLICY

Approaching Final Investment Decision: CCUS Developments in Norway

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Webinar Panelists

Kevin McCabe	CEM CCUS Initiative
Juho Lipponen	CEM CCUS Initiative
Kristin Myskja	Ministry of Petroleum and Energy, Norway
Ole Martin Moe	Fortum Oslo Varme
Per Brevik	HeidelbergCement Northern Europe
Sverre Johannesen Overå	Northern Lights, Equinor

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Kevinr — Hello, everyone. My name is Kevin McCabe. Welcome to today's webinar, which is hosted by the National Renewable Energy Laboratory. Today's webinar is brought to you by representatives from Norway and is titled, "Approaching Final Investment Decision: CCUS Developments in Norway". Before we begin, I'll quickly go over some 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 a box on the right side will display the telephone number and audio PIN you should use to dial in. If anyone is having technical difficulties with the webinar, you may contact the Go to Webinar's help desk for assistance by dialing the numbers shown on this slide; 888-259-3826.

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Today's webinar is centered around presentations of overview recent developments by various organizations in Norway as they approach investment decisions on major CCUS projects throughout the country.

Before we launch into the presentations, I'll provide a quick introduction of today's panelists. Then, following the panelists' presentations, we will have a question and answer session where the panelists will address questions submitted by the audience. Before introducing the panelists, I'd like to give a warm welcome to Mr. Juho Lipponen, Coordinator for the Clean Industry Ministerial Carbon-Capture Utilization and Storage Initiative, who would like to say a few introductory remarks. Juho?

Juho Thank you, Kevin. Can you please just verify that this is—that you can hear me?

Kevin Yes.

Juho Excellent. Thank you. So, my name is Juno Lipponen and I'm the coordinator of the Clean Energy Ministerial CCUS Initiative. I would like to, also, welcome you all to this webinar on behalf of the initiative and its members. Also, many thanks in advance to our Norwegian colleagues for giving today's presentation and, Kevin, to you and the NREL team over in Colorado for getting up early to handle this arrangement and for running through this webinar with us.

The CCUS Initiative is one of over 20 workstreams under the Clean Energy Ministerial or the CEM process. The CEM is in existence since 2010 and has 26 full members across the world. The CEM member countries make 90 percent of the clean energy investments globally, but they are also responsible for 75 percent of global CO2 emissions. So, this is a very relevant global partnership. Ministers meet once a year, typically end of May or end of June. The next Clean Energy Ministerial will be hosted by Chile in May/June 2020.

Now, in between these ministerial meetings, the workstreams ensure the day to day advancement of various clean energy topics including also carbon capture. In our initiative, in the CCUS Initiative, we have 11 government members plus observers. Our common objective is to accelerate carbon capture together. We do this because we believe that CCUS has a role to play as part of a clean energy portfolio and because now is really time to accelerate.

One of the activities is, indeed, these webinars where we disseminate information on key projects and government programs such as Norway that we will be talking about today. We will, in the future months, continue this webinar series and we'll keep you informed. We have several interesting country cases to bring to you from China, the U.S., the Netherland, Japan, the European Commission, et cetera. So, stay tuned for the announcements for the next webinar. I hope you will all enjoy this presentation and, as Kevin said, to use the dialogue function, the question function in the system to send in your questions at the end of the presentations. With that, back over to you, Kevin. Thank you.

Kevin Great. Thank you for those remarks. This is certainly an exciting time to be part of this initiative. So, now, I'd like to introduce our speakers. First up, we have Kristin Myskja, who is the assistant director general for the Ministry of

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Petroleum and Energy of Norway. Kristin has worked in the Norwegian Ministry of Petroleum and Energy since 2006. She worked four years in the Oil and Gas Department in the Ministry, where her responsibilities included a portfolio of oil and gas fields on the Norwegian Continental Shelf, infrastructure on the Norwegian Continental Shelf and ownership in the Norwegian oil and gas transport system.

Following Kristin will be Ole Martin Moe, Project Manager for Fortum Oslo Varme. Ole graduated as a civil engineer in marine engineering from NTH, now NTMU. He's enjoyed a long career in the shipping and offshore industries and has been fortunate to be involved in many interesting projects, both as project engineer and project manager. Says Ole, "The most exciting projects are those that can take us a step further and provide good solutions to small and large challenges for our customers and society."

After Ole, we'll hear from Per Brevik, the director of Alternative _____ _____ _____ Northern Europe. Per has a master's degree in business administration from the Norwegian School of Business Administration, NHH. Since 1993, he has worked with alternative fuel development in the cement industry. From 2007 onwards, he has been responsible for alternative fuels, climate, and sustainability at HeidelbergCement Northern Europe. He has been responsible for the carbon capture project at NORCEM Brevik since the launching of the project in 2011.

Finally, we will hear from Sverre Johannesen Overå, Project Director for Northern Lights Equinor. Sverre has been managing large investment projects for Equinor for the last 20 years. He was project manager for TCM, Technology Center Mongstad, in the design and construction phases from 2006 to 2012 before moving to Brazil and heading up Equinor's portfolio of modification projects there. After returning to Norway, he spent two years as deputy project director at the Nyhamna Expansion project for Ormen Lange, one of the largest oil and gas modification projects in the world at that time. In 2016, he returned to CCS, where he became project director for the Northern Lights Project, a key element of the Norwegian states full scale demonstration project. With those brief introductions, I'd like to welcome Kristin to the webinar.

Kristin Well, hello, everyone. Is this working? Good. Thank you. So, I'm so delighted to give this presentation on the Norwegian full-scale CCS project. This is an interesting project to work on and also a very different way of working in the Ministry. So, what I'm going to tell you today is the status of our project and how we work on CCUS developments in Norway. If you go to the next slide, please.

As you all know, CCS is a necessary part of the solution to reach a low-carbon society. This has been stated by the IPCC. It is important due to the Paris Agreement and also the World Energy Outlook, which came out today. It, also, shows the important of CCS and the importance of developing CCUS solutions. If we are to reach the sustainable development goals, we need energy for all. For that to happen, we do need to development CCS solutions.

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So, this is the background for the Norwegian Government's engagement in CCS. So, if you go to the next slide, please.

The Norwegian CCS strategy was presented back—five years ago, in 2014. It has a broad approach. We support R&D through our R&D program called CLIMIT. We have different research centers. So, there's a huge R&D community working on CCS in Norway. In addition, we have the technology centre at Mongstad where you can test different carbon-capture technologies at the site with extensive measuring. So, that is an important part of demonstration of the different technologies and to develop the technology and reduce costs. Finally, we have the large-scale solutions that is needed to reduce costs and develop the CCS technology. I'm going to tell you more about how we work on the large-scale project going forward. So, if you'd take the next slide, please.

The current political platform of the Norwegian government states that they have an ambition to realize a cost-effective solution for full-scale CCS in Norway, provided that this incite technology development in an international perspective. Our aim for a CCS project in Norway is to demonstrate the full chain of capture, transport, and storage of CO2, that it works, that it's flexible, and that we can actually capture CO2 from existing industry. Then we want to establish a flexible storage solution with excess capacity. The gentlemen in the room here—Per, Sverre, Ole Martin—they will tell you more about how to do this later on in the webinar. In addition, we want to provide cost and risk reductions for subsequent CCS projects. That is also a very important part of the project.

So, how it looks is that we have two different capture sites. One, here in Oslo at a waste incineration, waste managing facility, where they will capture 400,000 tons of CO2 per annum. It's owned by Fortum Oslo Varme, which is part of the Fortum Group, and also owned by the Oslo Municipality. Then we have NORCEM, owned by the HeidelbergCement Group, which are cement production. Also, on the eastern part of Norway. It's cement production, 400,000 tons of CO2 per annum. Then, the CO2 will be compressed and shipped to an online terminal outside of Bergan, where it will be put on tanks and then it will be transported through pipeline to an offshore storage complex. But Sverre will tell you more about that later on. So, _____ _____ slide, please.

So, we have worked on this project since 2014-'15. We have done it step by step through an industrial project development phase. So, we are currently in the very final stages of the FEED phase, Front End Engineering Design. The different industrial actors have handed in their FEED report and they are currently being evaluated by our crown corporation, _____ _____ _____ on behalf of the Ministry. Then, we will have a quality assurance of those reports and, also, of the negotiations on commercial terms for investment and operation that is going on between the government and the different companies. Then there will be an investment decision next autumn.

The way this is, is that the companies, they will make their investment decisions first, and then the government will propose to the Norwegian

Parliament, just to how—in connection with the budget process for 2021. So, then it will be cited whether or not the project will be financed, if it will be one of two capture projects and how to take this project further on. So, that will come next fall. We are very excited about this process going forward. These are interesting times. So, you can take the next—and if we make all this and everyone makes their investment decisions properly, then we will be in operation in 2024. If we take the next slide, please.

You see here a web page called ccsnorway.com which is a web page where you can get all the information that you would want on this project. It's operated by Gus Nova SF. So, with that, I think I'll leave the floor to Ole Martin. Then he can tell you a bit more about the Fortum project and how they are doing that. Please.

Ole Martin

So, next slide. My name is Ole Martin Moe. I'm the project manager for Fortum Oslo Varme's CC project _____ _____ in Oslo. As Kristin says, we are owned by Fortum. Fortum is a leading energy provider in terms of electricity and district heating with in their markets. Fortum is very focused on changing the energy systems from _____ sources to cleaner sources and also increasing the energy efficiency. We'll take the next slide, please.

As we have said, Fortum Oslo Varme is owned 50 percent by Fortum, 50 percent by City of Oslo. The main business of Fortum Oslo Varme is to provide district heating to the City of Oslo. The main heat source for the district heating is the waste energy plant at Klemetsrud, just outside the City Center of Oslo. Currently, the plant incinerates approximately 360,000 tons of waste and the heat from the incineration is then used to district heating and also to electricity production. We produce approximately 150 gigawatt hours for a year from the waste incineration. The district heating network is covering some 600 kilometers of district heat piping and providing heat to some 3,289-domestic housing, 952 apartment buildings, 1,141 commercial buildings all in the City Center of Oslo. Both owners have a very high focus on reducing emissions and cleaner energy solutions.

City of Oslo have renewed their climate strategy and have set a goal to reduce the greenhouse gas emissions in 2013 by 95 percent compared to the 1990 levels. This is an extreme reduction in emissions and Fortum Oslo Varme carbon-capture project or the waste energy plant at Klemetsrud is widely important to reach those goals. Fortum, the other owner, is likewise focusing on decarbonizing their energy production, to focus on carbon capture from _____ _____ power plants and renewable energy sources _____ is among the drivers for the decarbonizing of the energy production. Fortum is a large organization with the majority of all the operations in Northern Europe, but also operations in Asia, especially within solar power plants. The Fortum organization is a total of 8,800 people and Fortum Oslo Varme is selected as the center of excellence for the carbon capture within the Fortum organization globally. Next slide, please.

The Fortum Oslo Varme Carbon Capture project _____ have been through the phases as described previously; the feasibility, the concept, and the FEED phases. The goal is to capture 400,000 tons of CO2 annually from the flue gas

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from the waste-to-energy plant. This is approximately 90 to 95 percent of the total annual CO2 from the incineration. It's a significant contribution to the planned emission reduction in the City of Oslo. Klemetsrud, as such, is the largest point source of emissions in the City of Oslo. Incineration of Klemetsrud is mainly based on multiple solid wastes, which contains approximately 50 percent of the biogenic origin. The CCS plant will capture both the fossil and the biogenic CO2 and, hence, contribute to a net reduction in the CO2 in the atmosphere.

The plant at Klemetsrud is located approximately seven kilometers star gland from the port which means that we need to transport the CO2 from the capture site to the export site, which will be at the Port of Oslo. The transport is decided to be done by trucks and we will have approximately 40 to 45 truck transports from Klemetsrud to Port of Oslo every day on a 24/7/365 basis. The trucks will be run on emission-free fuels. That means either biodiesel, bio gases. But when we come to the actual transport, we believe that also electric trucks with capacity of transporting 50 tons will be available. The goal for the transport solution, that we will use electric trucks for the transport. This will give important experience also for other CO2 capture plants which are not directly located close to ports.

The selected capture technology have been extensively tested at Klemetsrud through our pilot plant which has been specifically tailormade to replicate the full-scale conditions at Klemetsrud. The pilot has now been running for eight months, getting a lot of learnings and demonstrating that technology is mature and capable of capturing CO2 at the rate we have decided. A _____ has been used as a qualifier for the technology and they have given their statement of qualified technology for the Shell captured technology used at the Klemetsrud waste-to-energy through gas emissions. Shell capture technology provides more than 90 percent cleaning of the CO2, which also have been demonstrated by the pilot. This technology has also been used in other full-scale plants, although with different flue gas compositions. Shell, with their capture technology and TechnipFMC, with their strong project portfolio through gas cleaning projects were selected as the main suppliers to the FOE carbon capture project. Next slide, please.

Waste is one of the world's biggest climate challenges. About 2.2 billion tons of waste is produced every year. This is increasing. Poorly managed waste contributes to the global climate change to maintain generation. The waste industry has a unique position and responsibility in reducing the greenhouse gas emissions from wastes. Household waste and multiple solid waste counts for more than five person of the total global emissions alone. Additional waste streams like industrial waste, agricultural waste, et cetera, accounts for additional emissions.

The majority of the emissions is due to handling of the waste in open landfills without any gas collection system. The use of landfills has been reduced by increased sorting and recycling in combination with efficient waste-to-energy plants. Waste-to-energy is the most sustainable solution today for it's a dual waste that cannot or should not be recycled. Carbon captured included in the

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waste-to-energy plants will further enhance the contribution to emission reduction in the waste industry.

As previously stated, multiple solid waste has normally a high content of biogen material and, as such, the waste-to-energy plants with carbon capture will contribute to negative CO2 emissions. The waste-to-energy industry will also contribute to increasing plastic _____. The amount of plastic in the world is growing, even with increased focus on sorting and recycling. There will be still large quantities that cannot be recycled or have been recycled a number of times and is no longer possible to recycle. Waste-to-energy is the most sustainable way to treat those whole limbs.

EU have set specific targets for moving away from landfills and towards increased sorting and recycling. Assuming the EU meets its targets of 65 percent material recycling and reduction to 10 percent landfilling, a total of 142 million tons of residue waste will need to be treated. Currently, the waste-to-energy capacity in EU is 100 million tons and new capacity of 40 million tons of waste-to-energy capacity will be needed to meet the targets. Combining the new waste-to-energy plants with carbon capture will have a major potential for global CO2 reduction. As one ton of CO2—one ton of waste is equal to one ton of CO2 capture. Other parts of the world will have similar challenges and even larger benefits from applying waste-to-energy with carbon capture. Based on the experience and knowledge from Fortum Oslo Varme, new waste-to-energy plants can be prepared for, in the future, built with cost-effective and integrated carbon capture facilities. I think that was my part of the Fortum Oslo Varme carbon capture facility.

Kristin Okay, then we move on to Mr. Per Brevik will tell you about the capture project at NORCEM Cement factory.

Per Yes, hello. This is Per Brevik. I'm working for NORCEM and HeidelbergCement. HeidelbergCement is one of the main emitters in the cement industry. Altogether, the cement industry counts for five to eight percent of the total emissions, CO2 emissions in the world every year. HeidelbergCement, on itself, we emit approximately 17 million tons of CO2 every year. That makes us having a responsibility to do something because we accept that climate change is a huge—absolutely, a huge challenge. Then, if you go to the next slide, please.

Cement is one of the main building materials in the world and maybe the biggest of everything. It's easy to form. It's durable. It has negative effects on the cement—on the climate change. But you can't imagine a society without using concrete, especially when you're going to see a future sustainable society. It will be so important to have it. When you look around in the world, you put a lot of efforts and resources in the world today to build infrastructure. On the infrastructure side, you can't have very many other building materials can compete with them. So, if you are and really needed product, then you have a special responsibility to do something with it. That's the way we are thinking in HiedelbergCement and in NORCEM. We have to do something. We have to contribute to find a good solution. Next slide, please.

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The reason why it's so easy for us to say that is because the cement industry, we are quite easy for us to engaged in carbon capture, et cetera because we have some good sight that it's easy for us to be an active part in this. We are large, stationary units. We are often big. Our emissions is in the level of half a million tons per year, up to 2 million tons per year. Then you have a concentration and an easy way to do it, at least easier than for all the small emissions sources. We are often clustered. So, maybe we can do something together, different producer of cement, et cetera. This is not only build for ten years. It has a really long lifetime as a cement plant. The plants in Norway, they are more than 100 years, and other sites, we know that they are 160 years. They are located to sea, close to sea very often. As trace in shoulders, that is important when we are talking about Norwegian demonstration protect because sea transport is an important part of it.

Then we have that fact. The reason why it's so huge emissions from the CO2—of CO2 from the cement plants is that two-thirds of it coming from the process where the limestone is split into carbon monoxide and CO2. That is inevitable to do. We can't avoid it. Therefore, we have to do something to technology way to do that, to take it out of the system. Only one-third of it coming from the fuels we are using, which we work every day, try to reduce the CO2 emissions connected to the fuels. This is a demonstration project which we are part of. Therefore, we also said, "Okay, to reduce the investments and to reduce the operating costs." We tried to really use the excess heat we have available in the cement plant. Then we can reduce the cap x, et cetera. The concentration in the flue gas is quite high, 20 to 24 percent. So, we think it's a huge potential for us to work with this and we have worked with this for a long time.

If you take the next slide, you can see that we have worked with it actually since 2005, and especially since 2011 up to today. We have been working different—we are taking the small steps along the leather and now we are close to the FEED. We have delivered the FEED study. We are in the entering period now and we are waiting for a decision. Hopefully, we will be part of the huge fuel scape project together with Fortum, together with Northern Light, et cetera. That will be really good thing for the cement industry, in general, and for NORCEM. Next slide, please.

Here is a picture of what we are going to do. It's a demonstration plant. We are going to capture 400,000 tons per year, 55 tons per hour. That's approximately 50 percent of the CO2 from the cement plant. The reason why we do this is, as I tried to explain, is that we will use the excess heat. We will not have any energy source in addition to what we have in the plant today. We don't build any new electricity plant or things like that. That's the one thing. The other thing here is that you see from the picture, everything with color, that is what we are going to build. You can see, we are going to build a new plant at the same time we are running the existing cement plant and to the requirement for us to produce 1.3 million tons of cement every year at the same time as we are going to build this new plant. That's the main challenge. Really huge and maybe the biggest risk in the execution phase. So, as you see, we are going to integrate it. That's a challenge, but we are sure we will

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make it and we will be the first cement plant in the world with a carbon capture plant. Thank you.

Kristin Okay, so then we will move down the value chain to the transport and storage. I'll leave the floor to Mr. Sverre Overå, who is the project director for the Northern Lights project.

Sverre Thank you. So, the Northern Lights project is led by Equinor being the largest oil and gas producer in Norway, which we have teamed up with two other major companies; Shell and Total. So, we are doing this as a joint effort. All companies have experience in storing all CO2 actually. Equinor has been doing it for the last 23 years. We've been storing more than 1 million tons every year in the North Sea. So, that's kind of the background for why we believe we are a good team to bring this part of the project forward. So, you can _____ the next slide.

This illustration shows the part that we are responsible for. On the left, you see a generic capture plant representing Fortum, NORCEM, and others who may come as you sell the storage. They are not part of what we are working in. Our scope starts at the seaside where we bring in our ships. They are part of our scope, the transportation scope. We believe the ships are a very good solution for the initial phase of CCS. _____ is flexible. It can go anywhere that is essentially the sea lanes and harbors. It's shooting four to five staff we believe will be the initial sites, around 500,000 tons a year, which is, it appears, the size needed to demonstrate _____ but still small enough, if we can use that word, to be possible to implement as a first step. Later, there will be larger facilities, but I do believe that most industries and companies would like to see a demonstration working before they go to the really large scale.

Following from the ship, we then go to an onshore facility, where we essentially only temporarily store the CO2, offload it from the ship, and then pump it out to some sea pipeline directly out to the location where it will be stored out there. There is nothing visible on the surface. Everything is at the seabed. The same technology we use for subsea production of oil and gas and have a long experience with. So, it's essentially just what we have been doing for a long time, but in reverse. You're seeing the same technologies and the same systems and solutions pumping, then, the CO2 down thousands of meters into a geological formation suitable for storing of the CO2. The major part of the work, actually, is to qualify the storage site, the geological storage site to ensure that it is suitable in the sense that it has capacity and that it is safe and that nothing will migrate or leak from that formation and back out to the surface and into the air again. That is the key work that we're doing.

So, the first phase of the project, if you look at the bottom of the illustration, you'll see that we tried to illustrate capacities. So, there is a phase of what we're doing is sized for more than the two initial Norwegian capture project in order for us to actually start receiving CO2 from others. We are seeing an increasing interest in utilizing that capacity from industries all over Europe. So, that's very good, very positive. The bottleneck of our system is the pipeline. That's the least expandable part. Therefore, we will put in a pipeline with a significant excess capacity to allow us to scale-up by adding a little bit

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more of extra hardware onshore or add extra ships. That's easy and quite scalable. The pipeline then is our bottleneck. Five million is what we believe we can go and get through, initially. If we want to scale up from that, we need additional pipelines or other solutions. But when we get there, then this is a success. So, that will not be a problem to get in place. So, if you take the next slide.

While we, just like the capture plants, have concluded our studies, we're doing a little bit more. What you're seeing in this illustration is actually the hardware, on the left, that is needed to have an injection well in place. That was constructed and delivered to us months ago. Then it was installed at the location where we intend to drill and have the first injection well. It's currently sitting on the seabed together with the fishes waiting for the drilling rig to come. The drilling rig is scheduled to come next week—well, next month, sorry, which is almost next week, but a little bit longer. Then we will start drilling the first well. Why are we doing this before any decision is being made to actually execute the project? Then if you take the next slide\.

What we need in order to document that we have a suitable storage site is to document and show that we have the correct geological formation. There needs to be a sandstone with sufficient porosity and formability that allows us to inject CO2, that it will flow away from the well and that it will have capacity to receive CO2 from the capture sites for a long time. It also needs to have a seal, a caprock above the sandstone that acts as a barrier towards the surface and ensures that the CO2 stays where it should be forever. Certainly, it needs to have properties that allows us to monitor this from the surface, because we can't go in there. This is 3,000 meters below the seabed.

So, we have to be able to monitor this to seismic service that show us where the CO2 is. This is important, both because we want to document that it is stable and that it stays there permanently. But also, because if there are anomalies or something happens, we need to detect it so that we can do mitigations in order to avoid any chance of leakage of the CO2 back to the surface. We need this before we can make the necessary investment decisions. We don't want to start the project and then find this out later, which is why we're drilling it now, to have that information in hand before we ask the authorities to make the final decision.

Kristin Thank you, Sverre. I think we're—we've concluded the presentations from Oslo. I'll send over to you, Kevin, to do—to lead us through the Q&A session.

Kevin Yes, wonderful. Thank you to each of the panelists for those outstanding presentations. As we shift to the Q&A, I'd like to remind our attendees to please submit questions using the question pane at any time. We do have some great questions from the audience that we'll use the remaining time to answer and discuss. One of the first questions that I received was with regards to the Fortum capture facility. Are there any thoughts on trying to capture far closer to 100 percent at the Fortum facility rather than just 90 percent?

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Ole Martin I think that, through our pilot testing, we have seen that we can capture 99 percent. There will always be some leakage of the CO2 through the process. But I think having aiming at 90 percent, 90 to 95 percent is still a high degree of capture rate. But for a demonstration project, I think that is suitable.

Kevin Certainly. Yes, thank you. Another question, a more broad question on financing. How do companies make their investment decision and risk evaluation without knowing if the government is going to support the project? What's the reasoning behind some of the timeline related to that decision process?

Kristin I think I can start answering from the Ministry side and then the different companies can follow up. I think from—we have stated, from the beginning, that the state will have to take a major part of the cost and risks in this project. But from the government's perspective, it is crucial that we see that the companies actually put money into this because that's the important indicator that they actually believe in this as a climate solution because the government should not pick the winners when it comes to technology. That's up to the industries and the different companies to decide.

So, from our side, this is sort of—we are, or the government as to say, if offering to take most of the costs and risk of the project, but we need contribution from the industrial actors to prove that this is an important climate technology that the industry believes in, and also to, of course, to sort of as this is a project that we're together in. So, from the government perspective, it is crucial for us to know that when we make this decision that will involve billions of—at a billion Euros, that it is important for us to know that the companies are actually in there. So, this has been a _____ from the state that the companies will have to make their decisions before the states make their fund investment decision. That said, we are currently in the final stages of negotiating the terms on how to share the costs and risks so that the government—the industrial investment decisions are based on a knowledge of so if this project comes through, these are the terms. So, it's not like they're in full sort of—they will know what the terms are if we have an investment decision. So, Sverre?

Sverre Just from the perspective of all the transit and storage partners, we all see that mitigation measures are needed to bring us to where we want to be with respect to emissions. CCS is one important tool in that tool box. We believe it will become a significant business over time. It's not today. It's not in the near future, but it will. We believe strongly enough in that that we are willing to take a certain amount of risk together with the Norwegian government that this will initiate that industry. So, we go into this knowing that if it does not develop as we expect, then we will have a loss. So, there is a risk that we lose money on this. But there is also and we believe a higher probability that we will ultimately be kickstarting a new industry that will become a business. Not very profitable, I have to say, but it will become a business and it's needed to be a business in order for it to grow over time.

Kevin Great. Thank you.

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Kristin Per. I think Per would like to have some comments as well.

Kevin Please.

Per Yes. I will follow-up what Kristin said that this is a demonstration plant or project. Of course, there are a lot of risks with it. But we try—all parts of us will try to reduce the risk as much as possible. But as we see—and I think Fortum and Heidelberg is quite agree upon this that we have to take measures. We have the responsibility to do that. So, as long as we believe we have done testing, we believe in the technology, we think this is possible to do, then we go on. As Kristin said, we are in the last phase of the negotiations about sharing the costs and the terms we are working on, et cetera. I'm sure we will find a solution. Then it's up to the higher part of our organization, et cetera, to accept this negotiation and the results from the negotiations and the terms. But, of course, we have—our advice to our top managers is let's go for it.

Ole Martin I can just, from Fortum side, agree that we are in the final stages of the negotiations and this has already been raised by the board of Fortum and the process is ongoing.

Kevin Great, thank you. We had a question, I think, specifically for Per. As you expect to use excess heat from the plant, what do you expect to be the main operating costs for the project?

Per I didn't—I'm sorry, I didn't hear. You have some—

Kristin Main operating costs.

Per The main operating costs, if you ask us for that, the main operating cost for us will be electricity. That's for the capture plant. That's the main operating cost we have for it. I think approximately 50 percent of the cost will be that. We have a lot of electricity in Norway, but it has to be build a new transformator, et cetera for this plant because we need quite much electricity, please.

Kevin: Great, thank you. We have a sort of related question. Is there any external financing required for any of these project or workstreams or will these costs be self-financed?

Per I think that, for all of us, if you call the recent state or government, external then is external funds, as Kristin said, the main cost will be covered by the Ministry and the Norwegian government.

Kevin Great, thank you. Changing gears. We have a question related to public support of the project. What is the status of public support? Do you have to deal with any considerations related to folks in Norway perhaps not on board with the project goals, in general?

Kristin That is a very good question. I have to say that, in Norway, we are quite glad that we have a very broad support for this project. In the Parliament, all the different parties are pro CCS and they see this as an important measure to

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combat climate change. So, we have a very broad political support for the project. When it comes to local support, my impression is that there is also very much support locally, close to the different capture project. As opposed to what the situation other places may be, as the transport and storage part here is offshore in the North Sea, we don't have very much of the sort of "not in my backyard" syndrome in relation to this project.

So, I would say, overall, there's a lot of support, public support for the project. As far as I know, we haven't seen any opposition or people being against the project as such. That said, I would also say that it's very important for us that we, in this project, deal with agency and the local communities in a very good way. So, we have a very high focus on agency in the project and to make sure that everyone is, of course, in line with all the relevant regulations. So, I think we are very confident that this will work out fine.

Kevin Great, thank you. We have a couple related questions here. Specifically, how is the government approaching some of the cross-chain risk or rather how challenging is the integration of the various components of this chain? Will the operation of the entire system be constrained by any single component, perhaps the CCS portion?

Kristin I think from the government perspective, when we—we have some experience with projects in Norway not going forward. So, when we started this project, one of the main—one of the first things we discovered was to delink the capture from the transport and storage part. That was due to the industrial companies telling us that, "We can do the capture but you will have to take care of the transport and storage. That's the only way to go forward."

So, that has been the basis for this project from its very infancy, basically, that the interface risk between capture and transport and storage is for the state. That implies that the capture box is the capture box. If there's trouble on the transport and storage part of the chain, then that won't inflict the capture part of the project, and the other way around. So, if there's trouble at the capture sites, then that will not inflict the transport and storage part financially. When it comes to sort of bottlenecks, I think I will leave that to the industrial actors to answer, if there are any.

Sverre I mean, obviously, the storage looks like a bottleneck as you see from the outside because there is a common storage for at least two—hopefully many more—capture sites. The way we are approaching that is you should consider it as a service being provided. There is possibility of the Northern Lights partners to provide storage. If we need to develop additional sites in order to make that happen, then that will be part of the business development over time. Not in the demonstration project, obviously, because that's kind of everything is one-off since it's the first of a kind. But once it gets going, there needs to be redundancy in the storage solution being provided. That is the plan.

Per Yeah. I can say from cement industry, of course, the main risk, as I said, is that the capture plant compromised with the cement production. We are cement producers and that will have the priority. But if it—all the testing, all

DRAFT

our assessments say that this will be—this is mandible. We have—all of the systems, they are in parallel. So, we can stop the capture plant and then we can run the cement plant. Hopefully, that will not make any huge problem. We are going to capture the 400,000 tons. We will manage that, I'm quite sure.

Kevin Great, thank you. I think, in the interest of time, we will have to move on. Thank you, again, to the panelists for that informative Q&A session. For any questions we didn't have time to get to, we will connect with those attendees offline after the webinar and forward any responses from the panelists afterwards. So, in the final few minutes, I'd now like to provide the panelists with an opportunity to provide any additional or closing remarks you'd like to make before we end the webinar.

Kristin I think, from my side, I would like to underscore that, from the government's perspective, this project is a success if it's the first of many CCS project. What we don't want is this to be the last CCS project in Europe. We believe that this could be a good basis for development of CCS in Europe. That is a very important aspect for us. So, when the government are to assess this project, a little less than a year from now, that will be their main focus is, "Is this the first of many? Do we believe that this is the first of many CCS projects?" We certainly hope it is.

Per I can add that we have discussed this for a long time and during different phases, et cetera. I'm quite sure that the situation today is much better than it was one year ago, two years ago, et cetera. The interest for CCS in the industry is much higher and better today. I'm sure that a lot of interest plants, groups, et cetera in the cement industry, they follow closely what's happening in Brevik. I we manage to do this, this will definitely be the first in the row.

Ole Martin If I can just add to that, also in the waste-to-energy business, there has been a lot of interests lately. Also, Fortum has different energy plants where we now look into applying CCS for those plants, both existing and new plants. There is a lot of interest when we have had the pilot up and running at Klemetsrud. A lot of waste-to-energy companies has been there looking at it. Someone is also wanting to continuing testing with our pilot in their plants. A lot of interest and I'm sure that, if this is a success, then it will be several more projects.

Sverre From our side that we have been discussing now, essentially, the scope of the Norwegian demonstration projects. But it has the component that it also is open for others outside of Norwegian demonstration project, and we are seeing a lot of interest, which is good. Other companies are joining forces, hopefully, with us in not too long. Kristin mentioned that there was a web page for the total project. I would also like to do a little bit of a commercial for our web page because it is a NorthernLightsCCS.eu web page as well, which contains quite a lot of information about what we're trying to achieve.

Kristin Finally, I would just like to thank CEM CCUS platform for hosting this webinar and to give us the opportunity to tell you all about what we're doing

DRAFT

on the daily basis. Of course, that's something that we are very engaged in and proud of. So, thank you very much for organizing this webinar.

Kevin It's our pleasure. Thank you, again. If you want to learn more about the CCUS initiative, please reach out to Mr. Juho Lipponen at the email displayed on this slide. For other news and developments, follow us on Linked In by following the link displayed here, and also on Twitter @ccuscem. One more time, I'd like to extend a thank you to all of our expert panelists and to our attendees for participating in today's webinar. We very much appreciate your time and hope, in return, that there were some valuable insights that you can take back to your ministries, departments, or organizations. Please enjoy the rest of your day. We hope to see you again at future CCUS events. This concludes our webinar.

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