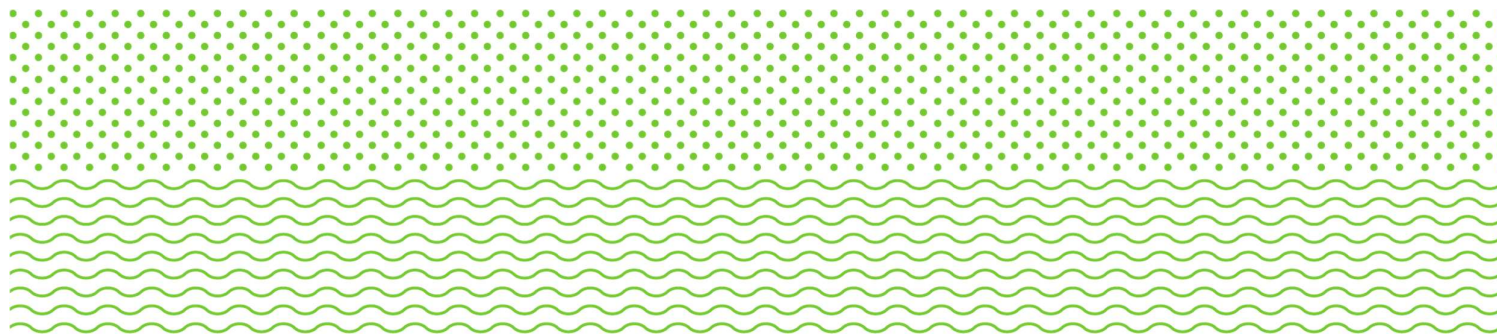


# Telling the Norwegian CCS Story

## PART II: CCS: the path to sustainable and emission-free cement

Webinar Q&A with Per Brevik, Director for Alternative Fuels and Sustainability, Heidelberg Cement

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All the questions featured in this document were submitted during the webinar hosted by the Global CCS Institute. The answers below are the views of Per Brevik from Heidelberg Cement.

**Q: If you do not have a by-product with an economic value, what is the economic incentive of CCS in cement industry? Is it just the CO<sub>2</sub> reduction the only goal?**

- As we see it today, the main purpose is to reduce CO<sub>2</sub> emissions by capturing and storing it. The Brevik cement plant will be operating as one of the “most environmentally friendly cement plants in the world”. The value of the project is connected to avoidance of CO<sub>2</sub> and the costs we have in the EU ETS.

**Q: In the typical cement process, the off gas from the kiln is contacted with the incoming feed material in a preheater feed tower. This intimate contact of the off gas with freshly ground limestone will have the effect of absorbing contaminants, notably SO<sub>2</sub>. After this contact, what is the remaining concentration of CO<sub>2</sub> in part per million. Is flue gas desulphurisation necessary before the flue gas is scrubbed for CO<sub>2</sub> in the amine plant?**

- The CO<sub>2</sub>-content of the flue gas in our cement kiln is 18-20 %. Desulphurization is necessary. The Brevik plant has already installed a SO<sub>x</sub>-scrubber.

**Q: How much additional land is required for the CCS plant as a fraction of the footprint of the host process?**

- Approximately 4.000 m<sup>2</sup>.

**Q: What is the intermediate condition of CO<sub>2</sub> storage prior to ship loading? Liquefied? Supercritical pressure?**

- The CO<sub>2</sub> is liquefied. The pressure is 16 bara at -26 degrees.

**Q: On the 3D schematic, what was the large purple rectangular building next to the 6 yellow intermediate storage tanks?**

- It's the new limestone storage. In the future, the plant will “import” most of the limestone. Today approximately 30 % is imported. This building is not part of the CCS project.

**Q: How much of the CO<sub>2</sub> that is going to be captured at your facility is from biogenic origin?**

- Approximately 35-40 %.

**Q: Who can we contact at Aker Solutions regarding the technical components for this project?**

- Oscar Graff is responsible for this area in Aker Solutions.

**Q: The Capex cost of a 400,000 tonne CO<sub>2</sub> capture. What is the Opex cost estimate of running a system like this?**

- This is a demonstration project and “first of a kind”, so I do not think the figures will be representative for future installations. Therefore, I cannot give exact figures.

**Q: What will happen with the CO<sub>2</sub> captured? How will the financing of the project take place?**

- There will be the conditioning of the captured CO<sub>2</sub> at the cement plant and preparation for transport by ship to a hub on the western coast of Norway. Then further pre-treatment before transport by ship or pipeline to a storage area below the North Sea.
- The funding will be mainly by the Norwegian government, but I anticipate a fair share by Heidelberg too. We are negotiating this with the Ministry now.

**Q: This is a question regarding the 2<sup>nd</sup> point on the last slide: What will be assessed/evaluated? Will the life-cycle carbon emissions be assessed?**

- Yes, a life cycle analysis will be done by us and assessed by an environmental authority. The third-party evaluation will focus on costs, risks and uncertainty.

**Q: What was size of the mobile test unit that was used for the 8,000 hours?**

- The mobile test unit have a flue gas capacity of 500 Nm<sup>3</sup>/h. The capture rate was 0,2t CO<sub>2</sub>/h. During the test period, we captured approximately 1000 tonnes of CO<sub>2</sub>.

**Q: Any thoughts on CO<sub>2</sub> usage and application on usage, rather than just storage?**

- My personal view is that usage is always interesting but the emissions are enormous, so storage will be the main measure needed. I think it is important to support good and economic viable usage projects. Many of these projects are close to storage, especially when CO<sub>2</sub> is used in building materials.

**Q: What policies or incentives are in place in Norway that make this project attractive to Norcem and Heidelberg?**

- The Norwegian government has decided to take a lead in CCS. They established Gassnova (a state-enterprise, 100 % funded by the Ministry) as their main measure to coordinate this work. Through Gassnova, they have established different funding schemes. These are different depending on degree of maturity of the project. This has helped us to develop the project through the necessary steps.

**Q: Did Aker Solutions observe issues with solvent degradation during their 8,000 hours of pilot testing? If so, what was their approach to mitigating it?**

- Aker Solutions observed some solvent degradations, but much less than expected.

**Q: How did Aker Solutions managed particulates in the flue gas upstream of the capture unit?**

- Aker Solutions had installed their anti-mist system, and experienced small challenges during the 8,000 hours of testing.

**Q: Will you have to stop the cement plant during CO<sub>2</sub> capture construction project? If so, for how long?**

- I hope that we can avoid that. We will install a lot of the tie-ins during the yearly maintenance stop (3-4 weeks every spring) during the building/installation period. According to the schedule, we will have three maintenance stops. Some of the periods might be a little longer, but we really hope we will avoid stopping the plant for a longer period.

**Q: Are you planning to use waste heat from the existing cement plant in the FEED study? If so, waste heat from which unit operations?**

- Yes, we will install heat recovery units connected to the raw meal mills, the cooler and connected to the conditioning train.

**Q: How extensive will be the change in existing cement plant infrastructure with the addition of the CO<sub>2</sub> capture unit?**

- Regarding buildings, quite extensively. But since Aker Solutions' technology is "post-combustion", the "two systems" will operate without too much interaction. If the capture plant is not operating, we have the possibility to operate the cement plant in the "old way".