

Frequently asked questions about the CinfraCap project

1. What is the CinfraCap project?

Answer: The partners in the CinfraCap project have pooled their resources to identify the most suitable and effective means of establishing an industrial-scale CCS logistics system. The aim is to produce concrete proposals for an optimised infrastructure and at the same time ensure the link to other carbon capture and storage projects is maintained. CinfraCap is examining the process whereby liquefied carbon dioxide is captured, transported, stored, and shipped. The basic idea is for the envisaged infrastructure to be an open access system that will allow more operators to join. CinfraCap stands for Carbon-Infrastructure-Capture.

2. What are you aiming to achieve with the prestudy?

Answer: The aim of the prestudy is to produce proposals for identifying the best way for captured carbon dioxide to be collected from companies and transported to the port. We will present details of what form intermediate storage could take, which permits need to be secured, and the risks posed by the project. We will also present a prospective business model.

3. Question: Why have you made this initiative a collaborative project?

Answer: Working collectively will generate reciprocal synergies. The idea is that while each facility will capture its own carbon dioxide, transport and storage could take place jointly. In that case fewer pipelines would be required, and fewer storage systems would need to be created. The number of berths could be kept to a minimum, and the number of shipments could be optimised. If the prestudy were to confirm that this is the way forward, then we would seek to bring in more stakeholders and partners in the future. It is our belief that all the parties involved will benefit if a joint concept is created that is both climate-smart and cost-effective and covers the entire logistics chain. Several of those involved are major emitters of carbon dioxide. It is vital for all of us that our policies and ambitions are transformed from theory into practice, and that our highly ambitious climate goals are achieved in the process. The Swedish Environmental Protection Agency is one of many organisations to highlight the importance of the technology behind the process of capturing carbon dioxide and returning it to where it originated – below the Earth's surface – if Sweden is to achieve its climate goals.

4. Question: You say that you are aiming to create the smartest logistics chain for handling and storing liquefied carbon dioxide, all the way from facility to quayside. Why are you not taking responsibility for the entire chain, from production of liquefied carbon dioxide through to final storage?

Answer: Each company is responsible for capturing carbon dioxide from its operations. Carbon capture works best if carried out locally at the point of emission. At the other end of the chain, Norway and Equinor (formerly Statoil) have made considerable headway in developing carbon dioxide storage solutions and have

offered to establish facilities that could receive carbon dioxide from the rest of Europe – Northern Lights in Norway being a good example. It would be pointless for each operator to create their own system that would in effect be the same as all the other systems.

5. Question: What will the project cost?

Answer: The current study will hopefully give us an indication. The aim is to present a concept that is both cost-effective and viable.

6. Question: why focus on just western Sweden? Is this not a matter of urgency for the whole of Sweden?

Answer: A prerequisite when formulating the concept is that it should also be available for use by other stakeholders. The most important aspect in the concept design phase is ensuring that the concept works well in practice. Based on the results from the current study, the Port of Gothenburg appears to be the obvious location. If everything proceeds according to plan, the proposed solution could be replicated at other locations in Sweden and throughout the world.

7. Question: Why is carbon dioxide produced within your operational processes?

Answer: All combustion of hydrocarbons, whether it is in the form of natural gas or refuse, produces carbon dioxide and water.

8. Question: Why are you not working to reduce carbon emissions instead?

Answer: Carbon capture should be regarded as a complement to the work being done to facilitate the transition to more climate-neutral operations. A parallel transition is taking place with the aim of reducing fossil fuel dependence and making the switch to biofuels. The use of biofuels also produces carbon emissions although in time these fuels could be regarded as being carbon neutral as new biomass can absorb the carbon dioxide. Unfortunately, biofuel availability is insufficient at the present time to fully replace fossil fuels such as oil, coal, and natural gas.

9. Question: why should carbon dioxide not be emitted?

Answer: Carbon dioxide is what is termed a greenhouse gas, which contributes to global warming. All forms of combustion produce carbon dioxide. When fossil fuels, such as coal, oil, and natural gas, are used, carbon that was previously bound in the Earth's crust is released into the atmosphere, reinforcing what is termed the greenhouse effect.

10. Question: What does CCS stand for?

Answer: Carbon Capture and Storage, i.e. the capture and storage of carbon (dioxide), is aimed primarily at developing a method for separating the carbon dioxide produced during combustion and storing it in a way that prevents it from being emitted into the atmosphere. By doing so, any negative impact on our climate would be prevented.

11. Question: How is carbon dioxide captured?

Answer: Carbon dioxide is found in flue gases resulting from combustion. Amines are a group of chemicals that can bind carbon dioxide. In a gas absorption column, which could be likened to a tall, thin tower, the flue gases come into contact with the amino solution that binds the carbon dioxide. Other elements in flue gases, such as water, hydrogen, and oxygen, continue up and out through the tower. The carbon dioxide is then heated up, releasing it from the amine, whereupon the amino solution can be returned to the absorption tower. The separated carbon dioxide is compressed under pressure, equivalent to 15 times our own atmospheric pressure, and liquefied at -20°C.

12. Question: Is liquefied carbon dioxide dangerous?

Answer: One should have respect for all types of chemicals, and they must be handled correctly at all times. However, liquefied carbon dioxide is not a new discovery and it has been used in many operating processes, including use as a coolant. High levels of gaseous carbon dioxide can be dangerous as it forces out oxygen and could cause suffocation.

13. Question: What happens when liquefied carbon dioxide is stored?

Answer: The carbon dioxide is injected deep down below the seabed in ready-made rock formations – natural caverns that previously contained oil and natural gas and which are expected to remain in place for several million years.

14. Question: Is it necessary to store the carbon at such great depths? Doesn't it require a lot of energy to go down that far below the seabed?

Answer: The whole purpose of capturing carbon dioxide would come to nothing if it were to be released into the atmosphere again. The carbon dioxide must therefore be stored where the conditions are optimal, i.e. the correct pressure and temperature for the carbon dioxide to be preserved in the required state, and with the right type of dense rock above it to prevent leakage.

15. Question: Is it possible for the liquefied carbon dioxide to leak out into the sea?

Answer: The envisaged storage locations are selected in a way that the risk of leakage is minimal.

16. Question: What happens if liquefied carbon dioxide leaks out into the sea?

Answer: Locally: When dissolved in water, carbon dioxide forms carbonic acid, which locally could give rise to slightly more acid surroundings. It should be borne in mind however that the sea is an enormous expanse of water and any carbon dioxide that leaks out would be diluted relatively quickly.

Globally: An individual leak would in all probability have limited implications globally. It should of course still be avoided as far as possible as the whole idea of capturing carbon dioxide would then be lost.

17. Question: Should the carbon dioxide be transported using road trucks, on trains, or In pipelines?

Answer: This is one of the questions to which the current study will hopefully provide an answer. Aspects such as distance, volume, frequency, and location must be taken into account to determine which solution is most suitable. The answer could very well differ from one case to another.

18. Question: Does the carbon dioxide need to be liquefied before being transported? If so, why?

Answer: No, carbon dioxide can also be transported in gaseous form although to reduce the volume during transport and storage the gas needs to be liquefied, as it then takes up much less space. This can be compared with the IKEA flatpack concept, which requires much less space during storage and transport than would be the case with ready-assembled furniture.

19. Question: What happens if the gas leaks out while it is being transported?

Answer: A small leak would probably go completely unnoticed although the whole idea of capturing carbon dioxide would lose its meaning slightly.

20. Question: Are there other examples in Sweden or Europe of similar projects?

Answer: There are initiatives in the Western world, in Norway for example, where the state-owned company Gassnova has made substantial funding provisions for development. There is a project taking place at the heating plant in Oslo and at the company Norcem, where the plan is for carbon dioxide to be captured, transported to the Port of Oslo for intermediate storage, and then onwards by freighter to the west coast of Norway. However, there are currently few projects in which several parties are working together to find an infrastructure solution. One such initiative is the Porthos project at the Port of Antwerp.

21. Question: Where can carbon dioxide be finally stored? Are there several alternatives?

Answer: Carbon dioxide can be stored in exhausted oil and gas fields, and in subterranean formations containing salt water. The important thing is that the carbon dioxide remains at the intended location.