
Executive Certificate in Carbon Capture and Storage

Geological Storage of Carbon Dioxide

Geological Storage of Carbon Dioxide (CO₂) is a critical technology in the fight against climate change. It involves capturing CO₂ emissions from industrial sources, such as power plants, and injecting them into rock formations deep underground for long-term storage. In this explanation, we will cover key terms and vocabulary related to geological storage of CO₂ in the context of the Executive Certificate in Carbon Capture and Storage.

Carbon Capture and Storage (CCS): Carbon Capture and Storage (CCS) is a set of technologies that captures CO₂ emissions from industrial sources, transports them to a storage site, and injects them into rock formations for long-term storage. CCS is a critical technology for reducing CO₂ emissions and mitigating climate change.

CO₂ source: A CO₂ source is any industrial facility that emits large amounts of CO₂, such as power plants, cement plants, and refineries. CO₂ sources are the starting point for CCS, as the CO₂ emissions must be captured before they can be transported and stored.

CO₂ capture: CO₂ capture is the process of separating CO₂ from other gases in exhaust streams from industrial facilities. There are several methods for CO₂ capture, including post-combustion capture, pre-combustion capture, and oxyfuel combustion.

Post-combustion capture: Post-combustion capture is a method of CO₂ capture that involves separating CO₂ from other gases in the exhaust stream after combustion has occurred. This is typically done using chemical solvents or membranes.

Pre-combustion capture: Pre-combustion capture is a method of CO₂ capture that involves separating CO₂ from other gases before combustion occurs. This is typically done by converting fossil fuels into a gas mixture that contains CO₂ and hydrogen, and then separating the CO₂ from the hydrogen.

Oxyfuel combustion: Oxyfuel combustion is a method of CO₂ capture that involves burning fossil fuels in pure oxygen instead of air. This produces an exhaust stream that is almost entirely CO₂ and water, making it easier to separate the CO₂.

Transport: Transport refers to the movement of CO₂ from the capture site to the storage site. CO₂ can be transported via pipelines, ships, or trucks. Pipelines are the most common method of transport, as they are the most cost-effective and efficient.

Storage site: A storage site is a geological formation that is suitable for long-term storage of CO₂. Common storage sites include depleted oil and gas fields, saline aquifers, and coal seams.

Depleted oil and gas fields: Depleted oil and gas fields are geological formations that have previously been used for oil or gas production, but are no longer productive. These formations can be used for long-term storage of CO₂, as they have already been characterized and their geological properties are well understood.

Saline aquifers: Saline aquifers are geological formations that contain saline water. These formations can be used for long-term storage of CO₂, as the CO₂ can be injected into the pore space between the grains of rock, displacing the saline water.

Coal seams: Coal seams are geological formations that contain coal. These formations can be used for long-term storage of CO₂, as the CO₂ can be adsorbed onto the surface of the coal, effectively trapping it in place.

Injection: Injection refers to the process of injecting CO₂ into a storage site. This is typically done using a well that has been drilled into the storage site. The CO₂ is injected under pressure, causing it to flow into the pore space between the grains of rock.

Trapping mechanisms: Trapping mechanisms are the physical and chemical processes that keep CO₂ in place in a storage site. There are several trapping mechanisms, including structural trapping, residual trapping, solubility trapping, and mineral trapping.

Structural trapping: Structural trapping is the physical trapping of CO₂ by an impermeable cap rock. This prevents the CO₂ from escaping to the surface.

Residual trapping: Residual trapping is the physical trapping of CO₂ in the pore space between the grains of rock. This occurs when the CO₂ becomes trapped in small pockets or "ganglia" within the rock.

Solubility trapping: Solubility trapping is the chemical trapping of CO₂ in saline water. When CO₂ is injected into a saline aquifer, some of it dissolves into the saline water, effectively trapping it in place.

Mineral trapping: Mineral trapping is the chemical trapping of CO₂ in minerals. When CO₂ comes into contact with certain minerals, it can react to form new minerals that are stable and do not release CO₂.

Leakage: Leakage refers to the release of CO₂ from a storage site. Leakage can occur due to geological or operational factors, and can result in the release of CO₂ to the atmosphere.

Monitoring and verification (M&V): Monitoring and verification (M&V) is the process of monitoring a storage site to ensure that CO₂ is being stored safely and securely. M&V involves measuring the amount of CO₂ that has been injected into the storage site, as well as monitoring the geological and operational conditions of the site.

Risk assessment: Risk assessment is the process of identifying and evaluating the risks associated with a storage site. This involves identifying potential hazards, estimating the likelihood and consequences of

those hazards, and developing strategies to mitigate those risks.

Regulation: Regulation refers to the legal framework that governs CCS activities. Regulation is typically established at the national or regional level, and may include requirements for permitting, monitoring, and reporting.

In summary, the geological storage of CO₂ is a complex process that involves a variety of terms and concepts. Understanding these terms and concepts is essential for anyone working in the field of CCS, as they provide the foundation for safe and effective storage of CO₂. From CO₂ sources and capture methods, to transport, storage sites, and trapping mechanisms, there are many factors to consider when developing and implementing a CCS project. By understanding these key terms and concepts, we can ensure that CO₂ is stored safely and securely, helping to mitigate climate change and protect the environment for future generations.