Executive Certificate in Carbon Capture and Storage

and Verification of Carbon Storage

Carbon Capture and Storage (CCS) is a technology that captures carbon dioxide (CO2) emissions from sources like power plants and industrial processes, transports it to a storage site, and injects it into rock formations for long-term storage. The Executive Certificate in Carbon Capture and Storage covers key terms and vocabulary related to CCS, which are explained below.

1. Carbon Dioxide (CO2): A colorless gas with a density about 53% higher than that of dry air. It is a greenhouse gas that traps heat in the atmosphere and contributes to global warming.
2. Carbon Capture: The process of capturing CO2 emissions from sources like power plants and industrial processes before they are released into the atmosphere.
3. Carbon Storage: The process of storing CO2 in rock formations, typically in deep saline aquifers or depleted oil and gas fields, for long-term storage.
4. CCS Chain: A series of interconnected processes that include capture, transportation, and storage of CO2.
5. Carbon Capture, Transportation, and Storage (CCTS): Refers to the entire process of capturing, transporting, and storing CO2.
6. Carbon Capture Utilization and Storage (CCUS): A variation of CCS that includes the utilization of CO2 for industrial or commercial purposes, such as enhanced oil recovery (EOR), before storage.
7. Point Source Emissions: Emissions that come from a single, identifiable source, such as a power plant or industrial facility.
8. Pre-combustion Capture: A method of capturing CO2 before combustion occurs, typically through chemical or physical processes.
9. Post-combustion Capture: A method of capturing CO2 after combustion has occurred, typically through chemical or physical processes.
10. Oxy-fuel Combustion: A method of combustion that uses pure oxygen instead of air, resulting in a higher concentration of CO2 in the flue gas.
11. CO2 Purity: The percentage of CO2 in a gas stream, typically expressed as a volume fraction.
12. Transportation: The movement of CO2 from the capture site to the storage site, typically through pipelines or ships.
13. Compression: The process of increasing the pressure of CO2 to facilitate transportation and injection into rock formations.
14. Injection: The process of injecting CO2 into rock formations for long-term storage.
15. Caprock: A layer of rock that acts as a seal to prevent CO2 from escaping the storage site.
16. Monitoring: The process of monitoring the behavior of CO2 in the storage site to ensure safe and secure storage.
17. Tracer Technologies: Methods used to track the movement of CO2 in the storage site, typically through the injection of harmless tracers.

18. Risk Assessment: The process of evaluating the potential risks associated with CO2 storage, including leakage and seismic activity.
19. Verification: The process of demonstrating that CO2 has been stored as claimed, typically through monitoring and modeling.
20. Validation: The process of confirming that the CO2 storage system is functioning as intended, typically through third-party verification.

Challenges in Carbon Storage Verification:

Verification of carbon storage is a critical step in ensuring the success of CCS projects. The following are some challenges in carbon storage verification:

1. Long-term Monitoring: Carbon storage projects require long-term monitoring to ensure that CO2 remains trapped in the storage site. This requires significant resources and infrastructure.
2. Leakage Detection: Detecting and quantifying CO2 leakage is a major challenge in carbon storage verification. Current monitoring techniques may not be sensitive enough to detect small leaks, and false positives can occur.
3. Seismic Activity: Seismic activity can affect the stability of the storage site and lead to CO2 leakage. The risk of seismic activity must be evaluated and monitored to ensure safe storage.
4. Regulatory Framework: A robust regulatory framework is necessary to ensure the safe and secure storage of CO2. This includes regulations for monitoring, reporting, and verification.
5. Public Perception: Public perception of CCS projects can be negative, particularly if there are concerns about safety and environmental impacts. Communication and engagement with stakeholders is critical to build trust and support for CCS projects.

Examples and Practical Applications:

1. The Sleipner gas field in Norway has been injecting CO2 into a sandstone formation since 1996. The project has demonstrated the long-term storage potential of saline aquifers.
2. The Quest CCS project in Canada has been capturing and storing CO2 from an oil sands facility since 2015. The project includes a 65 km pipeline and a storage site in a depleted oil reservoir.
3. The Illinois Industrial Carbon Capture and Storage project is a commercial-scale CCUS project that captures CO2 from an ethanol production facility and stores it in a saline aquifer.

Conclusion:

Carbon Capture and Storage is a critical technology for reducing CO2 emissions and mitigating climate change. Understanding the key terms and vocabulary related to CCS is essential for those involved in the development, implementation, and regulation of CCS projects. Carbon storage verification is a critical step in ensuring the success of CCS projects, and challenges in verification must be addressed through long-term monitoring, leakage detection, seismic activity evaluation, regulatory framework development, and public perception management. Examples and practical applications of CCS projects demonstrate the

potential of this technology for reducing CO2 emissions and promoting sustainable development.