
Executive Certificate in Carbon Capture and Storage

Environmental and Societal Impacts of Carbon Capture and Storage

Carbon Capture and Storage (CCS) is a technology that captures carbon dioxide (CO₂) emissions from industrial processes or power plants and stores it safely underground to prevent its release into the atmosphere. The technology has the potential to significantly reduce greenhouse gas emissions and mitigate climate change. However, CCS also has environmental and societal impacts that must be considered. In this explanation, we will discuss key terms and vocabulary related to the environmental and societal impacts of CCS in the context of the Executive Certificate in Carbon Capture and Storage.

1. Greenhouse Gases (GHGs)

Greenhouse gases (GHGs) are gases in the Earth's atmosphere that trap heat from the sun, causing the planet to warm up. The primary GHGs are carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O). Human activities, such as burning fossil fuels and deforestation, have significantly increased the concentration of GHGs in the atmosphere, leading to global warming and climate change.

2. Carbon Capture and Storage (CCS)

Carbon Capture and Storage (CCS) is a technology that captures CO₂ emissions from industrial processes or power plants and stores it safely underground to prevent its release into the atmosphere. CCS includes three main stages: capture, transportation, and storage.

Capture: CO₂ is captured from the emissions source, such as a power plant or industrial process, using various methods, such as chemical absorption, physical adsorption, or membrane separation.

Transportation: The captured CO₂ is transported to a storage site, typically through pipelines or ships.

Storage: The CO₂ is injected into rock formations deep underground for permanent storage.

3. Environmental Impacts

The environmental impacts of CCS can be divided into direct and indirect impacts. Direct impacts refer to the impacts associated with the construction and operation of CCS infrastructure, such as CO₂ pipelines and storage sites. Indirect impacts refer to the impacts associated with the continued use of fossil fuels, enabled by CCS.

Direct Impacts:

- * Land use change: The construction of CCS infrastructure, such as CO₂ pipelines and storage sites, can result in land use change and habitat loss.
- * Water use: The capture of CO₂ from power plants and industrial processes requires significant amounts of water, which can impact local water resources.
- * Brine production: The injection of CO₂ into rock formations can result in the production of brine, which can contain harmful chemicals and impact groundwater resources.
- * Leaks: Although rare, leaks from CO₂ pipelines and storage sites can result in the release of CO₂ into the atmosphere, posing a risk to human health and the environment.

Indirect Impacts:

- * Continued use of fossil fuels: CCS enables the continued use of fossil fuels, which can lead to further GHG emissions and environmental degradation.
- * Carbon lock-in: The long-term storage of CO₂ can create a "carbon lock-in" effect, where the expectation of future CO₂ storage can discourage the development and deployment of low-carbon technologies.
- * Rebound effect: The reduction in the cost of fossil fuel-based energy due to CCS can lead to an increase in energy consumption, offsetting some of the GHG emission reductions achieved through CCS.

4. Societal Impacts

The societal impacts of CCS can be divided into economic, social, and political impacts.

Economic Impacts:

- * Job creation: The construction and operation of CCS infrastructure can create jobs, contributing to economic growth and development.
- * Cost: CCS is currently a costly technology, adding to the cost of fossil fuel-based energy.
- * Competition for resources: The demand for resources, such as water and land, for CCS infrastructure can compete with other sectors, such as agriculture and renewable energy.

Social Impacts:

- * Public perception: The public's perception of CCS can influence its acceptance and deployment. Public concerns around safety, health, and environmental impacts can pose challenges to CCS deployment.
- * Community engagement: The involvement of local communities in the planning and development of CCS infrastructure can help to address concerns and build support for CCS.

Political Impacts:

- * Policy: The development of policies and regulations that support CCS can help to drive its deployment.
- * International cooperation: CCS is a global issue, requiring international cooperation and coordination to address GHG emissions and climate change.

Examples and Practical Applications:

- * The Illinois Industrial Carbon Capture and Storage project captures CO₂ from an ethanol production facility and stores it in a saline aquifer.
- * The Quest CCS project in Canada captures CO₂ from a bitumen upgrader and stores it underground.

Challenges:

- * The high cost of CCS remains a significant barrier to its deployment.
- * The public's perception of CCS can be negative, with concerns around safety and health.
- * The long-term storage of CO₂ poses technical challenges and risks.

Conclusion:

CCS has the potential to significantly reduce GHG emissions and mitigate climate change. However, the environmental and societal impacts of CCS must be carefully considered and addressed. Direct impacts, such as land use change and water use, and indirect impacts, such as the continued use of fossil fuels and carbon lock-in, must be balanced against the benefits of CCS. The involvement of local communities, the development of supportive policies and regulations, and international cooperation can help to drive the deployment of CCS and address climate change.