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Carbon Sequestration and Neutralization

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Abstract:

Reducing carbon dioxide (CO2) emissions and reaching carbon neutrality are becoming more important due to rising worries about climate change and global warming. In order to stop carbon dioxide from being released into the atmosphere, carbon sequestration entails capturing and storing the gas for a long time. A variety of methods, including direct air absorption, afforestation, reforestation, and soil carbon sequestration, are essential for absorbing and storing carbon. By reducing the quantity of CO2 released into the atmosphere, human activities like burning fossil fuels and conducting industrial operations can have a positive influence on the environment. A larger objective is to achieve carbon neutrality, which is matched by an equal quantity of stored or offset carbon to equal the amount of carbon dioxide released. Reducing emissions, implementing sustainable practices, and funding carbon offset initiatives can all help achieve this.

Introduction:

Societies throughout the world are focusing more and more on creative ways to slow the growth in greenhouse gas emissions as a result of growing worries about climate change and its profound effects on the environment. The two main ideas driving this worldwide endeavor are carbon neutrality and sequestration. These ideas stand for essential tactics meant to counteract climate change via lowering atmospheric carbon dioxide (CO2) concentrations. Capturing and storing carbon dioxide over an extended period of time is known as carbon sequestration. This stops carbon dioxide from being released into the atmosphere, where it adds to the greenhouse effect. This procedure is essential for reducing the impact of human activities that have dramatically raised atmospheric carbon levels, such as the burning of fossil fuels, deforestation, and industrial operations. However, becoming carbon neutral is a more comprehensive objective that goes beyond sequestering carbon. In order to completely eliminate the carbon footprint, it entails balancing the amount of greenhouse gases released with an equivalent amount eliminated or offset. A variety of tactics, including switching to

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renewable energy sources, improving energy efficiency, and actively taking part in carbon offset schemes, are needed to achieve carbon neutrality.

Different methods for carbon sequestration:

The efficient storage of CO2 and mitigation of the effects of global warming are the main goals of carbon sequestration. Carbon sequestration techniques come in a variety of forms, but they may be generally divided into three categories.

Geological Sequestration:

Another name for it is CCS, or carbon capture and storage. In order to do this, CO2 emissions from power stations or industrial activities are captured and injected underground into geological formations like deep saline aquifers or depleted oil and gas reserves (Zhang and Song, 2014). These geological structures safely retain CO2 and keep it from escaping into space.

Procedure for geological sequestration

- **Capture:** At the source, which is usually a major industrial facility like a power station or another location with considerable emissions, CO2 is absorbed.
- **Transport:** After that, the CO2 is transferred to an appropriate storage location. Pipelines or other forms of transportation could be involved in this.
- **Storage:** Deep under the surface, the geological formations are pumped with CO2. Depleted oil and gas reservoirs are common places to store CO2 since they can hold it safely. Another resource used for storage is deep saline aquifers, which are porous rock formations loaded with salty water.
- **Monitoring and Verification:** Strict monitoring and testing procedures are implemented to guarantee that the CO2 that has been stored stays safely sealed and does not escape back into the atmosphere. This entails routinely assessing the efficacy of the storage and the integrity of the geological formations.
- **Terrestrial Sequestration:** The goal of this approach is to improve the organic processes that land ecosystems utilize to capture and store carbon. Common techniques to boost carbon sequestration in forests include reforestation—planting trees in deforested regions—and afforestation—planting trees in previously unforested areas. Furthermore, better agricultural land management techniques like cover crops and no-till farming can boost soil carbon storage.

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Improved Land Management Practices

- **No-till Farming:** In agriculture, conventional plowing releases carbon that has been stored in the soil. Plowing is minimized or avoided in no-till farming, which lowers the total carbon footprint of agriculture and helps keep carbon in the soil.
- **Cover Cropping:** Involves sowing cover crops while the primary crops aren't producing. These cover crops strengthen soil structure, reduce soil erosion, and increase soil carbon storage.
- **Agroforestry:** Planting agricultural crops next to trees and bushes in the same space. Increased soil fertility, varied agricultural yields, and carbon sequestration are all benefits of agroforestry systems.
- **Ocean Sequestration:**Although oceans naturally take up CO2 from the atmosphere, there are ways to speed up this process. Iron fertilization of the ocean is one suggested strategy to promote the development of phytoplankton, which takes up CO2 during photosynthesis (Leonard et al., 2021). Direct CO2 injection into the ocean at depths where it may be retained for long periods of time is an additional strategy.

Conclusion:

Carbon sequestration and carbon neutrality both highlight how important it is to innovate, work together, and embrace sustainable methods widely. These ideas highlight how critical it is to switch from traditional, carbon-intensive methods to more ecologically friendly ones. In order to achieve a sustainable and carbon-neutral future, individual and societal behavioral adjustments are just as important as large-scale initiatives and technology developments. The combination of these techniques is critical in light of the pressing climate problem. Given the interdependence of environmental, social, and economic factors, governments, businesses, and individuals must collaborate to execute and continuously improve these strategies. In addition to being necessary for the environment, carbon sequestration and neutrality provide chances to create a resilient and sustainable future for future generations.

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