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Air-CCS: Climate geoengineering in use of untapped natural energy in remote regions

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A new geoengineering scheme ("air-CCS in the remote regions") is proposed to assure the long-term safety of the carbon storage and to overcome the energy penalty for the carbon capture and injection. Because of the concentration of population and economic activities, the energy demands and therefore CO₂ emission sources are also concentrated in the restricted industrial and urban regions. The energy demands and CO₂ emission sources are rare in the remote regions far from the industrial regions. The wide remote areas in the high-latitude, high altitude and oceanic regions are suitable as CO₂ sink areas. The conventional carbon capture and sequestration (CCS) scheme is not viable in the remote areas due to the large infrastructure investment and energy loss for long-distance transportation of huge amount of CO₂.

But some new modified versions of carbon capture and technology ("air-CCS") may be viable while CO₂ is extracted directly from the atmosphere instead of the flue gas of fossil fuels. The transportation of CO₂ is not inevitable for the air-CCS. However, as the atmospheric CO₂ concentration is very thin (about 390ppm), the excess energy is required to extract the CO₂ from the atmosphere. The unused natural energy (wind, solar, geothermal and natural gas) is used for the recovery of CO₂ from the atmosphere and for the underground injection of CO₂-rich gas. Energy penalty of air-CCS can be compensated by use of unused natural energy in the remote regions.

The CO₂-hydrate-sealed layer is formed at the cool temperature combined with high pressure ("self-sealing") at the aquifers deeper than about 300m in the high-latitude regions such as Canada, Alaska and Siberia, in the high-altitude regions such as the Tibetan plateau and in the sediments under the ocean floor deeper than about 300m. The air-CCS provides vast leakage-free reservoirs beneath the remote regions enough to accommodate all of the excess CO₂ in the atmosphere. The air-CCS in the remote areas is the ultimate greenhouse gas mitigation option.

Keywords: geoengineering, CCS, carbon dioxide, greenhouse gas mitigation, natural energy, global warming