

# Certified Carbon Removal is Critical to an Effective and Resilient Response for Stabilizing the Climate

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**Background/Objectives.** The main driver for climate change is the unmitigated waste stream of carbon dioxide resulting from the still rising consumption of fossil carbon. To stop climate change from getting worse, the world will need to approach a net-zero carbon economy. Even after stopping emissions, it may take decades for the climate to stabilize. Unfortunately, carbon dumped into the environment will reside as excess carbon in the ocean/atmosphere/biosphere system for tens to hundreds of millennia. The world has already or is about to enter an overshoot scenario that will require the removal of excess carbon from the environment, in other words, a net-negative carbon economy. Certified permanent disposal of excess carbon becomes a critical ingredient in an effective and resilient response for stabilizing the climate.

**Approach/Activities.** We propose the introduction of certificates of sequestration that allow balancing past and future extraction of carbon with carbon removal with an assurance that the carbon or an equivalent amount of other carbon is kept out of the environment for tens of thousands of years. This requires guidelines for the development of standards that bring all reservoirs to an equal footing, both in terms of duration of storage and producing verifiable outcomes. Furthermore, we propose a regulatory framework that demands that carbon coming out of the ground is immediately canceled out as demonstrated by a certificate of sequestration.

**Results/Lessons Learned.** Despite large variations in expected storage durations of carbon reservoirs, guidelines for the development of standards can bring them all on an equal footing by focusing on responsibility. Buyers of certificates transfer their responsibility to storage operators who are responsible for the reservoirs they manage. Their responsibility is to monitor the reservoir and if monitoring finds a loss of carbon, to remediate the loss with the purchase of an equivalent amount of new certificates. Some reservoir operators can make a scientifically sound (and accepted) argument that storage will last with a high probability for the required tens of thousands of years. Other reservoirs will not be able to make such claims, yet should be included as they will play an important role in managing the overshoot. For such reservoirs, the storage operators will have to demonstrate their ability to pay for the re-sequestration if carbon is lost, or show how they could transfer their responsibility to a willing party. Monitoring and remediation require standards that produce verifiable outcomes. Verifiable outcomes are created using measurements. Although the specific equipment will vary for each reservoir, all standards must include methods that identify the boundaries of the reservoir, quantify the addition of carbon, and quantify the change in carbon content. Allowed uncertainties in measurements must be uniform across different methodologies. The focus on measurements allows for third party verification to compare the reservoir carbon content to the number of certificates awarded, eliminating the possibility of greenwashing. A dual ledger could trace the uniquely identified certificates to their point of claim at the source of carbon extraction, increasing transparency and eliminating the possibility of double counting. In conclusion, it is important to structure a transition from today's economy to a net zero economy. We propose to begin by demanding that carbon producers are held liable for all future carbon produced while acknowledging that this will imply the creation of a carbon debt that will have to be paid over time.