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Bringing the World to Net Zero Carbon Dioxide by Sequestering Biomass Carbon

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Abstract : Many corporations aspire to become Net Zero Carbon Carbon Dioxide by 2035-2050. This paper examines what it will take to achieve those goals. Achieving Net Zero CO_2 requires an understanding of where energy is produced and consumed, the magnitude of CO_2 generation, and proper understanding of the Carbon Cycle. The latter leads to the distinction between CO_2 and biomass carbon sequestration. Short reviews are provided for prior technologies proposed for reducing CO_2 emissions from fossil fuels or substitution by renewable energy, to focus on their limitations and to show that none offer a complete solution. Of these, CO_2 sequestration is poised to have the largest impact. It will just cost money, scale-up is a huge challenge, and it will not be a complete solution. CO_2 sequestration is still in the demonstration and semi-commercial scale. Transportation accounts for only about 30% of total U.S. energy demand, and renewables account for only a small fraction of that sector. Yet, bioethanol production consumes 40% of U.S. corn crop, and biodiesel consumes 30% of U.S. soybeans. It is unrealistic to believe that biofuels can completely displace fossil fuels in the transportation market. Bioethanol is traced through its Carbon Cycle and shown to be both energy inefficient and inefficient use of biomass carbon. Both biofuels and CO_2 sequestration reduce future CO_2 emissions from continued use of fossil fuels. They will not remove CO_2 already in the atmosphere. Planting more trees has been proposed as a way to reduce atmospheric CO_2. Trees are a temporary solution. When they complete their Carbon Cycle, they die and release their carbon as CO_2 to the atmosphere. Thus, planting more trees is just 'kicking the can down the road.' The only way to permanently remove CO_2 already in the atmosphere is to break the Carbon Cycle by growing biomass from atmospheric CO_2 and sequestering biomass carbon. Sequestering tree leaves is proposed as a solution. Unlike wood, leaves have a short Carbon Cycle time constant. They renew and decompose every year. Allometric equations from the USDA indicate that theoretically, sequestrating only a fraction of the world’s tree leaves can get the world to Net Zero CO_2 without disturbing the underlying forests. How can tree leaves be permanently sequestered? It may be as simple as rethinking how landfills are designed to discourage instead of encouraging decomposition. In traditional landfills, municipal waste undergoes rapid initial aerobic decomposition to CO_2, followed by slow anaerobic decomposition to methane and CO_2. The latter can take hundreds to thousands of years. The first step in anaerobic decomposition is hydrolysis of cellulose to release sugars, which those who have worked on cellulosic ethanol know is challenging for a number of reasons. The key to permanent leaf sequestration may be keeping the landfills dry and exploiting known inhibitors for anaerobic bacteria.

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