SLICING THE PIE: HOW BIG COULD CARBON DIOXIDE REMOVAL BE?

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The current global dependence on using fossil fuels to meet energy needs continues to increase. If 2°C warming by 2050 is to be prevented, it will become important to adopt strategies that not only avoid CO_2 emissions, but also allow for the direct removal of CO_2 from the atmosphere, enabling the intervention of climate change. The primary direct removal methods discussed in this contribution include land management, mineral carbonation and bioenergy and direct air capture with carbon capture and reliable storage. These methods are discussed in detail and their potential for CO_2 removal assessed. The global upper bound for annual CO_2 removal was estimated to be 12, 10, 6, and 5 $GtCO_2$/yr for BECCS, DACS, land management, and mineral carbonation, respectively – resulting in a cumulative value of about 33 $GtCO_2$/yr. However, in the case of DACS, global data on the overlap of low-emission energy sources and reliable CO_2 storage opportunities – set as a qualification for DAC viability – was unavailable and the potential upper bound estimate is thus considered conservative. While direct CO_2 removal at the upper bounds identified in this review is insufficient to completely mitigate the projected 1,800 $GtCO_2$ emissions projected by 2050, the cumulative impact of these methods could counteract up to ~60% of these emissions. The upper bounds on the costs associated with the direct CO_2 removal methods varied from approximately \$100/tCO_2 (land management, BECCS, and mineral carbonation) to in excess of \$1000/tCO_2 (again, these are the upper bounds for costs). In this analysis these direct CO_2 removal technologies are found to be technically viable and potentially important options in preventing 2°C warming by 2050. However, caution is warranted in moving forward with implementation of CO_2 removal, especially in the case of attempting to rapidly decrease atmospheric concentrations; it is recommended that the risks of scaling up too quickly be weighed against the existing risks associated with global warming.

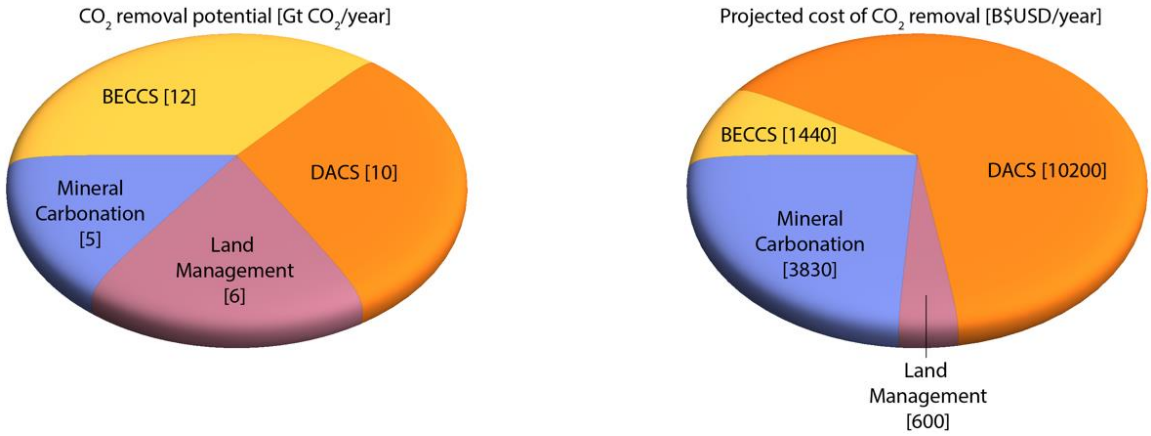

Figure 1 - Carbon dioxide removal methods for the intervention of climate change are discussed in addition to their potential annual impacts on a global scale. Relative CO2 removal potential per year (left) and projected cost of removal (right). Though DACS and mineral carbonation have the potential for high impact, based on the low projected cost of BECCS and land management, these methods may be a more appropriate place to start.