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Our Sustainable Earth

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Recent evidence demonstrates that the Earth has been warming monotonically since 1980. Transient to equilibrium temperature changes take centuries to develop, as the upper levels of the ocean are slow to respond to atmospheric temperature changes. Atmospheric CO_2 concentrations, from ice core and observatory measurements, display consistent increases from historical averages, beginning in about 1880. They can be associated with the use of coal ecause of the spread of the industrial revolution from Great Britain to the European continent and beyond. The climactic consequence of this human-dominated increase in atmospheric CO_2 has been suggested to define a geologic epoch, termed the "Anthropocene." This could be a short term, relatively minor change in global climate, or an extreme deviation that lasts for thousands of years. In order to stabilize global temperatures, sharp reductions in CO_2 emissions are required: an 80% reduction beginning in 2050. U.S. emissions have declined sharply recently because of market conditions leading to the substitution of natural gas for coal for electricity generation. Whether this is the best use for this resource may be questioned, but it nevertheless reduces CO_2 production by 67% from a coal-fired power plant, well on the way to the 80% reduction required for global temperature stabilization. Current methods for CO_2 capture and storage are not cost effective, and have been slow (if not absent) to introduce at scale. This paper describes research into some potentially economically feasible approaches: cost-effective capture and storage of CO_2 from injection of flue gas into subterranean methane-saturated aquifers at the surface; fuels from sunlight without CO_2 production; and large-scale electrical energy storage for intermittent (and even constant) electricity generating sources.