‘Committed’ CO2 emissions jeopardize international climate goals, UCI-led study finds

Existing, planned fossil fuel-burning infrastructure must be retired early, replaced
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Fossil fuel-burning power plants, such as this natural gas-combusting facility in Huntington Beach, Calif., will need to be retired in 25 years, some 15 years ahead of schedule, in order for the world’s industrial economies to remain with the 1.5 degrees Celsius warming called for in international climate agreements.

Picture Credit:
Steven Davis / UCI

“We need to reach net-zero carbon dioxide emissions by midcentury to achieve stabilization of global temperatures as called for in international agreements such as the Paris accords,” said lead author Dan Tong, a UCI postdoctoral scholar in Earth system science. “But that won’t happen unless we get rid of the long-lasting power plants, boilers, furnaces and vehicles before the end of their useful life and replace them with non-emitting energy technologies.”

The number of fossil fuel-burning power plants and vehicles in the world has increased dramatically in the past decade, spurred by rapid economic and industrial development in places such as China and India. Meanwhile, the average age of infrastructure in developed countries has decreased. For example, old coal power plants in the U.S. have been supplanted by new natural gas ones which release far less CO_2.

According to the study, emissions from existing energy infrastructure take up the entire carbon budget to limit mean warming to 1.5 degrees Celsius and close to two-thirds of the budget to keep warming to under 2 C over the next three decades.

Although the pace of growth of fossil fuel-burning infrastructure has slowed in recent years, a significant amount of new electricity-generating capacity has been proposed globally; some of it is already under construction. If this prospective infrastructure is built, total future emissions take up three-quarters of the budget to constrain warming to below 2 C.

Tong and her colleagues used detailed data sets of existing fossil fuel-burning infrastructure in 2018 to estimate “committed” carbon dioxide emissions. They assumed that power plants and industrial boilers will operate for about 40 years and that light-duty vehicles will be on the road for 15 years, with some regional variation in fuel economy and annual miles traveled.

The researchers also tested different lifetime assumptions in order to see how early CO_2-emitting infrastructure might need to be retired in order to meet international climate goals. For example, a 1.5 C boost in mean temperature might still be avoided if current power plants were shuttered after 25, rather than 40 years of operation.

If existing infrastructure operates as usual, though, it will emit about 658 gigatons of CO_2 during its operational lifetime, the scientists found. More than half of these emissions are projected to come from the electricity sector, with China producing the largest share, 41 percent, the U.S. producing 9 percent and the European Union 7 percent. If built, power plants being planned, permitted or under construction would emit an additional 188 gigatons of CO_2, approximately, according to the study.

“Our results show that there’s basically no room for new CO_2-emitting infrastructure under the international climate goals,” said co-author Steven Davis, a UCI associate

professor of Earth system science. “Rather, existing fossil fuel-burning power plants and industrial equipment will need to be retired early unless they can be feasibly retrofitted with carbon capture and storage technologies or their emissions are offset by negative emissions. Without such radical changes, we fear the aspirations of the Paris agreement are already at risk.”

Contributors to this work, which received funding from the National Science Foundation, include Ken Caldeira of the Department of Global Ecology at the Carnegie Institution for Science in Stanford; Christine Shearer of San Francisco-based CoalSwarm; Qiang Zhang and Yizuan Zheng of the Department of Earth System Science at Beijing’s Tsinghua University; and Chaopeng Hong and Yue Qin of UCI’s Department of Earth System Science.

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