2020 a bad year in many respects, but what about global carbon emissions?

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The Global Carbon Project recently published the Global Carbon Budget 2020, giving world leaders access to data on atmospheric carbon concentrations, emissions and trends. Illinois atmospheric scientist Atul

Jain was part of an international team of scientists that contributed data to the report. Jain talked about the carbon budget and this year's findings with News Bureau physical sciences editor Lois Yoksoulian.

What is a global carbon budget and how is it prepared?

The global carbon budget determines accurate assessments of carbon dioxide emissions from human activities, such as fossil fuel burning and deforestation/reforestation, and their redistribution in the atmosphere, ocean and land-based biosphere. A budget estimate is essential to better understanding the global carbon cycle and supports the climate policy process. It provides a record of recent quantitative trends of the amount of carbon allowed for climate control limits, such as the Paris Agreement temperature target of 2 degrees Celsius.

The carbon budget team quantifies five different components: fossil fuel emissions, land use sources, atmospheric concentration, and land-based and ocean uptake. A range of data, algorithms, statistics and model results of carbon sources and their flux, or movement through the biosphere and ocean, are collected and interpreted by a broad scientific community.

Who prepared the 2020 report? What data did you contribute?

The Global Carbon Project is an international research project within the Future Earth research initiative and has 86 co-authors from 16 countries and 68 institutions. It is published as living data to provide the highest transparency and traceability in reporting this set of key indicators and drivers of climate change.

I contributed our earth system model—the Integrated Science Assessment Model—which estimates global land-use change, CO_2 emissions, and the land-based residual sinks, or storage reservoirs. This model provides a consistent assessment of the causes of carbon fluxes on land and their climate interactions.

What carbon emission trends are seen in the 2020 report, and what effect has COVID-19 had on this year's data?

The 2020 report shows that CO_2 emissions—the main contributor to global warming—are set to drop by 2.4 billion tons of CO_2, or 7%, in 2020, caused by worldwide COVID-19 restrictions. Such a drastic decline has never been seen before. The largest drop appears more pronounced in the U.S. (–12%), European Union (–11%) and India (–9%). China—the largest emitter—experienced the least pronounced drop (–1.7%), where COVID-19 restrictions occurred early in the year and were more limited in time.

Looking at historical trends, emissions in the years 2010-2019 declined an average of 1.2% per year, in contrast to the increasing rates in the 2000s (3.0% per year). The declining emission rate during the 2020s is due to various factors, including substantial declines in coal use in the developed world and weaker overall economic growth globally.

Are there any changes in the types of data presented in this year's report?

The main changes in this year's report are the inclusion of data for 2019 and a projection of the global carbon budget for 2020; the inclusion of gross carbon fluxes associated with land-use changes—all land-change activities gains and losses such as decaying wood material left on site

after clearing of natural vegetation for agricultural purposes or vegetation regrowth after agricultural abandonment and wood harvesting; and the inclusion of cement carbonation, a carbon sink, in the fossil fuel and cement component of the budget.

Where does the U.S. fit in as a contributor this year?

As stated earlier, the U.S. experienced a larger CO_2 emissions reduction in 2020 than other polluter countries. The peak of the decrease in emissions in 2020 occurred in the first half of April, when lockdown measures related to travel restrictions and other actions resulted in lower energy-related emissions. According to the U.S. Energy Information Administration, from March to April, CO_2 emissions from gasoline and coal consumption decreased by 25% and 16%, respectively, which were the lowest monthly CO_2 emissions on record for those fuels. Carbon dioxide emissions from natural gas consumption also decreased by 17% between March and April. However, unlike CO_2 emissions from gasoline and coal, those from natural gas in April were 22% greater than the previous April, largely because of the displacement of coal consumption by natural gas. The U.S. in 2019 was the second largest polluter of CO_2 emissions (14%) after China (28%) in the world. However, the U.S. per capita CO_2 emissions in 2019 were the highest (16.1 tons). The other three countries with higher per capita CO_2 emissions were China (7.0 tons), Europe (6.6 tons), and India (1.8 tons).

The report suggests that the atmospheric CO_2 concentration has increased in 2020, despite the significant decline in emissions in 2020. How do you explain this?

That's correct. Carbon dioxide continued to increase in the atmosphere by about 2.5 parts per million (19.8 billion tons), which is almost the 2019 growth rate. The atmospheric CO_2 concentration for 2020 is projected to reach 412 parts per million averaged over the year. Carbon

dioxide is currently entering the atmosphere more quickly than the land-based and ocean sinks can process or "bury" the excess carbon, leading to a buildup of CO_2 in the atmosphere. The modeling results suggest that atmospheric CO_2 levels, and consequently, the world's climate, will stabilize only when net global CO_2 emissions are near zero.

What changes in the past year or ongoing trends are most concerning or encouraging, in your opinion?

My major concern about the budget trends is that the international community is not on track to meet the Paris Agreement's climate change objectives. According to U.N. estimates, global greenhouse gas emissions in 2030 will be some 15 billion tons CO_2 equivalent higher than required under a 2-degree Celsius stabilization path, suggesting that 1 to 2 billion tons of CO_2 emissions reductions are needed each year over the next 10 years, and net-zero emissions by 2075 to accomplish the Paris Agreement goals.

COVID-19 restrictions are still acting to reduce emissions from industry worldwide. However, the latest data compiled by the Global Carbon Project based on different resources suggest that industrial activities have picked up in China, Brazil and the other biggest polluter countries, which may offset some of the reductions elsewhere.

However, there are a few bright spots. Renewables are the only energy source that experienced demand growth in 2020. According to the International Energy Agency, renewables increased their share of electricity generation to nearly 9% in 2020, twice as high as in 2015 and are expected to undergo additional growth.

The land-use change emissions were also lower in 2020 than the anomalously high emissions in 2019. Last year saw the highest

deforestation rates in the Amazon since 2008, which was associated with a 30% increase in deforestation and degradation fires over the previous decade. Additionally, unusually dry conditions in 2019 led to fire emissions from peat burning, deforestation and forest degradation in Indonesia, making the rate twice as large as the average over the previous decade.

However, these trends are not sufficient to accomplish the goal of the Paris Agreement. Therefore, the carbon policies on a global scale clearly must be tightened to control long-term growth in emissions and to start bringing global emissions down to meet the objectives of the Paris Agreement.

Provided by University of Illinois at Urbana-Champaign

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