Effect of COVID-19 confinement on daily global CO_2 emissions

Science Summary

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Climate-Carbon Interactions in the Current Century

- At the peak of the confinement, a **17% drop** was estimated in **daily global CO_2 emissions.**
- The drop in activity and consequently in emissions is **temporary.** Structural changes are needed for sustained emission reductions in line with Paris Agreement and the European Green Deal.
- A **new Nature Climate Change** study estimates the change in CO_2 emissions due to confinement measures, based on activity data from six sectors.

Le Quéré C., Jackson R.B., Jones M.W., Smith A.J.P., Abernethy S., Andrew R.M., De-Gol A.J., Willis D.R., Shan Y., Canadell J.G., Friedlingstein P., Creutzig F. and Peters G.P. Temporary reduction in daily global CO2 emissions during the COVID-19 forced confinement. Nat. Clim. Chang. (2020). doi.org/10.1038/s41558-020-0797-x

CARBON BUDGET

Since early 2020, confinement measures have been adopted by many nations worldwide in an attempt to contain the spread of COVID-19, resulting in drastic changes in energy demand, transport and consumption patterns.

In this study, a new method was developed to estimate, for the first time, the changes in daily fossil CO_2 emissions in 69 countries, accounting for 97% of global emissions, during January-April 2020. A revision of the values was performed on 11 June 2020.

Emissions were assessed after grouping in six economic sectors, including the power (44.3%), industry (22.4%), surface transport (20.6%), public (4.2%), residential (5.6%) and aviation (2.8%) sectors.

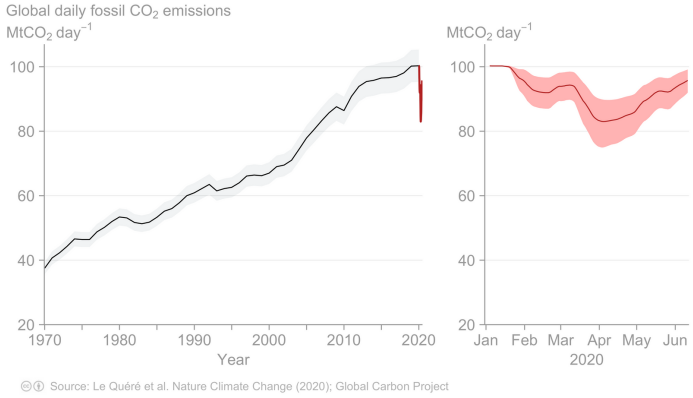
RESULTS

Activity changes

A marked decrease in activity was observed in the different economic sectors as a result of confinement measures. In countries under the maximum level of lockdown, activity decreased by about 75% in the aviation sector, 50% in surface transport, 25% in industry and 15% in power generation, whereas a small increase of 5% in the use of residential buildings was reported. No direct data were available for the use of public buildings and commerce, but it was assumed that activity decreased by 33%, halfway between the surface transport and power sectors.

CO_2 emissions

According to the activity data, the effect of the confinement on daily CO_2 emissions was subsequently calculated. The total cumulative change in emissions from January to June was estimated to be -1,396 $MtCO_2$. A 17% drop in daily global emissions was estimated during the peak of the confinement on 7 April 2020, as compared to the mean daily levels in 2019. Daily emission levels were comparable to those observed



in 2006. Over the period of 1 January to 11 June, emissions were 8.6% below the 2019 levels over the same period.

How emissions by each sector were affected

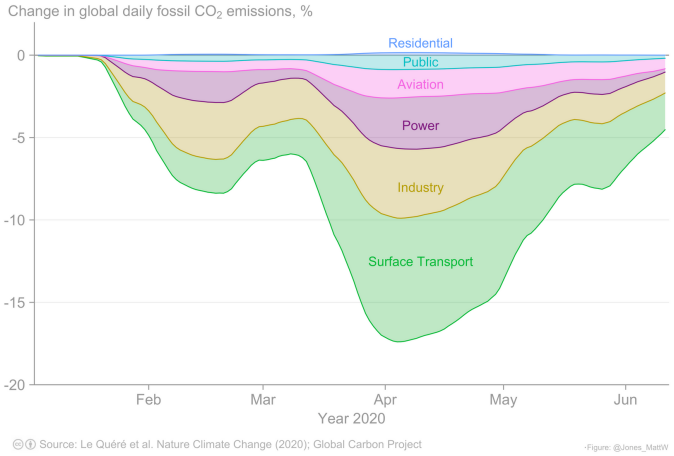
The most significant drop in daily global emissions at the peak of the confinement resulted from changes in surface transport, accounting for almost half (43%) of the total decrease. Combined drops in emissions from the industry and power sectors accounted for a further 43% of the decrease. The sector impacted the most by the confinement was aviation, although it only accounts for 3% of global emissions and was responsible for 10% of the decrease in global emissions during the peak of the pandemic.

How emissions by each country were affected

When looking at the impact of confinement in individual countries, an average decrease of 26% in CO_2 emissions was estimated at the peak of the confinement for each country.

Impact on annual emissions for 2020

The impact of the confinement on annual emissions in 2020 was then calculated considering whether mobility and economic activity would return to the pre-pandemic levels by mid-June, the end of July, or the end of 2020. Based on these scenarios, the total decline in annual CO_2 emissions is estimated to be approximately 4%, 5% or 7%, respectively (full range, 2%-12%).



IMPLICATIONS

Temporary drop

The drop in emissions observed in 2020 is likely to be temporary, since it does not reflect structural changes in the economic, transport, or energy systems. The social restrictions implemented to control the COVID-19 pandemic would not drive the deep and sustained reductions needed to reach net zero emissions and are not desirable because they do not improve wellbeing.

Overall impact on climate change

The confinement-induced decrease in CO_2 emissions in 2020 will do nothing to slow down climate change. This drop in CO_2 emissions is extremely small compared to the emissions accumulated so far in the atmosphere, and compared to the emission cuts needed to tackle climate change. In order to limit warming close to 1.5˚C in line with the Paris Agreement, a decrease of about 3-7% would need to be sustained year-on-year for the next decades.

Post-COVID-19 emissions

Rebound to higher emission paths compared to pre-COVID-19 levels could be observed if there are large-scale investments into fossil fuel infrastructure and if vehicle emissions standards and similar environmental measures are relaxed.

Structural changes

Structural changes aligned with low carbon pathways are needed to avoid a substantial rebound in emissions and tackle climate change. Such measures could focus on mobility in particular, which was shown to induce the most decrease in emissions during confinement. Such changes have additional benefits for public health and wellbeing, since they can help reduce air pollution. Supporting active travel (e.g. walking and cycling), clean energy and vehicles, and reduced demand for aviation are some of the possible structural changes reducing emissions.

METHOD

Daily emissions

Since real-time data on CO_2 emissions are not available, an alternative approach was devised to estimate the country-level emissions. CO_2 emissions were estimated considering proxies for change in daily activity, rather than changes in annual energy use, and as a function of the stringency of the confinement.

This approach examined the extent of the confinement policies in each country (termed the confinement index), in combination with daily activity data indicating how much each of the six economic sectors was affected by the pandemic. The data collected included mobility, traffic and congestion reports, electricity use and patterns, and industrial production.

Mean daily emissions for the latest available year (2017 to 2019) were used to calculate the changes in daily CO_2 emissions for each country, sector and day. These data were mainly obtained from the Global Carbon Project, the International Energy Agency, the US Energy Information Administration and national statistics (Chinese provinces). The results represent changes compared to a typical day prior to confinement, taking into account seasonality and day of the week.

Annual emissions

The study also estimated the expected impact that the confinement will have on the annual emissions for 2020, testing three hypotheses regarding the speed and extent at which mobility and the economy will recover to their pre-pandemic levels.

Green policies

The extent to which world leaders consider the net zero emissions targets and imperatives of climate change when planning economic responses to COVID-19 is likely to influence the pathway of CO_2 emissions for decades to come.

For a resilient recovery from the COVID-19 pandemic, the European Green Deal and sustainable recovery plans are crucial when rebuilding our economy. The negotiations of the Multiannual Financial Framework and Next Generation EU must keep green investments as priority to allow the EU to achieve sustainable growth. Urgent action to this global health and environmental crisis is needed to reach the goals of the European Green Deal for >50% reduction in emissions by 2030 (compared to the 1990 levels) and a climate-neutral Europe by 2050.

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