Short-term reduction in daily global carbon dioxide emissions during Covid-19 lockdown

**Government lockdown policies during the Covid-19 pandemic have drastically altered patterns of energy demand.** Researchers have estimated the resulting decrease in global daily carbon dioxide (CO₂) emissions from January to April 2020, indicating that levels dropped by up to 17% in early April, compared to 2019 averages. This indicates the effect of the extreme policies, while highlighting that most changes may be temporary as they do not reflect fundamental changes in global economic, transport or energy systems.

During the Covid-19 pandemic, government policies have closed international borders and confined many to their homes, drastically altering patterns of energy demand. The resulting decrease in global daily CO₂ emissions, from January to the end of April 2020, particularly from surface transport (roads and shipping), demonstrates that resulting government actions such as repurposing streets for pedestrians and cyclists, rather than cars, could continue to influence emissions after the pandemic, but also emphasises the limits to reductions under the current energy mix.

There are no systems in place to monitor CO₂ emissions in real time, the researchers note, as they are reported as annual values, often long after the end of the calendar year. Proxy data is available, however, such as electricity consumption in Europe and the United States (but not the associated CO₂ emissions, which depend on energy type) and changes in mobility. The researchers, therefore, developed an approach to estimate emissions based on changes in activity across six economic sectors, looking at 69 countries that produce 97% of global CO₂ emissions.

Sectors producing 30% of these emissions were under some confinement by early 2020, the researchers found. This proportion rose to 70% by the end of February and over 85% by mid-March, peaking at 89% in early April.

The study investigated six emitting sectors, with varying percentages of global fossil CO₂ emissions in 2019: power (electricity and heat production — accounting for 44.3% of global fossil CO₂ emissions in 2019); industry (22.4%); surface transport (roads and shipping including domestic and international shipping): 20.6%; public buildings and commerce (4.2%); residential (5.6%) and aviation (2.8%).

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**Source:**

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The total change in emissions from January to the end of April was 1.048Mt (million metric tonnes) of CO₂, an 8.6% decrease over the same period in 2019, with the largest difference in China (242Mt). European emissions dropped by 123Mt.

The overall reduction in daily emissions peaked on 7 April 2020 at an average of 17%. Just under half the decrease was due to reduced surface transport, where emissions dropped by 36% (7.5Mt CO₂) on this date, and power and industry accounted for the next largest reductions by mass (3.3 and 4.3Mt respectively). This was despite the fact that power consumption only dropped by 15% under strict confinement.

Aviation, which fell by 75% under moderate and strict confinement, saw the largest reduction in activity. However, decreased air travel only accounted for an average daily decrease of 1.3Mt CO₂. Meanwhile residential emissions increased by 5% under strict confinement, producing a marginal daily increase of 0.2Mt CO₂.

The researchers note that while the decrease in energy demand was the consequence of an extreme policy scenario, it provides an indication of the potential limits of such measures on emissions, under the current fossil/renewable/nuclear energy mix. For instance, even at the lowest level of emissions in April 2020, emissions were only reduced to 2006 levels, highlighting the large growth in global emissions over the past 14 years.

The researchers acknowledge that it is unclear how long the crisis will last and recovery will take but, if restrictions continue worldwide to the end of 2020, they estimate that the annual decrease on 2019 levels will probably be between 4.2 and 7.5% — comparable to the rates of decrease needed year-on-year for decades in order to limit global warming to 1.5°C.

These findings indicate that most of the reductions in emissions seen in 2020 are probably temporary, as they are not founded on structural changes in economic, transport or energy systems. The researchers posit that behavioural changes alone would not drive the deep reductions necessary to reach net-zero emissions; clean energy sources are also needed, for example. However, the research reveals how policy — such as net-zero emissions targets — can effect large changes in emissions from the surface transport sector.

While emissions are likely to rebound after a critical period, as they did after the 2008–2009 financial crisis, some changes could continue, say the researchers. For example, socially distanced, active travel is likely to be more desirable for some time, especially with moves to increase street space for pedestrians and cyclists — a policy which may positively impact on wellbeing. Ultimately, however, the trajectory of emissions post-Covid-19 will be most affected by whether net-zero emissions targets are considered in economic responses, the researchers suggest.