Commentary:

COVID-19: Clinching the Climate Opportunity

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Summary

The COVID-19 pandemic has triggered the largest drop in greenhouse gas emissions since World War II. Evolving mobility patterns, in particular, have shown the short-term mitigation potential of behavior change. Sustaining such changes could abate 15% of all transportation emissions with limited net impacts on societal wellbeing.

Keywords: COVID-19, Climate Change, Mitigation, Transportation Sector, Work-from-Home, Behavior Change

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As the world holds its breath to rein in the COVID-19 pandemic, global greenhouse gas emissions have fallen more rapidly in the space of a few months than they have from years of climate policy implementation. With more than half the global population subject to partial or complete lockdowns at different points in time, early estimates suggest that global emission levels will be 6% lower in 2020 than in 2019, the first drop of this magnitude since World War II.[1]

The drivers of these emission reductions – forced lockdowns and extensive restrictions on economic activity – are not a viable strategy against climate change. Widespread social hardship and curtailed freedoms are too high a price to pay for carbon emission reductions when alternative and less disruptive options exist. As Antonio Guterres, Secretary-General of the United Nations, rightly observed, the world "will not fight climate change with a virus."[2] And indeed, in regions where efforts to contain the pandemic have been lifted, emissions have already started to rebound to previous levels.

Still, the pandemic response as well as the changes in human behavior and economic processes it occasioned offer valuable lessons for the collective effort to rein in climate change. For the first time in a generation, deliberate policy choices have resulted in emission reductions at a scale approaching what climate scientists recommend to avoid the worst consequences of climate change. What if some of the observed emission reductions could be sustained without the social and economic disruption experienced during containment?

As a growing body of literature draws parallels between the pandemic and climate change, revealing dysfunctions that have hampered the societal response to both crises and identifying opportunities for a green recovery, less analysis has sought to systematically dissect the various causes of emission reductions to single out those that might promise lasting climate benefits. We venture such an analysis in this Commentary to provide a preliminary estimate of the climate opportunity and point to areas that offer the most potential.

To capture the climate opportunity, we use the heuristic notion of 'decarbonization levers.' We do not propose an analysis premised on formal conceptions of social welfare or individual utility. Instead, we identify those behavioral changes witnessed during the pandemic that yielded large emissions reductions, are not a direct result of falling economic output, and have the prospect of being sustained once the contagion ends. These include adjusted practices and processes, such as the increase in local sourcing and telecommuting, as well as evolving preferences, such as a surge in online shopping and biking to avoid crowded trains. Retention (and expansion) of such changes offers potential for emissions abatement without necessarily sacrificing societal wellbeing.

To identify the emissions reduction potential of such 'decarbonization levers', we first break down the emission reductions caused by how governments, companies, and individuals have responded to the pandemic. We then single out those changes in corporate processes and individual behavior that have the potential to be sustained, finding these primarily in the transportation sector. We conclude by quantifying the short-term potential for lasting emissions abatement and highlighting relevant policy implications.

Emission Reductions Due to Pandemic Response

Early research suggests that lockdown measures will result in the largest emission reductions since the end of World War II. The International Energy Agency (IEA), for instance, has calculated that global CO_2 emissions will decline by 8% in 2020, to levels last seen 10 years ago.[3] This represents a year-on-year reduction that is six times larger than the previous reduction caused by the global financial crisis in 2009. These figures are in line with the Energy Information Administration (EIA) forecast of a 7.5% drop for the U.S. in 2020.[4] Initial academic studies confirm these estimates. Liu et al. estimate an emissions decline of 5.8% for the first quarter of 2020,[5] and Le Quéré et al. expect a decline of 5.7% in 2020 based on the historic carbon intensity of economic activity and the global growth forecast of the International Monetary Fund.[1] The latter also apply a bottom-up approach to calculate that global emissions may have dropped by up to 17% at the peak, and expect the annual decrease to lie within a range of 4.2 to 7.5%, depending on the duration of confinement measures.

These early estimates point to the transportation sector as the sector that experiences the largest fall in emissions from the pandemic. Le Quéré et al. suggest reductions from surface transportation of 36% by 7 April 2020.[1] Likewise, the IEA observed a steep decline in demand for personal vehicle use and air travel due to restrictions on mobility and work-from-home policies: road transportation dropped between 50% and 75% in regions under lockdown, aviation activity experienced an even larger decline of more than 90% in some regions, and fuel consumption for shipping also dropped as global economic activity slowed down.[3] Other sectors likewise experienced major emission reductions during lockdown phases, but not at the same scale. For instance, lockdowns reduced electricity demand by 20%,[3] and emissions fell by 19% in the industry sector.[1]

Decarbonization Levers in the Transportation Sector

With changes in transportation identified as the largest driver of emissions reductions during the pandemic, researchers have suggested that the transportation sector also offer the greatest potential for retaining (and potentially expanding) emission reductions in the short term without negatively (or in some cases even positively) affecting societal wellbeing.[1] Tapping this potential would be particularly beneficial because decarbonization of the transportation sector has proven an intractable challenge: transportation emissions have steadily increased in recent years, SUVs sales continue to surge, and demand for air travel over the next two decades is set to double.[6] How difficult it is to decarbonize transportation is evidenced by the fact that the integrated assessment models used to project pathways towards achievement of the 1.5°C temperature target set out in the Paris Agreement still anticipate substantial emissions from the sector even in 2050.[7]

Changes in surface transportation have been found to account for nearly half of all emission reductions during the pandemic response.[1] At the same time, non-fossil/people-powered mobility has soared, and contributed to emission abatement and improved air quality. From Athens to Sydney, cities have rededicated public spaces from cars to cyclists and pedestrians, and some of these changes will likely survive the pandemic. To quantify the climate opportunity, we link emission reductions to behavior changes. Figure 1 depicts global greenhouse gas emissions by sector before the COVID-19 pandemic, highlights the share of transportation within the energy sector, and singles out categories and purposes of travel. Based on this breakdown, we explore the lockdown effects. Within air transportation, for instance, the Transportation Security Administration counted up to 96% fewer travelers in the U.S. compared with the same day of the previous year ,[8] while the number of cargo flights remained rather constant. Rail and ship transportation also reveal a heterogeneous picture (e.g., analysts reported that while cruises came to a halt, only 21% of transpacific container-sailings were cancelled in May[9]). The second bar of Figure 2 summarizes these lockdown effects. The aggregation shows that lockdown measures may have reduced transportation emissions by more than half, from 7.8 to 3.3 gigatonnes of carbon dioxide equivalent ($GtCO_2e$).

At such levels, transport-related emissions would be as low as they last were 45 years ago, lower than the emission levels climate models say are needed by mid-century to stay on a pathway toward decarbonization in line with the 1.5°C goal. What this unprecedented drop also illustrates is the mitigation potential of behavior change in transportation, a lever that the models tend to subordinate to technology substitution projections. Instead, the models suggest that emerging negative emission technologies will be more viable to address transportation emissions than changes that avoid or shift transportation activity. The scale of emission reductions during the pandemic cautions against underestimating the potential of behavior change to accelerate decarbonization of the transportation sector.

Going forward, we see two major opportunities for sustained emission reductions. First, commuting and business-related rides accounted for about half of vehicle miles travelled before the pandemic. Retaining work-from-home policies after the COVID-19 pandemic may permanently reduce the frequency and length of such rides. Twitter, for instance, has announced a work-from-home policy that allows 100% of staff to work remotely even beyond the pandemic. Some sectors, such as manufacturing, will be less able to accommodate work-from-home policies, but even there, a sizeable and growing share of the workforce holds desk jobs that could transition to remote working. One example is the car manufacturer BMW, whose workers' council has formulated the goal of achieving a permanent work-from-home share of 40% after the pandemic. With the services sector accounting for more than 50% of all employment globally, not including administrative and management jobs in other sectors, the potential for structural changes is significant. As the proportion of knowledge-based occupation continues to expand, so will this potential.

Regardless of sector, observed trends such as bike-to-work and online meetings may further reduce the number of car rides. Another behavioral shift affecting the extent of driving are shopping habits. Shopping was the main purpose of approximately one fifth of all passenger vehicle miles travelled before the pandemic (see Figure 2). The accelerated trend towards online shopping and stockpiling offers an opportunity to permanently reduce driving for this purpose. In total, we estimate that up to one third of miles driven by car before the pandemic could be avoided without net losses in societal wellbeing (see Figure 2). Some sectors – such as brick-and-mortar retail businesses – would see a loss of revenue and employment while others – such as online retail businesses – gain, however, creating distributional challenges that policy makers may need to address as part of a broader transition strategy.

Second, less business travel may not only reduce the number of car rides but also of flights. 10% of passenger flight emissions originated from business travel before the pandemic (see Figure 1). An analysis by airline experts suggests that four out of five flights may become obsolete as video conferencing solutions have become more accepted during the pandemic.[10] Since business travelers account for about three quarters of airline profits, a drop in business travel might disproportionately reduce the number of flights air carriers can perform profitably. Overall, we estimate that changes to travel patterns offer the opportunity to reduce transportation emissions by 15% from 7.8 to 6.7 $GtCO_2e$ (see Figure 2).

Our calculations provide an estimate of the climate opportunity arising from behavioral changes in the transportation sector that do not negatively impact societal wellbeing. Further behavioral changes than those we quantify in Figure 2 are feasible. For instance, a trend towards more local sourcing may permanently reduce emissions from trucks, planes, ships, and trains. Also, the number of non-business or shopping-related automobile rides may be lower after the pandemic if people permanently spend a higher share of their time online than on the road.

At the same time, some rebound or compensation effects have to be considered. The lockdown increased internet usage by 70% and streaming by more than 12%.[11] Work-from-home results in higher energy consumption at home, which may not be fully offset by reduced consumption in office buildings. Similarly, permanent work-from-home arrangements may incite a trend towards larger homes or additional outbuildings that can better substitute for traditional office spaces, increasing resource use. Local sourcing of food, finally, can sacrifice productivity gains from large-scale centralized agriculture. Such tradeoffs merit further study, and their dynamic nature makes them difficult to estimate with accuracy.

Conclusions and Policy Recommendations

Notwithstanding uncertainties and data gaps in this rapidly evolving context, our analysis suggests that the transportation sector offers by far the greatest emission reduction potential from the type of decarbonization levers we discuss in this Commentary: based on our estimate, 15% of all transportation emissions before the pandemic could be abated in the near term by sustaining changes such as increased uptake of work-from-home policies, reduced business-related travel, and altered shopping behavior. By comparison, the potential for emissions abatement in other sectors appears much more limited in the short term.

Many of the observed changes driving emission reductions during the lockdown come at a price: of reduced convenience, time savings, or even just – in the case of leisure and vacation travel – forgone pleasure and mental stress. Some changes also come with new benefits, however, such as improved health due to reduced air pollution and increased physical activity, or less productive time lost commuting and traveling to meetings. Balancing these tradeoffs involves sensitive and often highly personal decisions, which makes any interventions through policy mandates risky and potentially unpopular.

Which of these changes can or cannot be sustained is therefore something only an open and inclusive societal debate can help explore. Governments can play a role by enabling rather than forcing changes, and by facilitating deliberation across stakeholders from all parts of society and sectors of the economy. Such deliberation can, in turn, help foster awareness of the choices and their tradeoffs, and also build consensus around the desirability of certain changes.

Importantly, such a debate should occur against the backdrop of already committed decarbonization objectives, which will necessitate far-reaching changes and, in some cases, also sacrifices across all parts of the economy. What the collective response to the COVID-19 pandemic has provided is powerful evidence for the mitigation potential of behavior change: for the first time since climate change has been discussed at the political level, annual emission reductions are likely to be in line with what climate scientists tell us is needed every year for the next decades to limit global warming below 1.5°C. Where climate models assume continued high emissions from the transportation sector even by mid-century, relying instead on – as yet unproven or fledgling – negative emission technologies to achieve decarbonization, the pandemic response may prompt reconsideration of untapped opportunities from changes in mobility behavior.

As the recovery from COVID-19 continues to dominate the political agenda in upcoming months, we therefore advocate for a more robust debate of whether and how observed changes that have contributed to emission reductions can be sustained, especially in the transportation sector. Faced with an economic slowdown and falling consumer spending, however, many governments have reflexively focused their short-term efforts on accelerating a ‘return to normal’, including pre-pandemic demand levels and consumption patterns. In many cases, they have also faced pressure to relax environmental safeguards as a way to bolster the recovery.

Coupled with deferred investments in clean technologies and infrastructure, as well as prolonged hiatus of national and international policy processes aimed at advancing decarbonization, the ‘normal’ we return to risks being more carbon-intensiv than before the pandemic. The last time a global emergency resulted in significant short-term emission reductions – during the economic and financial crisis of 2008 – economic recovery also trumped sustainability concerns. In hindsight, many observers described it as a wasted opportunity for decarbonisation[12]. We must ensure that, this time around, climate objectives inform our collective choices lest we emerge from one crisis having only exacerbated an even larger crisis.

So far, the debate on how pandemic response efforts might support the struggle against climate change has largely centered on the role of stimulus packages[13]. Despite the moral and political sensitivities, however, an open discussion is also needed on how changes in individual and collective behavior can help progress decarbonization and unlock collateral benefits, such as health improvements. As our analysis of the transportation sector shows, such changes in transportation patterns offer significant potential for short-term emission reductions in a particularly challenging sector to decarbonize.

Mandating restrictions on mobility is unlikely to gain favor with voters. To tap the mitigation potential revealed in the transportation sector by the pandemic, changing mindsets and perceptions will matter as much as coercive or enabling policies. Still, the pandemic has also shown that countries watch and learn from each other, with successful approaches to containing the contagion quickly finding uptake elsewhere. Even in an era of diminished multilateral cooperation, countries can learn from each other, and events such as the July IEA Clean Energy Summit focused on green recovery can serve as forums to advance a structured exchange on best practices.

If the pandemic is to mark a historic peak in anthropogenic greenhouse gas emissions, we need to leverage such lessons and turn them into guardrails against a return to pre-pandemic emissions growth.

Figure Legends

Figure 1 | Sectoral breakdown of global greenhouse gas emissions. Emissions data from the World Resources Institute (WRI)[14] as of 2016 are presented in gigatonnes of carbon dioxide equivalents ($GtCO_2e$); Breakdown of transportation emissions based on data from the International Energy Agency (IEA),[15] International Council on Clean Transportation (ICCT),[16] Department of Transport[17] and Office for National Statistics (U.K.).[18] For further details, data sources, and assumptions, see Supplemental Information Table S1.

Figure 2 | Global t**ransportation emissions before, during, and after the COVID-19 pandemic.** All numbers are presented in gigatonnes of carbon dioxide equivalents ($GtCO_2e$). The GHG level before the pandemic is based on data from the World Resources Institute (WRI)[14], and the approach to split transportation emissions is analogous to Figure 1; The GHG levels during the lockdown are based on estimates from the International Energy Agency (IEA),[3] Le Quéré et al.,[1] as well as our own calulations (see Supplemental Information Table S1). The GHG levels after the pandemic are based on our own estimates derived from expert opinion as described in the section on 'decarbonization levers', and underpinned by empirical data (e.g., the observed basket size increase/stockpiling during the confinement – online as well as offline – underlines the mileage reduction potentials from less store visits and more efficient truck deliveries). For further details, data sources, and assumptions, see Supplemental Information Table S1.

Experimental Procedures

Resource Availability

Lead Contact

Requests for further information and resurces should be directed to the Lead Contact, Christian Stoll (cstoll@mit.edu).

Materials Availability

This study did not generate new unique materials.

Data and Code Availability

All data analyzed for this commentary have been included in Supplemental Table S1. The data is also deposited at Mendeley Data: http://dx.doi.org/10.17632/d7sty33h5g.1

Author Contributions

C.S. conceived of the study. Both authors contributed to the design of the study and data acquisition. C.S. aggregated and analyzed the data. Both authors drafted the manuscript.

Declaration of Interests

The authors declare no competing interests.

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