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COVID-19 and Emissions: An Opportunity for Sustainable Global Health

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COVID-19 has left city squares abandoned and our streets empty with a rising toll of human lives and livelihoods. But hidden in the fallout from the virus are trends in improving air pollution emissions and the possibility of solving the issues of air pollution and climate change (*Figure 1*). Ambient air pollution contributes to 8.8 million deaths globally, with over 50% of these attributable to cardiovascular causes, and like COVID-19, affects urban populations disproportionately. However, enforced sheltering-in-place rules and massive unemployment are unsustainable ways to cut anthropogenic emissions in the long term, unless there are permanent changes in the way we work, commute, and recreate.

The extraction and burning of fossil fuels is a major source of air pollution and carbon dioxide (CO_2). Global CO_2 emissions at least initially during the pandemic plummeted, with a fall of 7%, globally.[1] This unprecedented drop in CO_2 emissions is the largest drop since World War II and probably ever. However, the resumption of economic activity and removal of restrictions in many parts of the world are already starting to mitigate these impressive gains, suggesting that without structural changes in the energy sectors driven by policy that these drops are likely fleeting.

The benefits of curtailing some of the same anthropogenic sources responsible for both global warming and air pollution are persuasive and resonate with the public and health professionals alike. Air pollution is a complex mixture of pollutants of which, fine particulate matter air pollution ($PM_{2.5}$) and ozone represent components most implicated with adverse health effects. Primary pollutants [sulphur dioxide, nitrogen oxides (NOx), and some components of particulate matter are emitted from anthropogenic sources directly into the atmosphere, while secondary pollutants ozone and secondary $PM_{2.5}$] result from the chemical or physical interactions between primary pollutants and/or other atmospheric components.

Primary pollutants such as NOx and sulphates are excellent surrogates for traffic and coal power generation. Indeed, a massive 20–40% reduction in NO_2 was noted early on during the pandemic. Several studies initially reported a reduction in $PM_{2.5}$ in China, India, Western Europe, and USA, while recent trends seem to suggest smaller improvements, given resumption of economic activity. While emissions from transportation are a major source of $PM_{2.5}$, power plants and heavy industry are also major contributors.[2] It is clear that given the consistent relationship with health effects, even at levels below the current US EPA annual standard ($<12\ mg/m^3$), a structural shift in energy generation and consumption is needed to further lower $PM_{2.5}$ levels.[3]

Figure 1 COVID-19 and the unprecedented opportunity of transforming energy generation and consumption.

The impending climate catastrophe warrants a steep drop in CO_2 release of the magnitude seen with COVID-19, not just for 1 year, but compounding year on year for the next 10 to keep global warming below 1.5°C (above pre-industrial levels). Global emissions must also reach net zero by 2050, for a reasonable chance of keeping global temperature rise <1.5°C, with additional warming beyond 1.5°C expected

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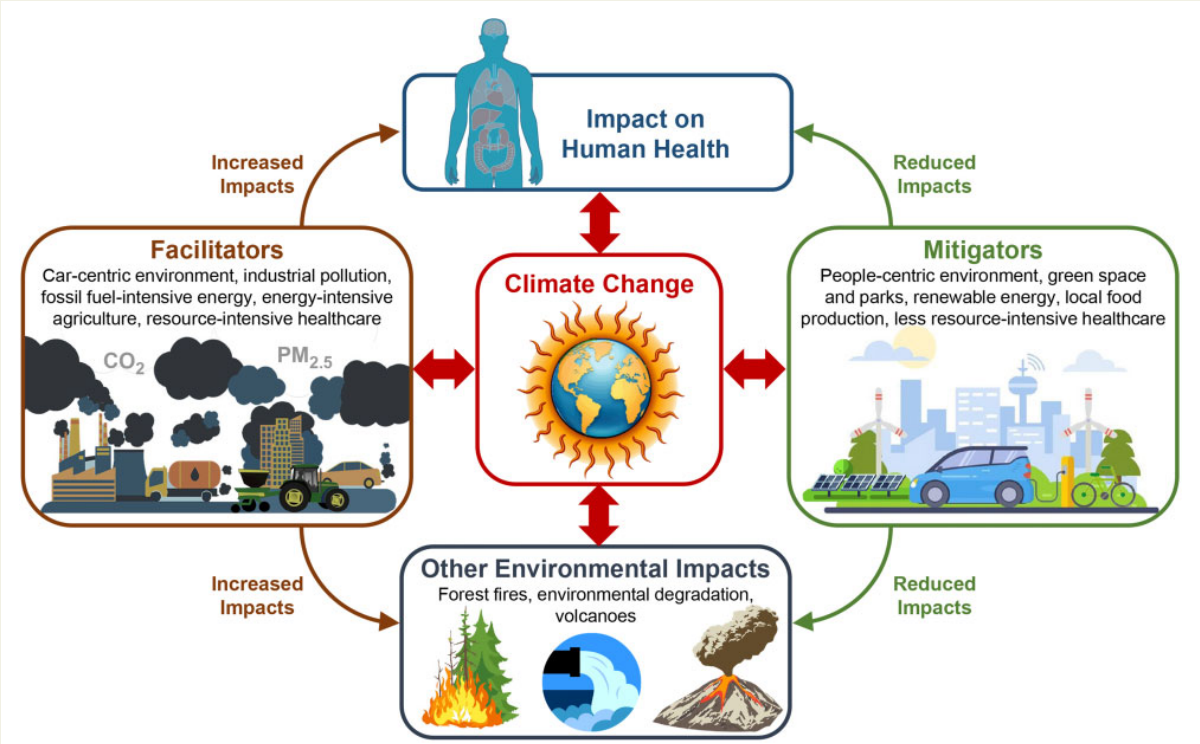

Figure 2 The links between air pollution and climate change. Air pollution enhancers and mitigators also serve in simultaneously fostering or minimizing climate change.

to have devastating impact.[4] The Trump administration had eliminated several long-standing deterrents against air pollution and greenhouse gas emissions. On 20 January 2021, President Joe Biden issued an executive order, 'Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis'. This order eliminates the prior changes proposed by the Trump administration and will force executive agency heads to review more than 120 changes in regulations related to energy and the environment. Most importantly, the Biden administration is committed to building a sustainable energy infrastructure that will create not only new jobs but will also address air pollution health effects and climate change.

Through stimulus funding a decade ago, a $50 billion investment jump-started the wind and solar revolution still bears fruit today with record-low wholesale electricity prices in the USA. A $465 million loan in 2010 to an upstart car company named Tesla helped them design and build cars at a Fremont, CA, facility that now employs 20 000 people. Contrary to the archaic belief that acceleration of infrastructure through continued reliance on anthropogenic fuel sources is the only means to jump-start economic activity with COVID-19, transforming power generation, grids and reimagining transportation may accomplish the triple goal of reducing emissions, improving global health, and accelerating economic growth.

Dramatic reductions in the cost of solar, wind, and battery technologies, many of which preceded COVID-19 offer immense potential to improve the economy and health. The results of a recent report on accelerating a Clean Energy Future are dramatic. Using the latest cost data and industry-standard modelling tools, this report demonstrated the feasibility and affordability of a 100% zero-carbon future by 2045. Setting a national clean energy standard of 55% by 2025, 90% by 2035, and 100% by 2045 although ambitious is achievable, giving America the clean energy backbone needed to decarbonize other sectors on the path to net-zero emissions. This scenario can be accomplished at an infrastructure cost of $1.7 trillion dollars over 15 years but will help support about 530 000 more jobs each year.[5] Importantly, this effort will dramatically reduce air pollution-related mortality and morbidity, avoiding at least $1.2 trillion in immediate and cumulative health and environmental damages. Without a doubt, such a bold vision will require unprecedented steps. Fortunately, significant structural changes in education, business, and government that would have ordinarily taken decades, have occurred within the last 8 months, including remote education, telecommuting, and avoidance of business travel. Governments in Europe have already been leading the way. Cities from Milan to Madrid are closing miles of streets to traffic permanently and opening them to pedestrians and bicyclists. Over 160 American cities have made 100% clean energy commitments that would dramatically reduce anthropogenic emissions. Together with transformation occurring in the automobile sector, these commitments will require resolute action, including manufacturing tax credits to support green energy infrastructure, federal debt financing for utilities, supporting transitioning of fossil fuel technologies including coal communities and a federal clean energy standard enacted by Congress, or an EPA successor to the Clean Power Plan, to ensure no state lags too far behind.

The medical and environmental community must join forces in emphasizing that reducing air pollution and emissions is good for both human and planetary health (*Figure 2*). COVID-19 is a call to arms for creation of a new zero-emission economy as the final frontier for sustainable global health and prosperity.

Conflict of interest: Dr R.B.J. is Chair of the Scientific Steering Committee of the Global Carbon Project and Prof., Earth System Science and Senior Fellow, Stanford Woods Institute for the Environment and Precourt Institute or Energy, Stanford University, CA, USA. Dr S.R. is Chief of Cardiovascular Medicine and Director of the Case Cardiovascular Research Institute, University Hospitals, Case Western Reserve School of Medicine, Cleveland, OH, USA.

References

1. Le Quéré C, Jackson RB, Jones MW, Smith AJP, Abernethy S, Andrew RM, De-Gol AJ, Willis DR, Shan Y, Canadell JG, Friedlingstein P, Creutzig F, Peters GP. Temporary reduction in daily global CO_2 emissions during the COVID-19 forced confinement. *Nat Clim Chang* 2020;**10**:647–654.
2. Le T, Wang Y, Liu L, Yang J, Yung YL, Li G, Seinfeld JH. Unexpected air pollution with marked emission reductions during the COVID-19 outbreak in China. *Science* 2020;**369**:702–706.
3. The need for a tighter particulate-matter air-quality standard. independent particulate matter review panel. *N Engl J Med* 2020; doi:10.1056/nejmsb2011009.
4. UN Environment. *Visual feature: The Emissions Gap Report 2019*. UNEP—UN Environment Programme; 2019.
5. 2035 The Report. *Plummeting Solar, Wind, and Battery Costs Can Accelerate Our Clean Electricity Future*. http://www.2035report.com/wp-content/uploads/2020/06/2035-Report.pdf?utm_referrer=https%3A%2F%2Fwww.2035report.com%2F (August 2020).