COVID-19, Climate Change, and the American Thoracic Society
A Shared Responsibility

Hari M. Shankar[1], Gary Ewart[2], Erika Garcia[3], Anne Hicks[4], and William Hardie[5]

[1]Division of Pulmonary, Allergy and Critical Care, University of Pennsylvania, Philadelphia, Pennsylvania; [2]American Thoracic Society, Washington, DC; [3]Department of Preventive Medicine, University of Southern California, Los Angeles, California; [4]Department of Pediatrics, University of Alberta, Edmonton, Alberta, Canada; and [5]Division of Pulmonary Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio

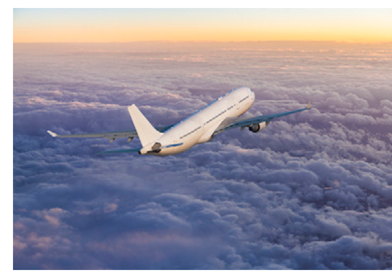
ORCID ID: 0000-0003-1540-9805 (E.G.).

On March 18, 2020, the American Thoracic Society (ATS) canceled the International Conference for the first time since its inception in 1905. The unprecedented social changes currently in effect to mitigate the coronavirus disease (COVID-19) pandemic provide opportunities for the ATS to address another looming health emergency: climate change. Though the energy, transportation, and agriculture industries typically bear the blame for their substantial contributions to greenhouse gas emissions, more easily overlooked is the significant role of the healthcare system; according to a recent report, the U.S. healthcare sector is estimated to contribute approximately 10% of the annual U.S. greenhouse gas emissions (1). Such numbers argue it is high time for us—both as individuals and as members of the ATS—to critically examine our roles in the climate crisis. Reducing the carbon footprint of the healthcare system is a worthy and necessary endeavor and one that many organizations are pursuing. Our focus here, however, is on a more tractable structure: academic conferences and their impact on climate and air quality. Though conferences remain valuable as a venue for physicians and researchers to disseminate research, build and maintain collaborations, and stay abreast of their respective fields, they also have a significant environmental impact. We detail below the carbon footprint of such meetings, including the ATS international conference, along with proposals to decrease our climate impact for future meetings with large numbers of in-person attendees.

The Contribution of Air Travel to Carbon Emissions

Climate Impact of Academic Air Travel

Greenhouse gas emissions from commercial air travel are expected to triple by 2050 as worldwide commercial air travel increases and likely make up the lion's share of the ATS international conference's carbon footprint (2). In an effort to examine the climate impact of flying to the 2019 ATS meeting, CO_2 emissions were calculated for air travel to and from Dallas, Texas. Data were available on the country or state of origin for 11,555 attendees, and delegates were assumed to have traveled from their country's or state's capital. CO_2 emissions were calculated using The International Civil Aviation Organization Carbon Emission Calculator (3), which uses a distance-based approach to estimate an individual's aviation emissions by accounting for factors including aircraft type, passenger and cargo load, and other variables. Total CO_2 emissions for 7,405 attendees traveling from the United States and Puerto Rico averaged 349 kg/person. Emissions for non-U.S. attendees from 84 countries averaged 983 kg/person. The overall average for all attendees was



577 kg/person. However, these values likely underestimate actual CO_2 emissions, as they do not fully account for the emissions inherent in connecting flights (2). For context, in 2009, the German Advisory Council on Global Change advised that to keep warming below dangerous levels, each human should be allocated an annual climate budget of 2,300 kg CO_2, with no more than 575 kg spent on travel (4). Therefore, according to these guidelines, a single conference trip would approach or exceed the recommended annual budget for yearly travel.

Recognizing the impact of air travel on climate change, several authors and environmental organizations have published recommendations to reduce the carbon impact of conference travel, which we selectively adapted here. In general, these recommendations can be grouped into three categories: *1*) fly less, *2*) fly more efficiently, and *3*) purchase carbon offsets (Table 1).

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Correspondence and requests for reprints should be addressed to Hari M. Shankar, M.D., Division of Pulmonary, Allergy and Critical Care, University of Pennsylvania, 3400 Spruce Street, 839 West Gates Building, Philadelphia, PA 19104. E-mail: hari.shankar@pennmedicine.upenn.edu.

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Table 1. Recommendations to reduce the carbon footprint of academic conferences

	Reduce Conference Waste	Fly Less	Fly More Efficiently	Purchase Carbon Offsets
Individual changes	Take public transportation to and from venue	Consider train or car travel	Take direct flights when possible	Purchase offsets when air travel is unavoidable
Organizational changes	Minimize signage, merchandise, and print materials Minimize meat and maximize plant-based food offerings Use sustainable suppliers	Increase use of teleconferencing technology Impose caps on academic carbon emissions	Host conferences in cities that minimize need for air travel	Offer or sponsor well-vetted offsets backed by international standards

Fly Less

Teleconferencing technology has improved to the point that it is feasible and possible to present research remotely, without needing to incur the financial and time costs of travel. Though remote meetings may never be able to fully substitute for the benefits of in-person meetings, the judicious use of such technology could pave the way for a more inclusive scientific community, fostering increased participation by students, trainees, and junior faculty on limited budgets or those with other time constraints. Teleconferencing would also allow increased international access to individuals with economic, political, or epidemiologic travel barriers, which is of particular relevance in the ongoing COVID-19 pandemic. Evidence suggests that smaller interactive workshops may be a more effective educational setting than large traditional conference lectures (5). Attending regionally located research or clinical workshops may also be an effective way to reduce emissions while maintaining the quality and frequency of scientific discourse (6).

Several authors have promulgated train or car travel to conferences as an alternative to aircraft when feasible. In general, data suggest that train travel may have only one-third the CO_2 footprint of air travel, though this varies based on the type of train, passenger load, and other factors (7). Automobile travel may also be more climate friendly, especially with carpooling, but may not always be feasible. Highlighting the benefits of regional transportation options on the conference website may encourage more participants to use this travel method and aid in reducing the conference's carbon footprint.

Ultimately, retaining high levels of scientific collaboration, quality, and productivity while remaining attentive to carbon neutrality will almost certainly involve reducing the total number of miles flown. This is only possible by way of a self-imposed cap on academic emissions. For instance, The International Society for Children's Health and the Environment recently committed to reducing its air travel by 20% (8). Other authors have recommended a commitment by academic institutions to reduce travel by 5% per year, similar to sectoral and national carbon cap schemes. A gradual but steady reduction in air travel may allow academia to steadily move toward a low-carbon future without restraining scientific progress (9).

Fly More Efficiently

When flying to a conference is the only practical means of transportation, the environmental impact of air travel may be partially mitigated by the specifics of the flight a passenger chooses. A study of air traffic data from the U.S. Department of Transportation found that per passenger, CO_2 emissions for the same departure and arrival cities varied fivefold for short-haul flights and twofold for medium or long-haul flights (10). These differences were driven by several factors, including aircraft fuel efficiency, the presence of connecting flights, and passenger load. For example, on long-haul flights, per-passenger CO_2 emissions are about three-times higher for business-class passengers and four-times higher for first-class passengers compared with those in economy class. The same study found that for the same departure and destination cities, the vast majority of nonstop flights show reduced CO_2 emissions compared with itineraries with connecting flights because of the shorter flight distance as well as reduced fuel consumption from the energy-intense landing and takeoff cycles that occur with stopovers (11). This difference was especially apparent in shorter-haul flights, in which CO_2 emissions per passenger differed by as much as twofold between nonstop and connecting flights.

Such data argue that holding the annual meeting in cities more centrally located that serve as major airline hubs may help to decrease the ATS conference's carbon footprint. In 2007, Callister and Griffiths estimated the aggregate CO_2 cost of attending that year's ATS conference in San Diego to be almost 10,800 tons. In comparison, analogous data for prior host cities included the following: Toronto, 7,813 tons; Atlanta, 8,349 tons; and Orlando, 8,976 tons. These numbers reflect a 38% difference in emissions between San Diego and Toronto, suggesting that careful choice of host cities, taking into consideration the geographic distribution of attendees, might help to make the conference more "climate-smart" (12).

Purchase Carbon Offsets

Carbon offsets offer a means of mitigating the environmental impact of one's own greenhouse gas emissions (such as from air travel) by investing in projects around the world that reduce the emissions of greenhouse gases that would otherwise not have happened without purchase of the offset. The funds from a carbon offset might, for example, support a project that generates wind power, captures methane gas from a landfill, or protects a forest from logging. Though carbon offsets are not without controversy (13), international standards have been created to verify that carbon offset projects are tangible and well run and that the purchase of a carbon offset actually reduces greenhouse gas emissions (14). Carbon offsets are gaining increasing acceptance even in the airline industry. The airline JetBlue recently announced its plans to become carbon-neutral on all domestic flights by investing in forest conservation, landfill gas capture, and renewal projects; other airlines including Delta, KLM, and Virgin Atlantic also have similar programs that allow consumers the option to purchase offsets (15). However, the scientific community has been slow to engage in such efforts. A 2017 review of the sustainability efforts of 116 international scientific and academic conferences discovered that only 9% advertised any effort that aimed to reduce the conference's carbon footprint, and only 4% offered carbon offsets (16). Recognizing that air travel accounts for the majority of CO_2 emissions generated by the ATS annual conference, the ATS had offered attendees the option to purchase carbon offsets to mitigate their carbon footprint during travel to the 2020 conference (17). Prior to the cancellation, 6,112 individuals had registered to attend the conference, of whom 824 (13.4%) had elected to purchase carbon offsets. This number provides a benchmark to challenge future ATS conference attendees to increase carbon offset participation and even to stimulate friendly competition among other medical societies to increase rates of participation.

Other Sources of Waste at Conferences

Several additional factors specific to the execution of conferences contribute to the carbon footprint. Print materials, merchandise, and signage contribute to a significant amount of solid waste destined for local landfills. The type of food served at the conference also plays a role. It is well established that meat production is extremely carbon intensive, and the Intergovernmental Panel on Climate Change has stated that decreasing meat consumption and promoting responsible agriculture are central pillars of the strategy against climate change (18). The practices of local hotels, such as energy consumption, water use, and use of disposable and single-use products, are also likely to play a role in each attendee's carbon emissions.

Conference organizers are in a unique position to insist that conference vendors and venues are less carbon intensive. For instance, event destinations can be chosen with sustainability in mind, taking into consideration distance from airports and public transportation, accessibility, and energy use at the venue. Local transit options around the conference undoubtedly influence how attendees reach the conference, including their use (or lack thereof) of carpools and public transportation. Planners can promote sustainable transportation such as car-shares and shuttles and provide incentives for public transportation (19). Conferences can work with venue staff and exhibitors to employ reusable signage and renewable materials and minimize print materials while ensuring that lanyards, nametags, and other conference materials are recycled or reused appropriately (19). They can limit the amount of merchandise or "swag" offered to attendees. Sustainable catering is key to reducing carbon emissions and waste. For example, conference food could showcase local, fresh, plant-based food, using compostable or reusable serviceware.

Importantly, conferences can influence venue behavior by promoting the ongoing use of sustainable suppliers, changing local culture around sustainability and waste, and setting expectations for future events (9, 19). Conference organizers can promote a legacy of sustainability and decrease conference waste by setting expectations for venues and suppliers, maintaining clear specifications for supplier management, and providing feedback to unsuccessful bidders to change behavior.

Conclusions

The ATS is a professional society dedicated to lung health. In this era of climate crisis, patients with lung disease are suffering from combustion-related air pollution, heat waves, wildfires, and other consequences of climate change. It is time for the ATS and other healthcare professional societies to take an active role in mitigating our own carbon footprints. The benefits of in-person scientific meetings are substantial. However, much can be done to reduce a professional society's contribution to the climate crisis while still maintaining scientific discourse and interaction. We have laid out a few options here, focusing on annual conferences given the high carbon impact of these events and the opportunity to inspire broader change. These measures are not the final answer but rather a first step toward more climate-smart academic conferences. Indeed, the ongoing COVID-19 pandemic has illustrated the great need for flexibility and creativity in conference planning. Climate-friendly conference practices such as videoconferencing have already proven their usefulness: virtual options are being planned in lieu of the now-canceled ATS conference and should have a greater role to play in the planning of future conferences. Although COVID-19 has uniquely exposed our vulnerability as a society, viral pandemics are hardly the only threat we face. Our adaptations to this crisis should undoubtedly influence and strengthen our responses to future shocks driven by the manifold effects of climate change. Just as self-quarantine and social distancing have been adopted as shared societal responsibilities to slow the spread of COVID-19, the looming challenges of climate change offer analogous opportunities to align our efforts as scientists and healthcare providers with the broader movements to reduce our civilization's climate footprint, with full awareness of the grim consequences that lie in store for our patients and communities if we do not. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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