How Can Individuals and the GI Community Reduce Climate Change?

Climate change is here; in fact, many refer to our current era as the "climate crisis."[1] It is an existential challenge that will affect our lives, our children, and the lives of our patients unless it is tackled urgently and decisively. The crisis is owing to increasing amounts of CO_2 and other greenhouse gasses (GHG) in the atmosphere, primarily owing to the burning of fossil and biofuels. The extra GHG leads to retention of energy that would otherwise be radiated out to space. This leads to higher air and water temperatures, melting of polar ice and glaciers, drought in parts of the world, and food shortage owing to the higher temperature and drought.[2] Increased water temperature leads to heavier precipitation and to more devastating hurricanes. You have only to turn to the News to be aware this is happening in the United States and worldwide. In this commentary, we highlight the important challenge of climate change and why we need to act now in our personal and professional lives as gastroenterologists and gastrointestinal scientists.

We who live in one of the world's richest countries produce much more GHG annually than most people. Because CO_2 accounts for 85% of the GHG total, other GHG, primarily methane, nitrous oxide, and hydrofluorocarbons, which have differing potencies and half-lives, are often quantitated as CO_2 equivalents. The total CO_2 equivalent produced by a person, an institution, or an object such as a pair of Nike running shoes is referred to as a "carbon footprint." The average US CO_2 production, calculated from national production divided by population, is 17.5 metric tons per person per year. Only Saudi Arabia, Persian Gulf countries, and Australia are similar to or exceed the United States. European countries and Japan generate 10 tons per person, whereas developing countries including China, Turkey, and Brazil are at approximately 5 tons and the under-resourced countries (Asia/Africa) are <2 tons per person. Because of its large population, China emits the most total GHG followed by the United States. India is another country with a large population and developing energy system that will soon join China and the United States in the top group.

Before we discuss how this will affect the practice of gastroenterology and what gastroenterologists can do, we need to consider what goes into our carbon footprint (Table 1) and makes the United States one of the world's largest producers of GHG.

For most individuals, transportation is a major component.[3] The average US auto in 2017 was driven 13,000 miles, at 25 miles per gallon (mpg), which produces 6 tons of CO_2. Small hybrid vehicles now average 50 mpg and large SUVs or pickup trucks average <20 mpg. The net effect on GHG production is affected, predictably, by how many individuals travel per vehicle, but 85% of trips to and from work are single occupancy. Walking, bicycles, and efficient public transportation greatly reduces the transportation footprint, but this factor depends on the distance from work and the availability of important adjuncts such as bike lanes and efficient public transportation. We are now entering a period where the use of electric vehicles (EV) has increased as more recharging stations are built. EV

Table 1. Components of a Carbon Footprint

Individual or Family	Business or Hospital
Electricity	Electricity
Heating and Cooling	Heating and cooling
Personal transportation	Transportation
Long-distance travel	Equipment and Supplies
Food	
Consumer Goods	

are more efficient than gas and have lower upkeep costs, but the GHG production depends on the source of electricity used for charging. Coal plants generate the most CO_2 per kilowatt-hour along with other pollutants; natural gas is intermediate, and wind, solar, hydropower, and nuclear operate carbon free.

Air transportation for business, tourism, and visiting family contribute significantly to our carbon footprint. Planes use jet fuel, which is not that much different from gasoline, but the carbon footprint is nonlinearly related to distance traveled as ascent and descent use more fuel and extra factors termed "forcing" exist when water and other molecules are injected into the stratosphere. Furthermore, there are efficiency differences between plane models, and occupancy is a factor though most flights nowadays are at or close to capacity. For one of us (JAW) who calculates his yearly carbon footprint, air travel is the largest component accounting for 7.7 tons of the total of 20.8 CO_2 equivalents (Figure 1).

Other components include food and manufactured or consumer goods, with beef and lamb contributing a large footprint for foods owing to methane production by ruminal bacterial fermentation. A plant-based diet, including some chicken and fish, is healthier and has a lower carbon footprint than the typical American diet, which generates 3 tons of CO_2 annually (17%–25% of the US total). A big problem for food is waste. For personal consumption of consumer goods, the mantra of "reduce, reuse, and recycle" is very valid.

Everyone's carbon footprint is different and depends in part on the dwelling size, mode of personal transportation, and lifestyle. We can all reduce the 6 components (Table 1); for some, the easiest component to decrease will be the auto for personal transportation, electricity by switching to green power, and air travel. There are a number of online carbon footprint calculators, but some do not include all components. Among them are CoolClimate Network

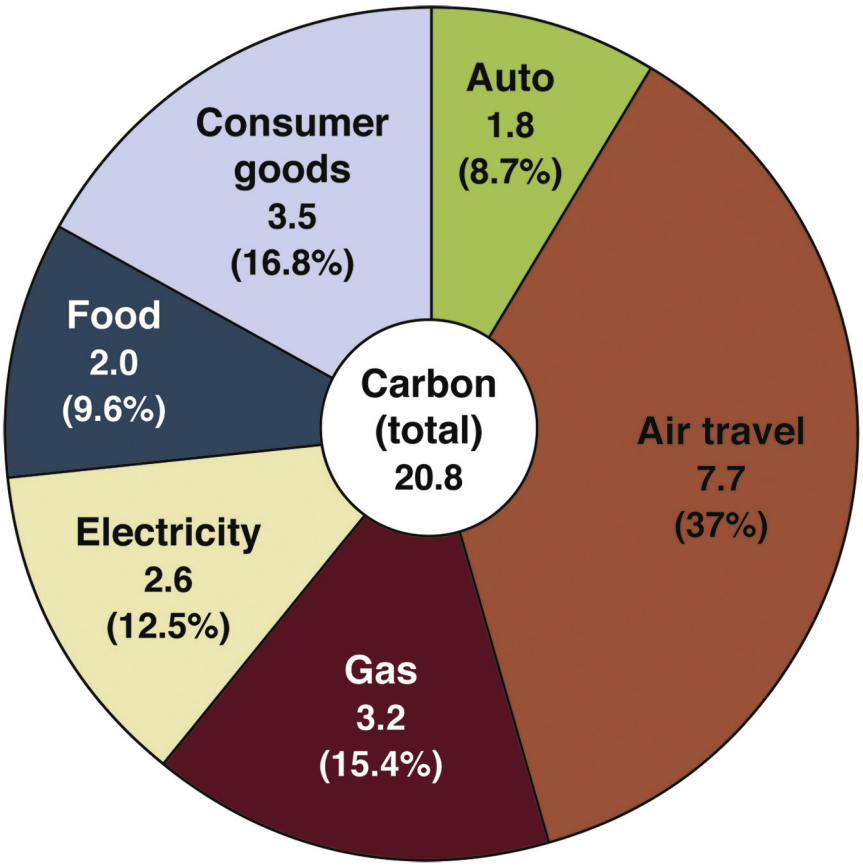

Figure 1. Carbon footprint of an academic GI scientist in metric tons of CO_2 equivalents. The individual, whose 2018 carbon footprint is summarized, lives with his partner in the northern United States in a duplex condo of 2500 square feet. Natural gas is used for heating, so the footprint amounts for gas and electricity shown are half of the total used and calculated from the ccf (100 cubic feet) of gas and kilowatt-hours of electricity per year and the source of energy used by the power company to generate electricity. They own an EV, which both use for local transportation, so the auto component computed from gallons of gasoline used is much lower than average. They have been working to decrease their footprint for several years, and their diet includes limited red meat. Their footprint for food and consumer goods is based on national averages. One-half of their total use is shown in the diagram to provide the estimate for a single user. Note that the average for this individual (20.8 tons/year) is higher than the US average of 17.5 metric tons per person per year, primarily because of his travel, although his carbon footprint 3 years ago, which has been reduced by carrying out some of the proposed measures, was 27 tons per year. Numbers in the carbon footprint were calculated using a worksheet developed by the authors and present in Supplementary Material.

(wwwcoolclimate.berkeley.edu/calculator) and the US Environmental Protection Agency (www3.epa.gov/carbon-footprint-calculator/).

The Global Response to Climate Change

Warnings of the effect of climate change on the planet date from the 1980s. The first international effort to deal with climate change was the 1992 Earth Summit, held in Rio de Janeiro, and signed by 197 countries. This established the United Nations Framework Convention on Climate Change, that was extended in Kyoto in 1997, but the Kyoto Protocol was not signed by the United States or the developing countries. After a failed attempt in Copenhagen in 2009, the first meaningful agreement was reached in a historic meeting in Paris in 2015, with all nations agreeing to reduce their GHG emissions. The target was set to hold global warming to 2°C and if possible 1.5°C. Presently, 184 countries have joined the Paris accord, but President Trump has signaled that the US will withdraw in 2020. To meet the Paris goals, the developed countries will have to decrease their carbon footprint by 50% by 2030. The other major international organization is the Intergovernmental Panel on Climate Change (IPCC), which was established to provide a comprehensive assessment and an objective source of information. Its 5th assessment released in 2013 concluded that climate change is real and primarily caused by human activity. In 2018, a special report by Intergovernmental Panel on Climate Change highlighted the major effects of a 2°C increase in global temperature on our planet by 2050 and 2100.[4] They estimate that limiting the rise to 1.5°C allows a more sustainable society. Although the Paris accord is a major step forward, multiple analysts have indicated that if all countries meet their 50% target, the overall goal of the accord would still not be met. Moreover, the global temperature has already increased by 1.0°C since 1950. Importantly, small temperature changes have big effects owing to positive feedback cycles, and an increase of 6°C–8°C would make most of our planet uninhabitable, along with the loss of most coastal cities.

The Response to Climate Change in the United States

Climate change is an existential challenge and requires governments to take action. Governments can institute various forms of carbon taxes and regulations such as standards for mpg in autos. In many parts of the world, including Europe and Canada, carbon taxes have been established, but at a minor level. Some states such as California and Washington have brought forward plans, but they have not been realized. An often-stated maxim is that we have the technology but not the political will.[5] The US government has set increasing standards for fuel efficiency and provided tax incentives for development of wind and solar power and the adoption of EV. However, the standards can change with politics, and the United States has always provided even larger tax subsidies to extract more fossil fuels. A major force that

supports alternative energy is that the cost of wind and solar power is now as low or lower than for fossil fuels. The primary movement away from fossil fuels is currently centered in the states and cities. Many of these have developed climate action plans and have committed to adhere to the standards of the Paris climate accord. The driving force for change is centered in nongovernmental organization with support from native Americans and religious bodies. Some companies are also at the forefront realizing that climate change will affect their business model.

How Can Individuals Respond to Climate Change?

In the recent past, a relatively easy and actionable response that came to mind was recycling. This helps to avoid pollution, landfill use, and in some cases decreases the need for primary materials such as metals and plastic. Some individuals have taken mpg numbers into account when buying a car, and have purchased energy star appliances or reset their home thermostats to conserve energy. These efforts are all important, but few alone will make a measurable effect on global warming. The first step is to educate ourselves on how we use energy and determine what each of us can do that will have the greatest effect. Although some changes may become government mandated, we will need to take proactive measures on our own. By doing so, we will be able to answer our young children and grandchildren who ask, "What did you do to help save the planet?" To meet the Paris Climate Accord, our goal should be to reduce our individual carbon footprint by 50%, and it is important not to overlook energy conservation as the first step. Often, local utility companies provide a free energy audit and recommend relatively simple but often ignored measures such as blocking air leaks, installing more insulation, ceiling fans, and using programmable thermostats that can be controlled by cell phones. One can also switch all incandescent or halogen home bulbs to LEDs that are much more efficient (and save on the monthly electric bill!).

Another major change is to consider securing home electricity from clean, renewable power; for some, this likely means adding home solar panels. For others, it may mean signing up for green power from the power company or going to an outside provider such as Arcadia Power to obtain wind power through the use of Renewable Energy Certificates. This step may mean paying a few more cents per kilowatt-hour, but it also sends a message to the power company to develop more renewable power, and cuts the electricity footprint to near zero. Another measure is to decrease the use of gas for home and water heating, and possibly clothes drying. When the furnace needs replacing, a heat pump that is more efficient than fossil fuels and runs on electricity might be considered. The most effective are geothermal and use the relative constant temperature of the earth. New models will work in high and low temperature zones and may provide rebates. An ultimate goal by 2050 is to eliminate using fossil fuels for home and water heating. This is being mandated for new construction now in some cities.

An additional measure is to decrease the use of fossil fuel for transportation and in other areas such as lawn care; the goal here can also be set initially at 50% reduction. This may mean more walking, biking, or using public transit when possible, or investing in a high mileage hybrid or EV. The question often asked is, "Won't I use more energy to manufacture my new car?" The answer is no; the manufacturing footprint is low compared with that of use. It is usually more of a question of cost to afford a new vehicle and some may need to consider a low mileage used car or leasing. Doubling one's mpg provides obvious significant savings on fuel, while helping save our planet. If you are a 2-car family, try to use a high mileage car for around town, which could be an EV or plug-in hybrid that can be recharged in your garage. Mileage costs are less for electricity compared to gasoline. At this point, a regular hybrid is more practical for long distance driving, although the number of highway charging stations is increasing rapidly. We also cannot forget other gas-powered tools such as lawnmowers and trimmers, which are now available with rechargeable battery packs.

A major portion of the carbon footprint for many higher-income individuals is air travel. We all have to make personal decisions on how much we travel. For intermediate-range trips from 100 to 400 miles we can consider the mode of transportation and use trains, or a high mileage auto for >1 person. In general, the ease of air travel has decreased, although for long distance travel there is no real substitute. Simple measures such as flying nonstop help, even if it costs a bit more, because extra fuel is used in ascending and descending. One may also wish to consider contributing to a carbon offset fund to cover the costs of mitigating the travel carbon cost, which for a transcontinental US roundtrip have been estimated to be $50. Another area in our footprint is food as highlighted elsewhere in this Commentary. As far as consumer goods (personal hygiene products, electronics, sporting goods, books, etc), buy what is necessary, but try to buy less stuff. Also, visiting a thrift shop can provide amazing goods that also save money and help the planet.

How Can Gastroenterologists Reduce Their Professional Life Footprint?

Several considerations have highlighted health, climate, and energy footprints.[6,7] As a community, gastroenterologists can contribute to mitigating climate change by raising the awareness of the carbon footprint concept among colleagues, staff, and patients by making every effort to reduce the carbon footprint in offices, clinics, and endoscopic practices by

considering the 4 components in Table 1. Creating a work environment and clinic space emphasizing energy conservation and adopting renewable power sources in common areas such as parking lots, waiting areas, and breakrooms will certainly lead to conversations about climate change with staff and patients, which they may bring to their homes and communities.

Starting with the workplace and clinics, visual cues including solar panels or EV charging stations in the parking lot and energy conservation measures such as reminders to switch off bathroom lights and installing motion sensors will be noticed and create opportunities to start a conversation about how our carbon footprint impacts climate change and what are some ways to improve energy efficiency (ie, treat your office as your home). Consider placing compost bins in the breakroom for food as well as recycling and placing signs to educate staff and patients on other ways to reduce climate change such as (1) getting away from grass lawns and overwatering; use native plants that do not need as much water, (2) resetting the thermostats to a broader range as most offices and clinics are overcooled in summer and overheated in winter, and (3) considering the carbon footprint in choosing how to obtain CME credits by attending more regional and fewer national meetings. It is also important to have a plan to respond to climate disasters.

In the clinic, depending on the practice setting,[8] one example to improve the carbon footprint is to embrace video visits for established patients. As an example at the University of Michigan Health System, a significant number of our patients travel several hours for their routine visits. Billable video visits are available for established patients who reside within the state, and patient experiences with such visits have been well-received, not only from the care delivery perspective, but also as time and financial savers. As for endoscopy procedures, minimizing the number of incomplete procedures owing to poor preps decreases unnecessary travel and patient discomfort and avoids the extra energy to clean the procedure room and endoscopic equipment.

The practice models of gastroenterology have evolved significantly owing to health care reform, regulatory and reimbursement pressures. Therefore, measures for gastroenterologists to decrease their carbon footprint depend on their work setting, be it an academic medical center, a large (or small) single practice or multipractice group, or sizable multistate practices.[8] Large groups can make a greater impact if they incorporate, as a part of their mission and strategic plan, undertaking effective measures (some highlighted herein) to reduce their work place carbon footprint contribution. For example, each practice, small or large, can estimate with relative ease its carbon footprint and make specific annual reduction plans and develop 5-year goals that they monitor annually. The time is also ripe for professional GI (and other medical) organizations to consider and provide specific effective recommendations that can be implemented broadly or that pertain to specific (sub)specialties or even specific practice models. Indeed, established professional organizations can play important leadership roles and have the bandwidth to take on such an effort. They can develop the equivalent of climate fitness devices (ie, climate fitness recommendations) that can be broadly used, albeit implementation of any recommendation has its own challenges. Our pitch is also an urging of individuals (as part of their home, personal and professional lifestyles) and groups that comprise the GI community at large, to singly and collectively decrease the detrimental effects of climate change and perhaps lead the way with other medical and surgical specialties in this ever-so-important and time-sensitive effort.

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Supplementary Material

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Conflicts of interest
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