nothing? The whole situation is a minefield, and one that is far better never ventured into. Almost certainly, it would be at least as difficult – if not more so – to achieve international consensus on a geoengineering plan as on an accord to slash greenhouse gas emissions in line with the science. Why then waste time, energy and money on something that does no more than address one of the symptoms of the climate crisis?

And, notwithstanding the associated risks and dangers, there are other reasons for kicking geoengineering into the long grass. It is often touted by its supporters as a 'Plan B', to be dusted off if and when Plan A (cutting emissions at a rate that circumvents catastrophic climate change) looks like failing. The problem with a Plan B, however, is that Plan A is no longer regarded as a last resort. In other words, the very existence of Plan B, detracts from the urgency with which Plan A needs to be enacted. If governments feel that a techno-fix is waiting in the wings, they are less likely to support those measures needed to slash emissions as the science demands, and more likely to champion net zero targets that are further in the future and require less effort or change to attain.

Reading Bill Gates's recent interventions on the climate crisis, it becomes apparent that what he means by 'avoiding a climate disaster' is knocking that pesky global heating on the head so that capitalism can keep moving forward in the fast lane – and so that, for example, he can keep criss-crossing the planet in his private jet. This is also how many of its supporters and advocates – not least the fossil fuel corporations – see geoengineering. Whether true or not, it seems to them to offer an opportunity to 'solve' the climate crisis without the wholesale reorganisation of society and economy that a rapid transition to a zero-carbon world would require. The bottom line, however, is that our planet is simply too small, too exploited and too damaged, to survive continued business as usual. So, if we want to save our world, and the people of it, we cannot afford to open the can of worms that is geoengineering. Instead of following what some like to think of as the easy road of the techno-fix, we must take the route that sees greenhouse gas emissions slashed and net zero carbon achieved, as soon as possible, not – as John F Kennedy said of the Moon landing programme – because it is easy, but because it is hard. And because it will change everything about our world for the better.

Bill McGuire is a Patron of SGR and Professor Emeritus of Geophysical and Climate Hazards at University College London. His new novel, Skyseed *– an eco-thriller about geoengineering gone wrong – is published by The Book Guild.*

The potential for rapid transition of the aviation industry after COVID-19

In an edited version of **Dr Lucy Gilliam**'s presentation to SGR's Responsible Science conference, she looks at the steps that need to be taken to prevent a resurgence of the aviation sector as we emerge from the pandemic.

Our current crisis presents an opportunity for rapid transition of the aviation industry in two different ways. One is through attaching conditions to bailouts, because the aviation industry is holding out its hand due to the financial crisis it faces. The other way is by mobilising people in institutions and corporations to make lasting changes to travel policy, which fits in very well with the pledge people make in SGR's Science Oath for Climate (see p.2).

Pre-2020, aviation growth was very high. In the EU, annual growth stood at around 5.9%, with a 26.3% increase over 5 years. Whereas other sectors within the European Emissions Trading Scheme (ETS) have been cutting their carbon, aviation has been on a very steep upward curve. Globally, the annual carbon emissions of international aviation are already about 70% higher than 2005.

≫

The aviation sector can be decarbonised, but it will require huge investment. The main way that it is possible to decarbonise aviation is through the scaling up of, and switching to, renewable fuels. New aircraft designs have a role, but they will take a fairly long time to have any impact on emissions. Meanwhile, alternative synthetic fuels will require huge amounts of renewable energy. So, the challenge of decarbonising aviation becomes much greater if the sector is allowed to continue to grow at pre-2020 rates. Also, the non-CO_2 impacts that planes have, such as aviation contrails, are not easily solved even with synthetic renewable fuels. For these reasons, we need additional measures to curb demand.

In the past, aviation growth has been the result of cheap tickets, indirect subsidies to the sector, and aggressive marketing campaigns that have all enabled flight prices to fall significantly compared to their levels 20 years ago.

Due to the pandemic, the airline industry is facing the worst crisis in its short history. Aviation has been seeking government bailouts from the public purse, and this is despite the fact that the industry has avoided contributing to that purse through tax exemptions.

Over €33 billion has been given in aid to airlines in Europe (at the time of writing) and they are looking for further bailouts. To put that into perspective, the industry also avoids charges of around €24 billion per year, just in untaxed kerosene alone. So, it is a critical time for the aviation industry when key decisions can be made about the structure and the financing of the sector. This will have consequences for the coming decades. In addition, in the next 30 years we need to tackle the climate crisis, and we've got to think about how we are going transition the sector to zero emissions in line with the Paris Agreement. We also have to think about a just and fair transition for workers. Currently, there is very real suffering for workers in the aviation industry with 5.6 million jobs lost in Europe in aviation in relation to COVID-19 alone.

We need to be sensitive when talking about the need for long-term reductions in the aviation industry, and to have realistic solutions for how we can manage the transition fairly. It's important to think about what limits should be placed on the size of the sector, given the difficulties of scaling up technological improvements, within the timeframes to meet the climate goals. If we don't have these conversations right now, we'll see that things very quickly will revert back to business as usual, just as they have done following other recent crises.

Something else to consider, when talking about transition of the industry, is the question of who flies? Even in Europe, flying is not that 'normal'. In the UK, for example, the top 1% took one in five of all flights abroad. About half of the public don't fly at all in a given year, and on a global level we can see that ten percent of the global income spectrum is responsible for three quarters of flight emissions. So, when thinking about bailouts, it is really important to question whether we should continue to subsidise the rich so they can fly cheaply.

Another thing to consider is the huge shifts in working and travel patterns that we've seen during the COVID-19 crisis. Behaviours shifted very rapidly due to the uptake of online technologies for meetings. We've seen a 'Zoom boom' and the resistance that used to exist towards this technology before the pandemic has perhaps been overcome. Now, we can think about what we can do to embed these behaviour changes for the long term.

Talking to people about what they expect when they return to work after the COVID-19 crisis, you can see that there has been a shift in attitudes towards home working, recruitment and business travel. It is highly likely that travelling for work will not return to previous levels and I think finance departments might also be looking at some of the recent cost savings and thinking, "well, maybe we can keep these savings and not return to how staff travelled before".

Business travel does make up a substantial part of the carbon footprint of an organisation.

Work on the carbon footprints of research organisations reveals that that more than 50% of their carbon footprint is down to business travel. Half of those are EU trips so, even though they are a smaller portion of the emissions compared to long-haul flights, because they are within Europe they could be shifted to other modes of transport if, indeed, those journeys are needed at all.

An interesting aspect of tackling the business carbon footprint relates to premium seating business travel. This type of travel leads to higher emissions per person, and makes up about 20% of flights. Three-quarters of an airline's revenue comes from selling tickets for business purposes, and premium seating is the most lucrative part of this sector. If the behaviour of this market is shifted, it will disproportionately impact on the profitability of the business models of the whole aviation sector.

This could be the thin edge of a wedge that changes the industry, if we consider travel policies within our institutions. For example, guidance could be introduced saying that a train should be taken for journeys of less than a certain timeframe or distance, or questioning whether meetings really need to take place face-to-face, rather than using online conferencing.

2021 is the European Year of Rail, so there is going to be a lot of debate around improving intra-EU rail and I'm hoping this will lead to a shift in passengers from air to rail across the continent.

Stay Grounded is a global grassroots network working to reduce aviation, and it runs a campaign to make lasting change and embed new travel norms in business institutions and universities, and empowering student networks to push for change. It produces many resources, available on their website – https://stay-grounded.org/ – and has a nine-step plan for shifting travel policies in institutions for anyone wanting to become an activist within their organisation. One Stay Grounded campaign is called 'Save people, not planes'. It started in the immediate aftermath of the first lockdown, but I think it is still relevant.

Dr Lucy Gilliam is Aviation and Shipping Campaigner at Transport and Environment, a European NGO based in Brussels, https://www.transportenvironment.org/

For references, see Dr Gilliam's slide presentation on the SGR website at: https://www.sgr.org.uk/resources/what-potential-rapid-transition-aviation-industry-after-covid-19