

Improving Science Advice to Governments

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Executive Summary

We present suggestions for improvement of scientific advice to government, aiming to minimize risks of unintended consequences such as loss of life, cost, and ecological damage. Key improvements would be: maximizing diversity of advice including crowd-sourcing; rapid challenge to the advice through red teams and crowd-review; ensuring reasonable accountability of scientists to discourage hype; and protection of scientists from career damage if they rationally disagree with mainstream views. The precautionary principle needs to be balanced against the opportunity costs incurred by 'playing safe'. Institutions such as universities, scientific academies and journals should not take official positions on scientific issues since this stifles diversity of thought, freedom of speech and the reliability of advice.

As countries around the world review their response to the Covid-19 pandemic, one topic coming to the fore is the quality of scientific advice to governments. Among the issues already in play within the UK are (i) the gross misuse of computer models in the absence of robust data with which to calibrate them, and (ii) the paucity of challenge to the scientific advice from any of a scientific, economic or societal perspective. Both these issues may have contributed to death tolls, economic decline and societal ills. We take this opportunity to review the science advice to policy makers over recent decades to learn lessons and suggest improvements for the future, and especially in the context of climate change. Although this paper is UK centric, many of the lessons apply more widely.

Policy makers need ready access to the fullest possible range of defensible scientific advice. Advice that has the potential for very high impact should be challenged both by scientists independent of the initial advice, in a 'red team', and by lawyers. This would give science advisers fewer incentives to exaggerate for effect, and those scientists themselves should be held responsible for knowingly, or recklessly, hyping or omitting relevant opinion. Key challenges would be finding, incentivising and protecting fully independent scientists, rather than just adding another layer of government-controlled, politically-aligned filtration. Scepticism must be recovered as a respectful term for scientific behaviour from its present position as an insult, and reinstated as a core duty of universities and learned societies.

In what we describe here as non-consensus views, we are not including anything that is not backed by robust scientific practice – this is not a charter for the indefensible, but for exposing it. It is also important to acknowledge that politicians are elected to make decisions on the part of society, and advisers are not. If the delay between advice and action in the case of Covid countermeasures is attributable to political considerations, the scientists are not responsible for the delay and any consequences.

Recommended Measures for the Short Term:

Challenging the Advice to the UK Government

In the UK the Scientific Advice to Government in Emergencies (SAGE) process involves convening an *ad-hoc* committee of experts relevant to the particular emergency, and answering directly to the Prime Minister. In the case of foot and mouth (F&M) outbreaks in 2003 and 2007, this largely involved experts in animal health. For Covid the expertise was in viral infections, public health, psychology and vaccine development. There was little formal challenge to ideas produced and agreed by the SAGE Committee, although a few dissenting world experts (*e.g.* Professors Sunetra Gupta and Carl Heneghan) were invited to comment by the Prime Minister. That is not to say there was no internal debate, and there was evidently at least one highly experienced dissenting epidemiologist in SAGE (Professor Mark Woolhouse) but the basis on which the agreed advice was

arrived at was never transparent. If there had been the report of a 'red team' challenging the assumptions on which the SAGE Committee were operating, the public may have had more confidence in the actual scientific advice. There is no defence in saying that the Committee were under pressure from the Ministers to act quickly, as the 'red team' challenge could have taken place in parallel with the main existing process, with only hours to complete the 'red team' report. The Ministers and public should know the strength of the arguments of the Committee and the weaknesses of alternative courses of action, not just their agreed output. Looking back further, there was no 'red team' at the time of the F&M outbreak in 2003, and many in agriculture still think that far too many animals were slaughtered than required to bring that outbreak under control.

A further lack in the advice to Government was a formal process by which the advice was challenged equally robustly from an economic and societal perspective. It would seem that Ministers did not take serious input from experts on these other consequential considerations, and proceeded on a basis of beating the pandemic at all costs. We are still living through the economic and societal consequences of actions taken during the Covid pandemic, not least the repeated lockdowns of society. Unlike earlier flu epidemics, the incidence of serious Covid among school age children was very small, and school closures probably played little role in shortening the pandemic. The amount borrowed to tide the economy over the lockdown and the vast sums spent on medical equipment, and, in particular, personal protective equipment, now looks excessive with the advantage of hindsight. Sir Peter Gluckman FRS (previous chief scientific adviser to the New Zealand Government) points out that the emergency scientific committee reported to the head of the Civil Service in New Zealand, not a Minister or Prime Minister, and so the advice was challenged in the round in the normal way. Similarly, Sweden gave relatively more power to experts and pre-debated contingency plans.

A House of Lords Science and Technology Select Committee held an inquiry in 2020 on the Science of Covid-19. The submission by Sir Bernard Silverman FRS made strong arguments for a more formal protocol for SAGE, and included a need for clear challenge so that the robustness of arguments was publicly available. See committees.parliament.uk/writtenevidence/6460/pdf/

At present the UK has a Climate Change Committee (CCC) responsible to the Government for advice on both mitigating and adapting to future climate change. Again, this body has no 'red team' to challenge their many reports. One thing a 'red team' would have done is to insist on looking at the whole trajectory of the route to net-zero and try to estimate the financial, material, human resources, ecological and societal costs involved. Just to expand the electricity system (extra generation, transmission and distribution) to cope with the extra demands of electrified ground transport and both industrial and domestic heat is estimated at £1.4 trillion, with 40,000 professional engineers devoted to this project alone for 30 years from now until 2050 (<https://www.thegwpc.org/content/uploads/2022/03/Kelly-Net-Zero-Progress-Report.pdf>). There may be an error of as much as 50% in these estimates, but certainly not a factor of 10. The electrification of heat and transport is only one part of the net zero target. In spite of a decade of advice, this firm grip on the scale of the problems of getting to a net-zero economy by 2050 is not to be seen spelt out in any of the CCC advice. Indeed the competences of the committee members do not extend to these extra considerations.

A key issue with red teams is to keep them from being 'stacked' by biased individuals, including political favourites or corporate shills. However, it is often very rapidly apparent from online discussion of research that there are some highly experienced and competent scientists who are dissenting - with logical criticisms of the 'mainstream'. Indeed, these scientists can often be identified conveniently by the ferocity of online bullying and *ad hominem* attacks on their capacity and integrity by some of the enforcers of alleged 'consensus'. In the early days of Covid some powerful dissenting voices emerged on social media such as Twitter (now X), who despite being vilified and censored have proved correct.

Irresponsible Use of Modelling

In the late 1950s, President Eisenhower called in scientists in the early stages of the flu pandemic and asked them 'How bad could it get?'. They debated and replied to the President 'We don't know.' That should have been the appropriate answer for both the F&M and Covid calls. In the meantime computer models were

produced that, in the absence of any reliable data to calibrate them gave no further refinement to the 'don't know' answer. Modelers should give a detailed description of their assumptions and the sensitivity of their predictions to errors in these original assumptions. One does not need a computer model to say that the incidence of either pandemic would rise and then fall if countermeasures are employed. The models, and especially the quantitative predictions, come into their own only when robust calibration with real-world data is possible and when validated by successful predictions. It is not yet clear - and unfortunately may never be - why the UK Government's preferred Covid models were so wrong: it may be such models are intrinsically unreliable. Some key inputs, such as the Basic Reproduction Number (in a fully susceptible population), R_0 , may have been erroneous or changed rapidly. The then Government Chief Scientist, Sir Patrick Vallance, when speaking at the Fellows' Day of the Royal Academy of Engineering on 25 May 2023 was very clear that much of the early effort in future pandemics should be focussed on getting clear data on the evolving crisis. Indeed, this was his own main lesson to learn. 'We don't know' remains the scientifically correct advice when key parameters are unknown and the model outputs are highly sensitive to assumptions and errors.

Much of the Covid panic was generated by the high early estimate of the infection fatality rate, as very much larger number of people had been infected than was noticed at the time, and almost the only people who were tested were people who were so ill they went to hospital. There was also confusion between case fatality rate and infection fatality rate, and false hope given that some counter-measures could suppress or wipe out the disease.

Climate models have become a *cause celebre* in their own right. It is noticeable that the most recent report of the IPCC (AR6, 2022) does not rely strongly on climate models for climate prediction, and for good reason. They have been consistently running too hot by a factor of 2-3 in terms of their predicted temperature rise compared with emerging data over recent decades. This gap is not narrowing, as should be the case if the models are actually modelling the evolving climate. This gap is a major embarrassment that would not be tolerated in any other field of science, and certainly not in engineering. If our knowledge of fuel burn in aeroplanes were as faulty as the climate models, we would place enough fuel to get to New York but find ourselves running out over Iceland. Separation of human-induced warming from the natural temperature rise from the Little Ice Age is far more difficult than that portrayed by IPCC, since experimentation and replication is simply not possible. So why are the models not taken out of the public discourse until they are fit for purpose? That would be the correct thing to do in the context of proper science. The inability to model clouds or the biota and the need to subjectively 'tune' the models to get consistency with observations are both fatal flaws in any system that is supposed to be predicting future climate change.

Furthermore, many of the predictions of climate induced species extinctions depend on the contested 'species-area' and 'climate envelope' models in which the area of habitat loss has been predicted by unvalidated climate models. The risk of error in such a complex system should be self-evident, as should the potential for climate change to reduce extinction rates, but IPCC is not tasked with finding possible good news on extinctions - nor on crop yields or human health. Expansion of warm zones in North America or Eurasia could help build populations of some species, enhance crop yields and reduce human deaths in winter.

In summary, models in any field are not as good as experimentation or direct observation. Models are not factual evidence, but this has not stopped claims that the models are more reliable than real-world observations in the case of future climates. Indeed, there is disturbing evidence the historical climate observations are being adjusted to fit the models, one hopes out of confirmation bias rather than political bias. This turns the basic assumptions of Baconian science on their head.

The Corruption of the Science of Public Bodies.

The United Nations, the IPCC (The Intergovernmental Panel on Climate Change) and IPBES (The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) and the World Health Organisation are by construction inherently political bodies, who offer scientific reports under their aegis. There are many recorded instances where dissenting voices have been overlooked, ignored or silenced. Conscientious scientists have dissociated themselves from the processes used for political massaging of the

messages (particularly egregious in the case of the IPCC's 'Summary for Policy Makers'). The lack of transparency of the WHO's expert investigation into the source of the outbreak in China of the Covid pandemic greatly weakens the authority of that organisation and undoes the credibility of any science that it sponsors or chooses to use. There is no evidence of 'red team' action as an integral part of their processes.

On a smaller scale public bodies such as Natural England have produced reports and policies which show little evidence of expert challenge. Where, for example, was the debate on bison 'reintroduction' to England or other 'rewilding' targets?

The Academies and Professional Scientific Bodies have taken unscientific stands.

In 2014, Dr Steven Koonin was asked by the American Institute of Physics to prepare a position paper on climate change. He convened a meeting with three climate scientists who were worried about the future and three who were not so worried. The transcript of that day represents the last known example of any major debate on the merits of the claims and counterclaims of what the future climate might look like. [See [140108001.SGNGL \(aps.org\)](https://www.aps.org/publications/apsorg/publication_author.asp?pubid=140108001)]. What was sobering was the frank and honest admission by all participants of the known unknowns and the lack of convergence of the scientific predictions about future climate change even after the then 60 years of modelling. Since the recent publication of his own book 'Unsettled: What Climate Science Tells Us, What It Doesn't, and Why It Matters', Koonin has become *persona non grata* in many academies and professional bodies with which he had previous associations.

A review of the outputs of the Royal Society, the Royal Academy of Engineering, the UK Meteorological Office, the Institute of Physics, the American Association for the Advancement for Science and the various engineering professional bodies show a worrying lack of challenge to the prevailing alleged 'consensus'. If this state of affairs had applied in medicine, we would still believe the consensus that stomach ulcers are caused mainly by stress. There has simply been no attempt to do a root and branch review of climate science as a service to the world when so much is at stake, economically and ecologically. In all the branches of science we are familiar with, progress is rarely linear, but one seldom hears any report from the academies which concludes that the future climate may not be as bad as the prevailing predictions. Humans, their crops and other species have thrived in warm periods of the early Holocene, the Roman Warm Period and the Medieval Warm Period. The species-rich tropical regions are relatively stable in temperature historically (and in model predictions), and thus are very unlikely to witness climate-related extinctions. There is evidence of warmer periods in the Holocene when coral atolls such as the Maldives were being formed underwater up to about 4000 years ago. Moreover, the temperate regions evidently become less habitable for most life in cooler periods and ice ages. This bias against 'beneficial scenarios' strongly suggests a pervasive form of censorship. There are many reports, and even personal experience of this censorship, with journals such as *Nature* and *Science*, and even the preprint server arXiv, commonly perceived to have policy not to challenge climate change orthodoxy.

One of us (MJK) has been trying to get some realism into the policy statements of the Royal Society and Royal Academy of Engineering for a decade now. There is a book to be written about the twists and turns of both organisations to avoid speaking of the scale of the real challenge of CO₂ emission reductions first to 80% and now net-zero by 2050. Back-of-the-envelope, but realistic, analysis is available for the problems of climate change, not least from the late Professor Sir David Mackay FRS, but when that same analysis is taken further to describe the actual engineering projects needed to achieve net-zero, all debate is suppressed. This is in breach of the codes of conduct of those learned societies, which requires them to be 100% honest when they give advice, and especially so when the advice is to governments. Again in 2014, MJK and three others submitted a proposal to have a two-day discussion at the Royal Society on 'The Downsides of Decarbonising an Economy'. It was held up in the system of approvals for nearly three years where it was taken from the original proposers and given to others who turned it into a discussion on 'Technologies to Decarbonise an Economy' held in 2018. Unusually there was no publication of papers presented at the discussion, but a summary made by the new organisers who conveniently omitted any reference to the content of the two papers prepared by MJK and another of the original applicants, while material from all the other papers were mentioned.

There will need someday to be an inquiry into how so many scientific bodies abandoned core principles of scientific integrity, taking strong positions on unsettled science, taking people's word for things uncritically, and silencing those who tried to continue the scientific endeavour.

While writing this, MJK received an email of an on-line meeting on climate science described as "Join the National Academies on July 11 and 12 for a summit engaging experts, community stakeholders, and decision makers on equitable pathways to meet the climate crisis." As a search for the word "crisis" in IPCC AR6 confirms, there is simply no compelling science that allows the phrase 'climate crisis' or 'climate emergency' to be invoked. Yet such invocations are commonplace.

Universities have abandoned their historical role of open and disinterested enquiry on behalf of humanity.

In the current era where wokism and other left-of-centre political views have become almost universal in academia, despite powerful 'diversity' officers, we have universities abandoning the hither-to-fore rule of strict institutional neutrality on issues of the day, and instead taking political positions unrelated to their mission. They should be sanctioned for this by revoking their charitable status. Group-think that maintains prevailing fads, and suppression of dissent against alleged 'consensus', is the opposite of the central purpose of universities: claims of "consensus" should be a red flag to academics. Universities have suffered institutional capture, and dissent from this has been so suppressed by group-think they often do not realise it.

Internal policies influence academic and student recruitment, encourage self-censorship and stifle honest debate. We know colleagues who have survived attempts by activist 'scientists' to remove them from their posts. Worse, university environmental policies, for example, encourage or impose an official line in research and teaching, and perpetuate bias and cause stress and disadvantage to dissenting staff and students. The policies often go beyond what the national law requires, *e.g.* in setting internal net-zero dates and changing canteen diets to meat-free. It is time for the manifold and often undeclared potential conflicts of interest to be registered and investigated, such as grants from, and investments in, renewable energy companies - as is the norm with grants from fossil fuel companies. Many conflicts go selectively unnoticed or unchallenged, while other scientists are often falsely accused of conflicts of interest while working to improve the use of fossil fuels to reduce their actual consumption and environmental impact.

The former Vice Chancellor of Oxford University, Professor Sir Richard Southwood FRS, was of the strong opinion that there should be no 'official' position on climate change (or other matters of debate) in a university. Such leadership should be revived.

Cross-examine scientists and modellers where they will impact decisions of high consequence.

In matters of pandemics, climate change, mass extinctions, the geology of tsunamis and mega-volcanoes and other issues that have a great impact on risks such as financial collapse, the scientists and economists and the relevant modellers should be cross-examined about their findings and advice to separate out any partisan views (whether implicit held or explicitly stated). The scientists and other advisers should be encouraged to clarify and justify their assumptions, and to tease out the implications of remaining uncertainties. The results of sensitivity analyses of the effects of proposed policies should be brought into the open. Counterfactuals need to be explored. There should be clarity about what validation of models have been done, and what the results were. Independent statisticians should be consulted to verify that best practice has been used. Such cross-examination requires lawyers briefed by red teams and expecting the evasive answers scientists may give. This investigatory process should also make very clear the consequences if the advice should prove to be wrong in the hereafter.

Make scientists professionally, legally but proportionately liable for poor advice.

An engineer who signs off (say) the designs for a stadium roof, assumes legal liability if the advice proves wrong and the roof collapses. Professional indemnity insurance is mandatory to cover such decision makings. On both the Covid and climate change issues, scientists have given advice and made decisions that proved to

be wrong, and yet they are not in anyway held to account. Sometimes there are enquiries, as in the 'hockey stick saga', but no consequences.

If opinions can be easily shown to be false by either crowd-sourcing¹, other experts or by a red team, consequences should follow. The aim is to deter pushy activist scientists and others speaking beyond their relevant experience.

Holding scientists accountable is one of the most important, yet sensitive, of our proposals. Numerous commentators have highlighted this accountability deficit in relation to epidemiological advice and climate change. Of course, deterrence needs to be carefully crafted to be proportionate to prevent honest errors doing unwarranted harm. It is also very important not to have the counter-productive effect of stifling innovation, or of discouraging engagement with the public and policy.

Society should end the recent pattern of rewarding failure which has resulted in part from encouraging hype without accountability. Bullying and harassment of dissenting voices should also not go be unpunished, and it is vital not to enable vindictive claims against individual scientists or to create a climate of fear that also suppresses free speech.

We propose that there is a continuum of acceptable behaviours and appropriate sanctions. At the one end is a scientist making a few simple or honest mistakes. Some of these might be rectified by the established practice of enforcing published corrections or retraction of a paper or other document. However, if a pattern of mistakes develops that are not corrected despite crowd review, then a penalty might be to debate such an individual getting subsequent grants, promotions, honours, awards, prizes or other academic benefits. When there is repeated apparent bias despite contradictory evidence, then a sanction might include reduced emphasis on the research element of their employment. When there is unfair treatment of dissenting authors (such as using the same editor or peer reviewers who rejected a paper to handle an appeal against its rejection, as with 'Snailgate'²) there should be consequences of that journal, editor or individual.

When misconduct is involved, such as conspiracy to prevent publication (as alleged in 'Climategate'²), suppression of results or fraud, then the penalty could include fines or dismissal. Similarly, when scientists lie, and say one thing in a publication but appear to believe the opposite in private (as alleged with the origins of Covid) then the penalty might be financial liability or even imprisonment - depending on the societal consequences.

There may have to be some relaxation of this stricture when advising in an emergency, or where there are serious national security implications - but in such cases the rapid scrutiny by red teams of the advice must be exceptionally vigorous and robust.

In summary, it is important to allow neutral assessment without unreasonable penalties against any parties.

Curb the Over-use of the Precautionary Principle.

The precautionary principle, 'look before you leap' in common parlance, has morphed in recent decades into an instruction to do nothing for fear of what might happen in consequence. If this last meaning had been in place Christopher Columbus would not have discovered America. Modern usage of the principle contains a myriad of internal contradictions. Precautionary approaches to biodiversity (enshrined in international law) are often ignored in favour those for climate action. While oil and gas come to the earth's surface in pipes of order one metre in diameter, the replacement materials for car batteries, turbine nacelles, and solar panels, all

¹ The internet now allows for crowd sourcing for alternative opinions, as well as crowd review of specific publications and proposals. This need not exclude traditional review.

² Snailgate was the use of the same peer reviewers to handle an expert rebuttal of a claim of climate-induced extinction of a snail, which subsequently was 'rediscovered' (as the rebuttal had predicted). Climategate included scientists discussing having to "redefine what the peer-review literature is" to prevent contradictory publication.

involve open cast mining of many square kilometres with the top soil removed to start the mining; without question, this is a much greater threat to biodiversity than the mining for oil and gas.

Lord Lilley (private communication) points out in his experience there is a serious asymmetry facing a minister in responding to projected problems. If he or she takes an unnecessarily tough/costly approach and the problem does not materialise they can claim success, i.e. they prevented it. No-one can prove that they could have achieved that result at lower cost by doing less. By contrast if they take a less tough/costly approach than some are advocating, and the problem does occur, they will be blamed for not doing enough. So the incentives are always to overreact and act on the most pessimistic advice. Indeed, arguably that, up to a point, is that not just the politically optimum course but objectively the most rational for society? This may be another form of the precautionary principle, which Lord Nigel Lawson also noted has become counter-productive. Lord Lilley is not sure how/whether the odds could be made less asymmetrical. We suggest that revealing the enormous opportunity costs of precaution may be the antidote to the precautionary principle: for example, species extinctions that could definitely be avoided verses those possibly prevented. Professor Judith Curry discusses a more holistic approach to precaution in her book 'Climate Uncertainty and Risk'.

Confront the Media on False Scientific Coverage

The general means by which the population receives information on matters of scientific importance is through the media, mainstream and more recently social media. The financial reward structure of universities now encourages self-promotion through proactive media releases and 'Comms Officers' communicating hype to the public and politicians. In both the Covid pandemic and climate change reports there are many errors, or deceptions, or censorship blighting the complete story being told in an unbiased manner. Much error goes uncorrected and accepted in the repetition.

Even a specific explanatory programme, such as the BBC's 'Climate Change: the facts' contains clear errors of fact, in our view, on critical topics such as species extinction and coral bleaching. Any reasonable observer will wonder whether Ofcom is asleep at the wheel, not requiring the BBC to correct the errors it has been made aware of by experts nor return to some form of neutrality. If 'non-conformist' scientists try to engage with the 'public understanding of science' mafia, they are often ignored, censored or bullied. Censorship makes it hard for politicians, and the public, to be presented with the full diversity of scientific opinion. In the few cases where corrections are made to published scientific claims they are usually given rather less exposure than the original claims – they should get as much or more publicity to ensure that truth will out.

Protect All the Scientists

In trying to get the public discourse on science to have much greater integrity than at present, some action needs now to be taken to protect and reward the scientists, students and their institutions if they are being hounded by colleagues and the media for speaking out.

Early adoption of critical positions should be rewarded more than a scramble to confirm or enforce 'consensus'. Politicians may expect such treatment and abuse, although even now this is derided in Parliament as a threat to effective democracy - and concern expressed that abuse has often gone too far. There is no reason why a scientist expressing a tenable point of view on some scientific matter should be subject to the same abuse.

Scientists are wary, and fear for their jobs. There is no career incentive to go against many 'consensus' views at present. When MJK tried to publish a paper on 'Intrinsic Unmanufacturability at the Nanoscale' it took nine attempts, with all sorts of referees saying that the scientific arguments were 'just management speak', or that 'too many people are having fun with nanoscience to start pouring cold water over it', or 'physics is an intrinsically positive subject'. One would not put a thesis student on this subject for fear of encountering bigoted examiners: this should not be the case.

It is our opinion that there is much that is not scientifically rigorous about much of the climate science literature today, including the IPCC and IPBES reports, and the fact that the scientific leadership is not speaking out about this is an abdication of professional responsibility. Research grants therefore continue to flow to

those reinforcing 'consensus' or politically expedient views, rather than to challenging prevailing thinking - even if privately many scientists have their doubts. Politicians would be surprised at the diversity of views actually held by practising scientists in frontier fields; they should not be - as that is the intrinsic nature of science which becomes lore once experiments have repeatedly given consistent findings.

It would be salutary if the wider public were aware of the paper by Ioannides, entitled "Why most research findings are false" to jolt the presumption that any view expressed by a scientist is true. [Ioannidis, John P. A. (2005). "Why Most Published Research Findings Are False". PLOS Medicine. 2 (8): e124.]

Longer Term Improvements in Scientific Advice.

Eliminate Bias and Indoctrination in Scientific Education.

Lord Lilley asked Her Majesty's Government whether any peer-reviewed scientific studies or reports by the Intergovernmental Panel on Climate Change predict the extermination of the human race in the next century as a result of climate change. Lord Callanan, for the Government replied: "We are not aware of any peer-reviewed scientific studies that predict the end of the human race in the next century as a result of climate change. ... The evidence does not point to humanity going extinct because of climate change."

Yet there are numerous reports of young people saying they expect to die from climate change. In geological history the pre-Cambrian period, when there was flourishing flora and fauna, had temperatures approximately 5°C warmer than today and >1000ppm of carbon dioxide in the atmosphere. Greenhouses are often supplied with extra carbon dioxide and warmth to provide conditions more like the evolved optimum for many plant species. Over the last several thousand years global temperatures have been warmer than now, evidenced by higher sea levels. All along there have likely been many more deaths because of excessive cold than excessive heat.

We must ensure that education stresses the essential nature of the scientific process – the ongoing challenge of theories with evidence from experiments and observation. The scientific process cannot be centred on the results or simulations which are constrained by the prior assumptions within the relevant models.

The fact that net-zero is accepted as the official line in science and education is a travesty - its origin was never the result of a series of experiments, but rather the political agreements from international governmental conferences, catalysed by vociferous activist scientists. Students can be bullied, pilloried or poorly assessed if they challenge the accepted line. It is interesting to watch the surprise of students when they are exposed to alternative views and the evidence to support them.

Although both of us are physical scientists who perform controlled experiments, we think that many of the problems we describe are worse in the social sciences, both the strength of politically biased positions dictating scientific insights and the sanction against those who refuse to toe the line.

Reduce Group-Think in Academia

It is easy, and lazy to go with the flow on a day-to-day basis. It takes courage bordering on recklessness to set out to challenge the consensus. There has been a recognisable and systematic downgrading of challenge and sceptical review in academia over the last 40 years.

The stress in recent decades that research proposals should have societal and political impact has spilled over to make media headlines a measure of success. This routinely rewards the pushy and arrogant, with not enough emphasis on the provisional nature of most results at the frontiers of science. This is one of several areas where the funding agencies can incentivise good behaviour. The UK's Research Excellence Framework (used as a benchmarking exercise to distribute much future funding) has direct responsibility for the sharp increase in hyperbole.

Behind the cloak of anonymity, there are individuals and cabals gate-keeping access to the pages of the mainstream scientific literature. The 'Climategate' emails from the Climate Research Unit at the University of East Anglia made explicit reference to this practice to keep their critics out of the journals. To repeat, many very experienced scientists perceive journals such as *Nature* and *Science* to be very unwilling to publish

challenges to the current consensus view on man-made CO₂ being the ultimate source of our climate problems. In March of this year the Editor-in-Chief of Science tweeted using the term "deniers", one hopes in a personal capacity. Very recently, Dr Patrick Brown has generated discussion about how scientists can evade or exploit perceived editorial bias to get papers into high-ranking journals (although such bias to mainstream views is denied by the journal *Nature*). There is self-censorship in not submitting to such journals. Through such influences, lessons from the origins of Covid have been delayed by suppression of debate on a putative lab leak.

It is tragically apparent from cases in hospitals and universities that institutions will often act in the short term to protect themselves from 'reputational damage', even if this is hugely counter-productive in the long term once whistle-blowers finally break cover when the failings become too extreme to bear.

The fact that the UK Parliament has had to pass legislation to protect free speech in universities is the clearest evidence of just how far the underlying principles of academic integrity have been compromised. Bullying, harassment and more subtle coercion are rife. Terms such as 'climate denier' or 'climate criminal' are actually a form of hate speech intend to suppress free speech; bullies using them should be punished.

We are not the first to draw attention to issues around scientific integrity, as for example the clear paper by Marc A. Edwards and Siddhartha Roy entitled "Academic Research in the 21st Century: 'Maintaining Scientific Integrity in a Climate of Perverse Incentives and Hypercompetition'³. This is a comprehensive take on the pressures under which scientists operate today. Another highly relevant paper to this discussion is the warning from the USA about the politicisation of science by Cory Clarke entitled "Use It and Lose It: Exerting Scientific Authority for Political Ends Undermines Scientific Authority"⁴.

A real clean up is needed, and it will take a decade until new patterns of behaviour are embedded.

The Need to Reform the Scientific Advisor System to Include Challenge

The position of Chief Scientific Advisor within individual Government Departments is a mixed blessing. In a few such as health and defence they have been of some decades' standing but in most of the others the system has worked to thwart much of their impact - or give too much impact. Just as there has been a 'nudge unit' to help shape action to change personal behaviour as a part of policy interventions, a science unit mainly of outsiders on call should be able to assist these scientific advisors and ensure that their advice is really given due consideration - as evidenced by minutes of relevant meetings where the agreed findings have been challenged and found robust, and all the appropriate caveats are mentioned explicitly. It is no good the politicians saying they want clear and decisive advice upon which to act, as it is precisely the job of the politicians to decide using the breadth of scientific advice taken in conjunction with the relevant economic and societal inputs.

We find it very encouraging that several open-minded and influential politicians have already engaged with the process of improving scientific advice to government - including by encouraging our review.

Conclusions

The dependence on 'government scientific advisors' is really only about 50 years old. Further back the advice was informal based on friendships between individual politicians and scientists, *e.g.* Frederick Lindeman, Lord Cherwell and Winston Churchill in Britain before and during World War II.

³ Environmental Engineering Science Vol. 34, No. 1 Published Online: 1 Jan 2017
<https://doi.org/10.1089/ees.2016.022>

⁴ Forgas, J. P. (2024). The tribal mind: The psychology of collectivism. The 25th Sydney Symposium on Social Psychology. Routledge

With reference to a pandemic as a scientific emergency in real time, and climate change a possible emergency on a long timescale, there are many lessons to be learned to improve quality and impact of the scientific advice to Government. We have described some of these lessons.

We hope that the academies and universities internationally will take the lead in implementing our recommendations, in part to atone for their roles in bringing about the problems we have just described.

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Science Advice to Government: The cases of Covid-19 and Climate Change

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Both Covid and climate change have been described as “emergencies.” Emergencies are extraordinary. Thus, the very word “emergency” suggests not only that something, somehow must be done but also that the things to be done are extraordinary. Beware, therefore, when politicians, government experts, journalists, and university professors declare something to be an “emergency.” Such declarations are dangerous. They open the door to extraordinary policies that may well do more harm than good. The word “emergency” encourages us to be afraid, to turn to authorities for help, to set aside normal life, all while discouraging thought. But we should think before acting in new and extraordinary ways.

One might object that we should respect the experts crying “emergency” because they know better. They’re the experts! The problem is that experts are people, and people respond to incentives. That’s a problem because experts have an incentive to predict doom whether the “emergency” is real or imaginary. Consider the March 2022 Parliamentary testimony of Graham Medley, the head of SAGE’s modeling committee. “The position we have is that the worst thing for me as the chair of the Committee would be for the Government to say, ‘Why didn’t you tell us it could be that bad?’ You know? So, inevitably we were always going to have a worst case which is above reality.” Consider incentives Medley describes. The Prime Minister or the President of the United States comes to you for advice in an uncertain situation. Do you reassure them that all is well? Or do you predict doom and gloom if certain corrective actions are not taken? What if you predict doom and gloom and corrective actions are taken? If things go well, you saved the day. If things go badly, you say how much worse it would have been but for the corrective action you prescribed. You look good in either event. What if you are reassuring and don’t sound the alarm, but things go badly? You will be blamed and shamed for failing to understand the gravity of the situation. To avoid this risk, predict doom.

This tilt toward doomsterism was evident in the Covid crisis. In the US we had mask mandates, lockdowns, and vaccine requirements, all justified by the doom and gloom pronouncements of the experts. The state of California, for example, produced a television ad (<https://www.youtube.com/watch?v=qtVQsGKNNgw>) with a patient on a ventilator and the warning that “Even without symptoms, you can spread COVID-19. And people can die. People like your mom.” If you don’t do what we say, your mother will die, die, die. Such fear mongering is shameful. And it may induce us to substitute fear for rational reflection.

Unfortunately, the same fear mongering is practiced with climate change. President Biden, along with many others, has described climate changes as an “existential threat to the planet” (<https://www.whitehouse.gov/climate/>). The President has articulated several “groundbreaking goals” to address this threat including, “Reducing U.S. greenhouse gas emissions 50-52% below 2005 levels in 2030,” “Reaching 100% carbon pollution-free electricity by 2035,” and “Achieving a net-zero emissions economy by 2050.”

Such ambitious goals are dangerous and costly. To reduce carbon emissions so much so fast, for example, is probably impossible. The effort, however, would require a massive overhaul of the physical infrastructure of

industrial production, which would, in turn, require the scrapping of old equipment and techniques now deemed less than “green.” But that means abandoning productive equipment and, therefore, production. It means throwing away productive capacity. To quickly ditch enough old technology to cut emissions by half would make us poorer. It’s going backward, not forward.

A massive reduction in emissions by 2030 would also require limits on the mobility of the people, likely in the form of “15-minute cities,” such as that planned for the Astoria Queens neighborhood of New York (<https://elevatorworld.com/news/daily-news/15-minute-city-master-plan-approved-in-nyc-borough/>). The idea of a 15-minute city sounds great . . . at first. Everything you might need should be within a short walk or bicycle ride of no more than 15 minutes or so. Sounds great. But what if my family lives further away than that? Will I, or will I not be allowed to visit them whenever I please? Defenders of the concept will protest that the idea is merely to have many small local shops nearby, not to imprison you in your neighborhood. But it will be hard for local governments to resist such restrictions when the national government is measuring performance by the number of miles driven per month by the average person or some other similar metric. And, in fact, Oxfordshire in the UK has passed a measure to impose precisely such restrictions beginning, it is projected, sometime in 2024.

The idea of a 15-minute city is a one-size-fits-all solution. No store should be so big that many customers must travel more than 15 minutes to get there. But what, then, happens to “big box” stores like Walmart and Ikea? Households with modest budgets willingly travel for more than 15 minutes to reach them because they have so much to offer including low prices, an important consideration for anyone on a budget. They have a large variety of offerings and may provide services such a play area for one’s children and low-cost eateries. But the 15-minutes city would sweep that all away in a futile effort to reduce greenhouse gas emissions. Consumers would get less for more. Again, that’s going backward, not forward.

We should remember how hard it is to be green. It has been over a decade since a study in *Nature Climate Change*⁵ showed that “each unit of electricity generated by non-fossil-fuel sources displaced less than one-tenth of a unit of fossil-fuel-generated electricity.” Thus, grand goals such as “net zero” by 2050 or halving emissions by 2030 are an invitation to institute extraordinary measures that little or nothing to promote “green” outcomes.

The lessons are, then, to be wary when officials declare an emergency, to resist ambitious “groundbreaking goals” on climate issues, and to be suspicious of one-size-fits-all policies that may not even achieve their putative ends.

⁵ York, Richard. 2012. “Do alternative energy sources displace fossil fuels?” *Nature Climate Change*, 2: 441-443.