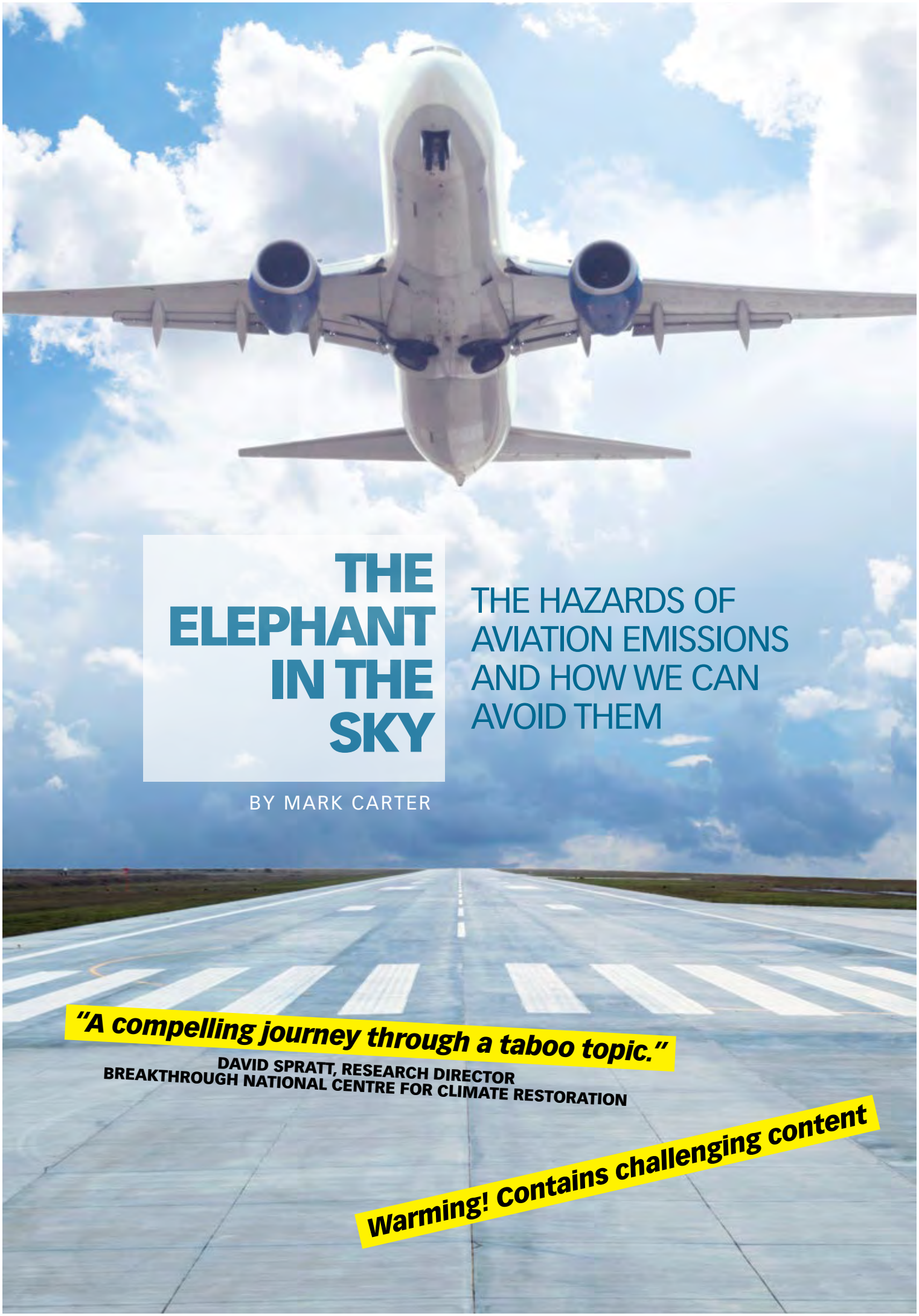


THE ELEPHANT IN THE SKY

THE HAZARDS OF AVIATION EMISSIONS AND HOW WE CAN AVOID THEM

BY MARK CARTER

"A compelling journey through a taboo topic."

DAVID SPRATT, RESEARCH DIRECTOR
BREAKTHROUGH NATIONAL CENTRE FOR CLIMATE RESTORATION

Warming! Contains challenging content

Yes, we're talking about jumbo jets. In fact, we're talking about all aviation.

Travelling by air, especially overseas, can be exhilarating. But the rapidly expanding aviation industry is putting our future in jeopardy.

In the collective task of tackling existential global heating, greenhouse gas emissions from international aviation are the elephant in the sky. They are booming, hidden, catastrophic, unregulated and tech-neutral. They need to be zero. We need to stand in the No-Fly Zone.

Read **THE PLANE FACTS** to understand why.

PAGES 3 AND 4

Aviation emissions are booming

Aviation is the transport sector's biggest, and one of the world's fastest growing sources of greenhouse gas emissions, with projected *increases* of 200 to 360% by 2050.

PAGE 5

They're hidden

International aviation emissions are excluded from the Paris Agreement voluntary national emission *reduction* commitments. They are ignored and unseen.

PAGES 6 TO 9

They're catastrophic

Left unchecked, aviation emissions *alone* could drive global warming to over 5°C by 2100.

PAGES 10 TO 13

They're unregulated

The UN International Civil Aviation Organisation's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) will allow aviation's greenhouse gas emissions to *continue* to grow.

PAGES 14 AND 15

They're tech-neutral

No technology, either in place or on the horizon, can reduce aviation emissions at the scale and speed necessary to avoid damaging climate system tipping points.

PAGES 16 TO 18

But need to be zero

To restore a safe climate, future emissions need to drop to zero by 2030, and at least 150 gigatonnes of previous emissions in the atmosphere needs to be drawn down.

Read **THE FLIGHT OR FIGHT RESPONSE** to understand how.

PAGES 19 TO 22

Your disbelief is believable

Our world-view is of growth not limits, technical solutions rather than difficult behaviour change. But this world is coming to an end.

PAGES 23 TO 25

We can be zero heroes

The warming effect of one return flight to Europe increases that of an average Australian's annual greenhouse gas emissions by 45%. Choosing to not fly is one of the behaviour changes we as a society must make to prevent catastrophic warming. It can kick off a conversation about the need for an urgent response.

PAGES 26 TO 28

Don't fly. Drive climate emergency action

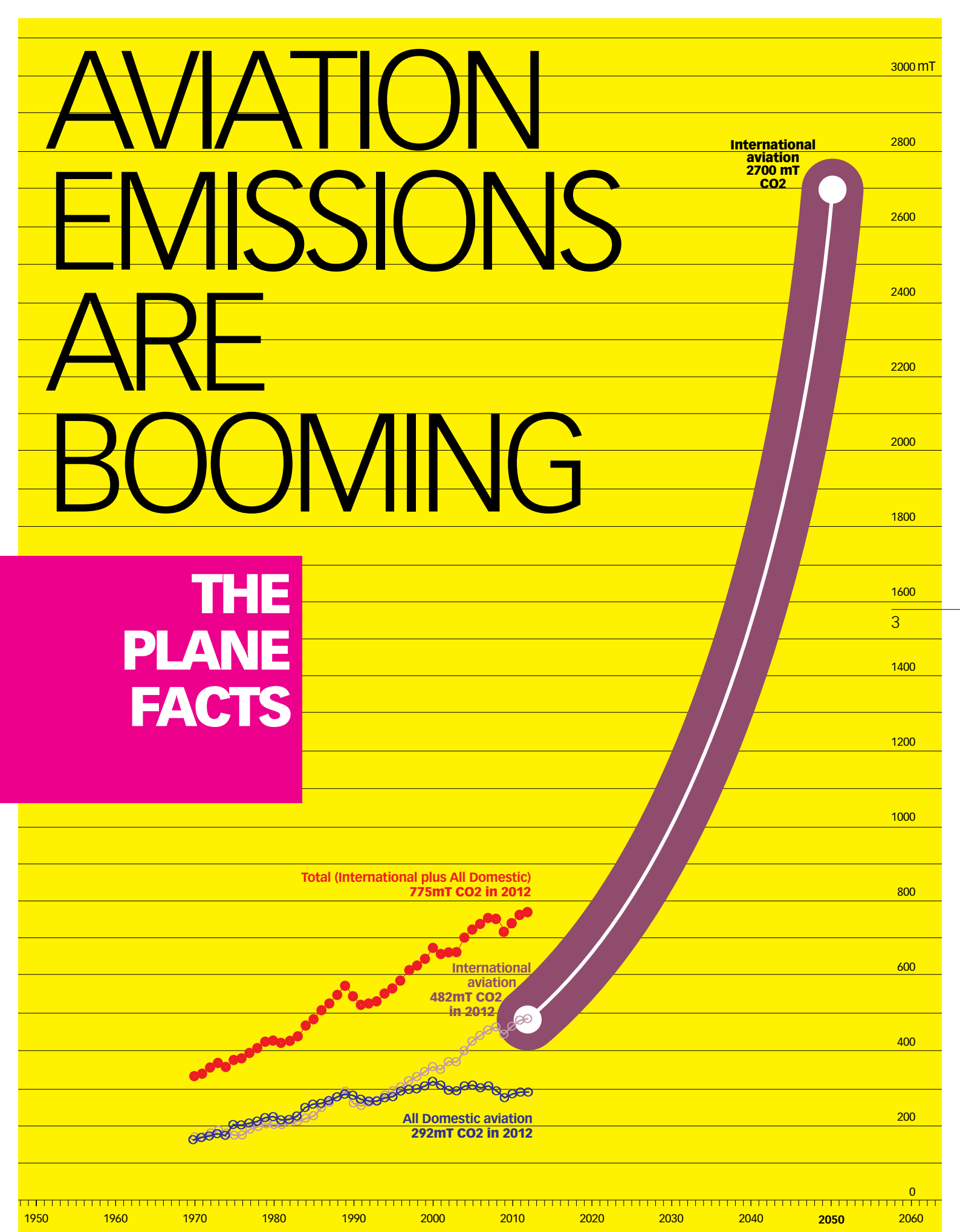
The only pragmatic route to climate safety is via an emergency response. Emergency action has appeal when we recognise it as an 'all-hands-on-deck' collaboration across society, with leaders advocating and effectively implementing solutions already available. It can fulfill our common need for a safe and secure future.

Published August 2018.
www.markmaking.com.au

Mark Carter is a graphic designer and amateur aviation emissions researcher, deeply concerned about our response to global warming's existential threat. In this paper he asks, How do we respond when the threat is embedded in a social norm — air travel? You can contact him at *mcarter@markmaking.com.au*

AVIATION EMISSIONS ARE BOOMING

THE PLANE FACTS



• Ascending not descending

International and all domestic aviation emissions growth 1970 to 2012[1] and projected growth in international aviation CO2 emissions to 2050.[2]

International aviation's CO_2 emissions are projected to increase 5% each year, to 2700 million tonnes in 2050

INTERNATIONAL AVIATION

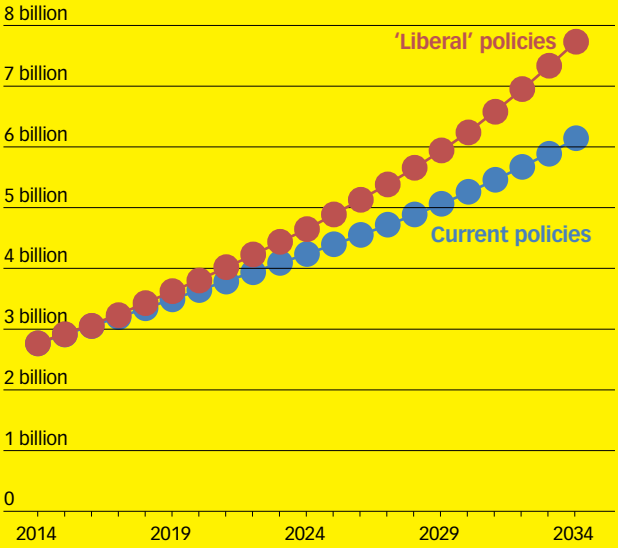
At the very time we should be reducing all greenhouse gas emissions, aviation emissions are projected to increase rapidly.

Civil aviation as a whole (international and domestic) is commonly cited as being responsible for around 2% of global anthropogenic CO2 emissions – 859 million tonnes (mT) in 2017.[3] These CO2 emissions are projected to grow 200-360% by 2050.[4]

The International Civil Aviation Organisation (ICAO), the UN specialised agency working with the aviation industry, projects CO2 emissions from international flights will increase 5% a year to 2700 mT by 2050.[5]

According to the Air Transport Action Group (ATAG), the not-for-profit association representing all sectors of the air transport industry, annual passenger-kilometres flown will more than double in the next 20 years – from 6.2 trillion in 2016 to 12.8 trillion in 2036.[6] These projected increases are largely driven by the anticipated increase in demand for travel from the ballooning middle classes in India and China.

Outlook for worldwide passenger trips[7]



SOURCE: TOURISM/ECONOMICS *AIR PASSENGER FORECASTS* WWW.IATA.ORG/PAX-FORECAST

DOMESTIC AVIATION

Australia has no aviation-specific emissions reduction targets. The domestic aviation sector's role in *reducing* Australia's emissions is that of a spoiler, *increasing* emissions all the while.

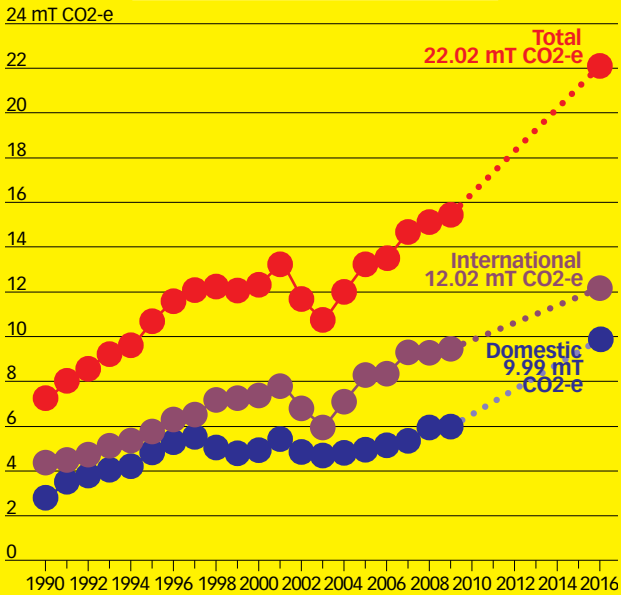
In 2011, according to the National Greenhouse Gas Inventory, Australia's civil aviation sector emitted a total of 17.7 mT of carbon dioxide equivalent (CO2-e, which is a standard unit for measuring carbon footprints). Of this, 7.08 mT, or 40%, were from domestic aviation and 10.62 mT from international operations.[8]

In 2015 domestic aviation emitted 8 mT CO2-e. Emissions from domestic aviation are projected to be 9.12 mT CO2-e in 2020 and 11.2 mT CO2-e in 2030, an increase of 40% compared with the 2015 level.

"Strong growth in domestic passenger numbers since 2011 is expected to continue through this period", says the Australian Department of Environment and Energy, driven by "a combination of falling airfares due to increased competition, lower oil prices and an increasing passenger preference for air travel over road or rail for long distances".[9]

According to the Australian Department of Environment and Energy, "Australia has not set a quantitative target for emission reductions in the domestic aviation sector. Under the 2015 Paris Agreement, Australia's Nationally Determined Contribution is to commit to implement an economy-wide target to reduce greenhouse gas emissions by 26 to 28% below 2005 levels by 2030. The government maintains that all sectors have a role to play that is important to reducing Australia's emissions."[10]

Australia's aviation emissions[11]



SOURCE: **1989-90 TO 2008-09** DEVELOPING AUSTRALIA'S CLIMATE CHANGE ACTION PLAN, AUSTRALIAN GOVERNMENT DEPARTMENT OF CLIMATE CHANGE AND ENERGY EFFICIENCY, 2009. **2016** MANAGING THE CARBON-FOOTPRINT OF AUSTRALIAN AVIATION, UPDATE AUGUST 2017

THEY'RE HIDDEN

International aviation emissions are not covered by the Paris Agreement

The international aviation industry has lobbied successfully for self regulation and in 2015 prevented its emissions from being included in the Paris Agreement and the voluntary pledges of nations to reduce emissions, known as Intentional Nationally Determined Contributions (INDCs).

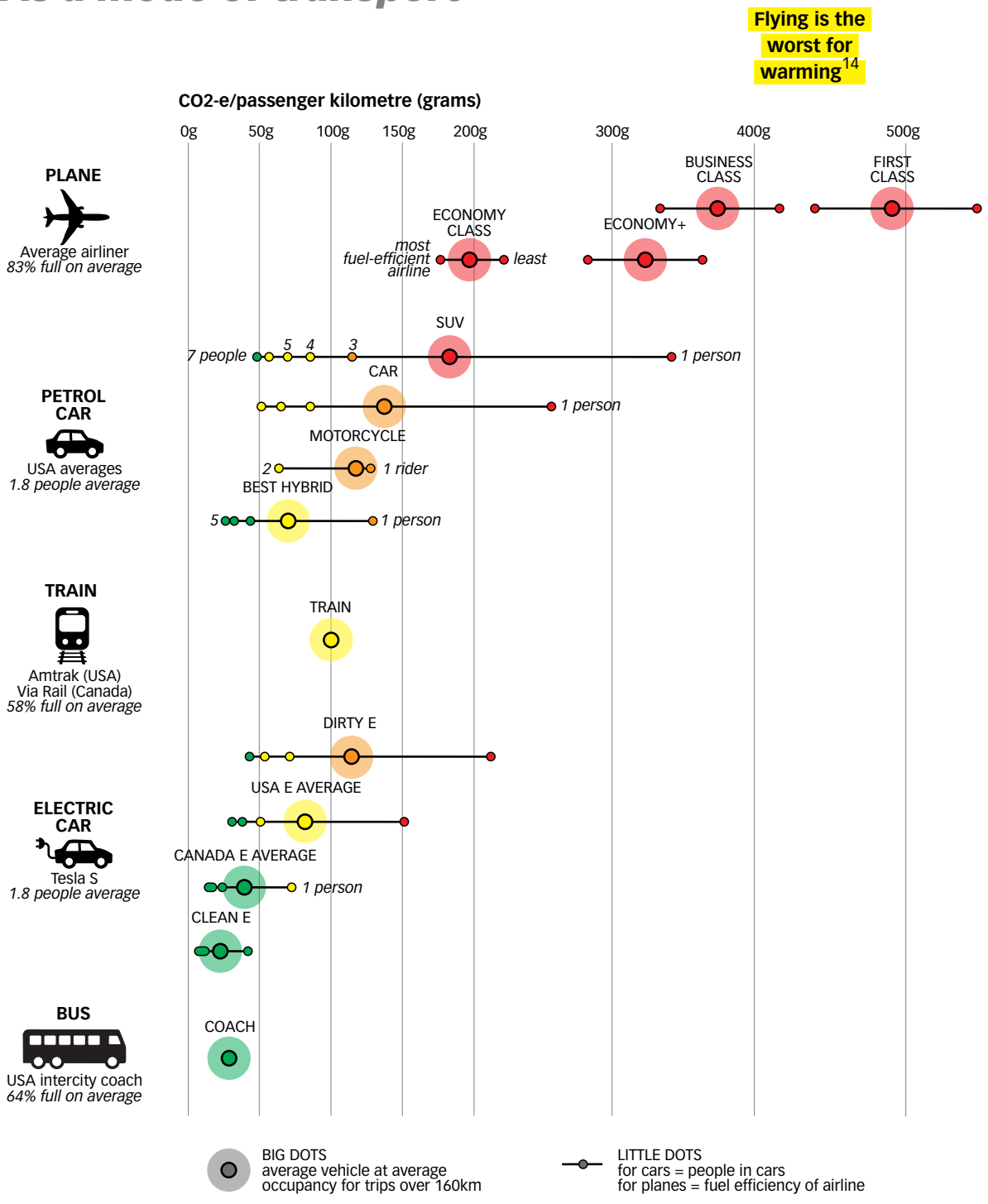
In December 2015, British newspaper *The Independent* reported: "One of the biggest gaps between the reality of our climate situation and the text of the Paris Agreement is in the absence of two sectors that are major contributors to the world's greenhouse gas emissions. Shipping and aviation were referred to in the world's previous climate change deal, the Kyoto Protocol, and were still referred to in the draft of the Paris Agreement until just a few days before it was signed. But they disappeared from the final text...".[12]

Disagreement over how to allocate responsiblity for emissions from international aviation to individual nations has been formally on the record since the drafting of the Kyoto Protocol in 1997.[13] Of three options most discussed, allocation of an international flight's emissions to the nation of departure (or arrival, or some proportion to each) is considered more practical than either allocation to the nation in which the carrier is registered, or allocation to the nation whose airspace is flown through.

Continuing disagreement is in the interests of an international airline industry intent on avoiding constraints.

THEY'RE CATASTROPHIC

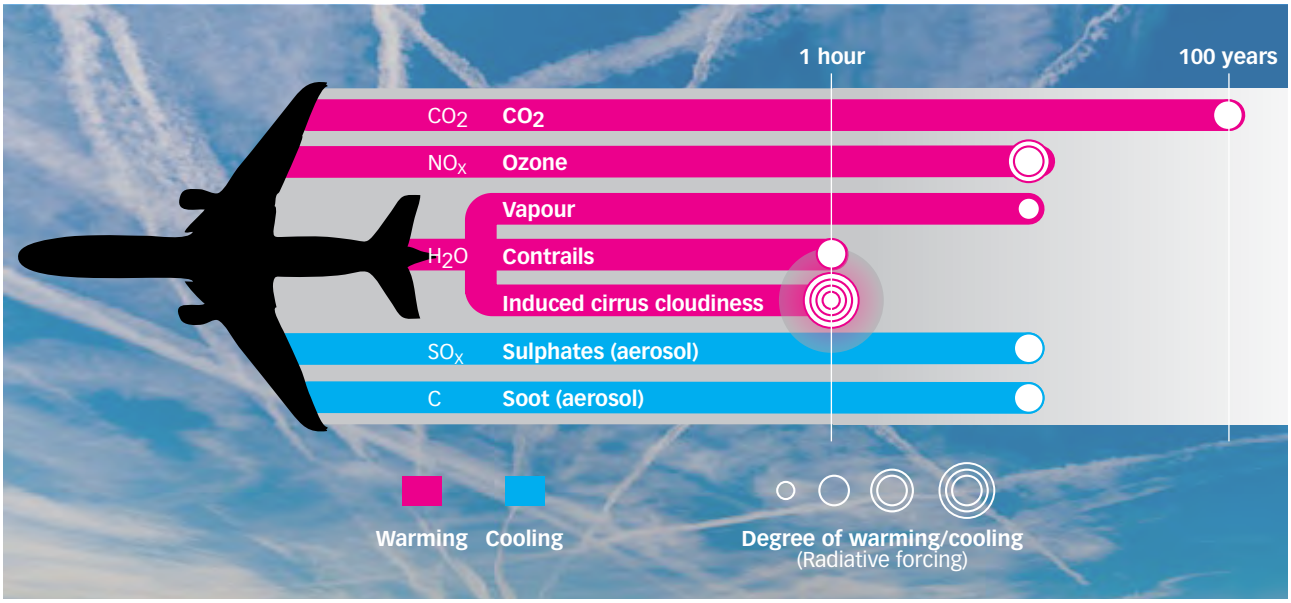
As a mode of transport



BASED ON CHART BY BARRY SAXIFRAGE OF VISUALCARBON.ORG AND NATIONALOBSERVER.COM, JANUARY 2016[15]

As a warming source

The duration and degree of warming or cooling by aviation emissions at altitude



Emissions from jet planes high in the atmosphere have a warming effect that dwarfs that from the same amount of fuel burnt on the ground.

Emissions from the burning of a jet engine's fuel include carbon dioxide (CO2), nitrogen oxides (NOx), water vapor (H2O), hydrocarbons, sulfur oxides (SOx), and black carbon (soot).[16]

These gases and particles interact at cruising altitude in the upper troposphere and lower stratosphere in different ways to that at ground level, altering the concentration of atmospheric greenhouse gases. Ozone (O3) forms from NOx, and condensation trails, or contrails, form when water vapor condenses rapidly into tiny water droplets that freeze as millions of ice crystals. Both ozone and contrails prevent heat from escaping the atmosphere, and add to the global warming effect.

All these emissions affect global warming either directly (CO2) or indirectly (NOx, SOx, black carbon[17]); by known (CO2) or inexact (NOx, H2O) amounts; and either briefly (NOx, H2O) or for decades (CO2).[18]

Radiative forcing is a measure of global warming. It's the difference between the sunlight energy absorbed by the Earth and the energy radiated back to space. Greenhouse gases cause radiative forcing, altering the Earth's radiative equilibrium by increasing the temperature of the climate system.

The Radiative Forcing Index (RFI) is the ratio of total radiative forcing to that from CO2 emissions alone. It is a measure of aircraft-induced climate change other than that from the release of fossil carbon alone.

The International Panel on Climate Change *Special Report on Aviation* in 1999 estimated an RFI range for aviation emissions of 2 to 4, with a best estimate of 2.7. And the IPCC *Fourth Assessment Report* in 2007 reported it as ranging between 1.9 and 4.7.[19]

But the warming caused by contrails and induced cirrus cloudiness – the biggest unknown when calculating the RFI – is excluded from the calculation of these RFI estimates.

The effect of aviation emissions on induced cirrus clouds is usually ignored in reporting the overall warming of aviation emissions because of high uncertainty.[20] While an accurate measure hasn't been pinned down because the mechanisms remain poorly understood, the IPCC *Fifth Assessment Report* said confidence is growing that it is real. And Carbon Brief reports that "research has indicated their impact on global warming could dwarf that of CO2 from aviation".[21]

So there is a very real risk that aviation's total contribution to warming is much more than currently reported.

Tourism's flight path

TOURISM IS THE MAJOR REASON WE FLY. WE look forward to experiencing other cultures and experiencing what the travel industry loves to promote as "exotic" locations. Tourist numbers are growing. In 2017 the UN counted 1.3 billion international arrivals – an increase of 8% in European arrivals. In 2016 in Asia arrivals increased 9%.[22]

But the package is no longer what it's cracked up to be. Even from the get-go. As the planet warms, air travel will become bumpier[23], and severe storms that ground aircraft will become more frequent, as will extreme heatwaves making it too hot for safe aircraft use.[24] There will be no thrill in joining the growing crush of tourists on St Marks bridge in Venice, or in staying in an Airbnb in Barcelona and many other cities, where the "sharing" accommodation economy and rising rents have driven the local people and urban culture out of the inner-city.[25] What pleasure will there be in holidaying in a hurricane-devastated Florida, in taking that trade trip to China only to land in a flooded Guangdong, or visiting the Philipines, sitting there in Asia's cyclone disaster alley?[26] Air travel emissions will help drown the Maldives, Tuvalu and hundreds of tourist destinations this century.

Not waving, drowning

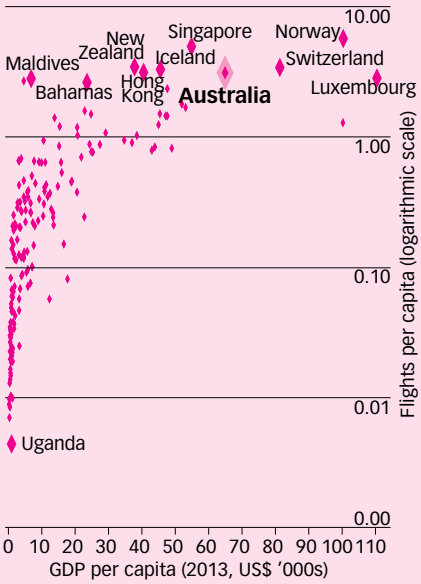
Even Australian tourism destinations are at risk from rising sea levels, including Fremantle, Port Douglas, Noosa, Byron Bay, and the Gold Coast, as well as Sydney and Hobart airports.[27] Scientists at the not-for-profit organisation Climate Central estimate that 275 million people worldwide live in areas that will eventually be flooded at 3°C of global warming.[28]

By 2100, chronic flooding will be occurring in the United States from Maine to Texas and along parts of the west coast including Oakland, California. It will affect as many as 670 coastal communities, including Cambridge Massachusetts, Miami and St Petersburg Florida, and four of New York City's five boroughs.[29]

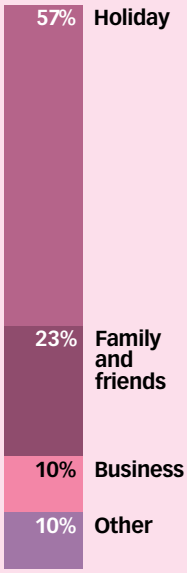
A recent study reported that "between 2009 and 2013, tourism's global carbon footprint [excluding non-CO2 emissions such as contrails] has increased from 3.9 to 4.5gT CO2-e, four times more than previously estimated, accounting for about 8% of global greenhouse gas emissions ... Driven by the desire for exotic travel experiences and an increasing reliance on aviation and luxury amenities, affluence has turned tourism into a carbon-intensive consumption category. Global demand for tourism is outstripping the decarbonisation of tourism operations, and, as a result, is accelerating global carbon emissions."[30]

AUSTRALIANS ABROAD

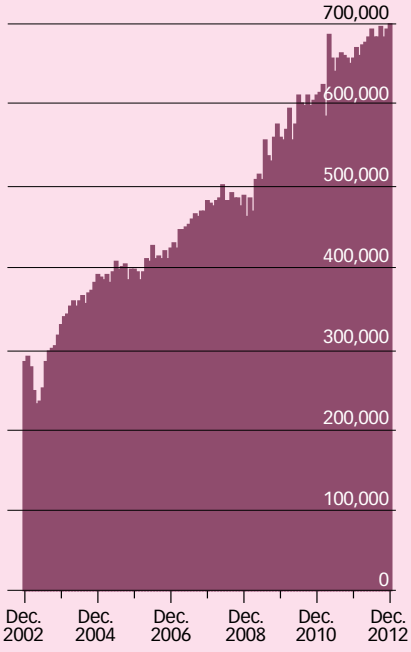
• Of the 5% of the world's population that have ever flown, we are amongst the most frequent flyers.[31] Average flights per capita by country GDP[32]



• Mostly we fly for holidays. Reasons for short term Australian resident departures of an average 15 days in 2012[33]

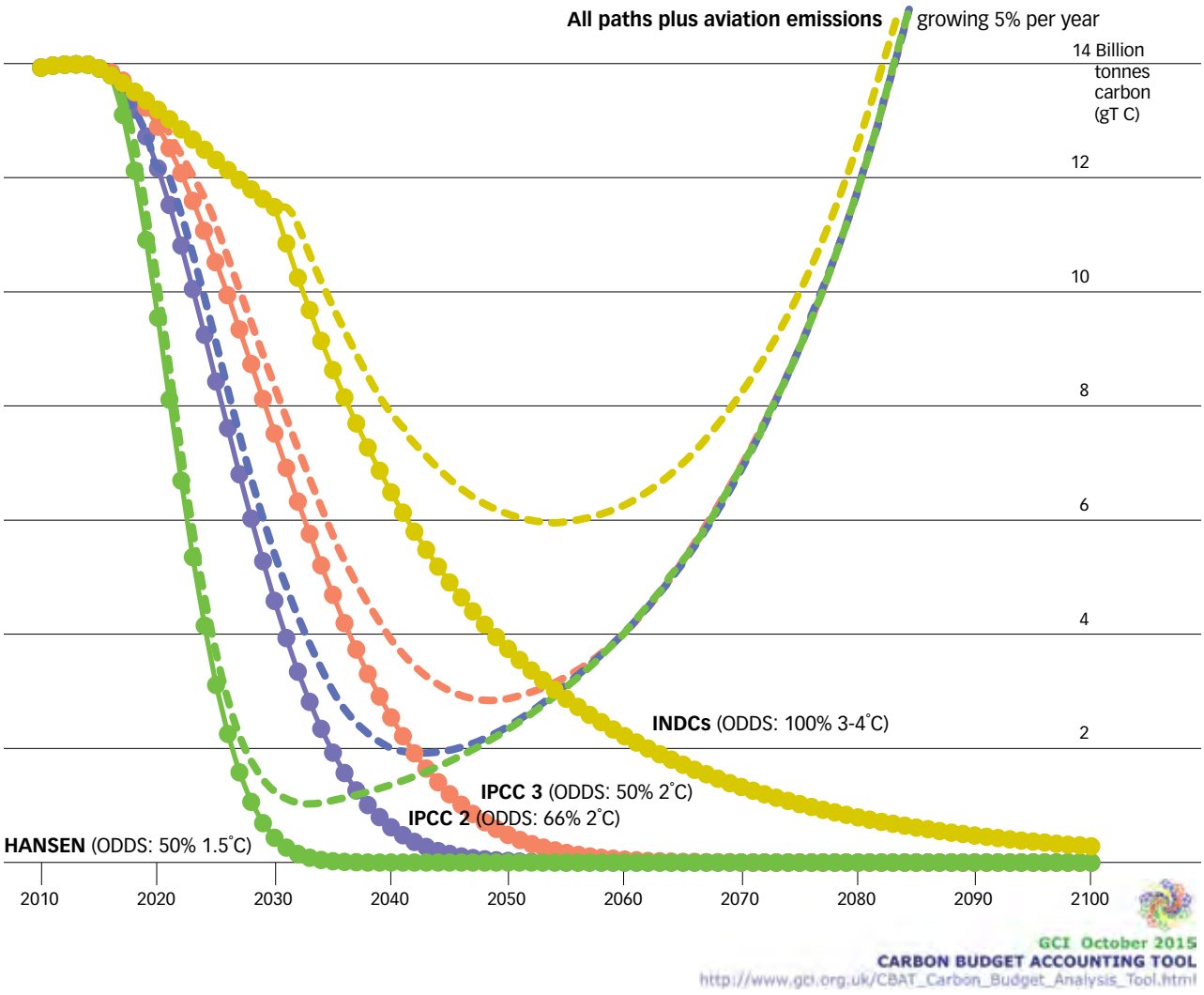


• More and more. Short-term Australian resident departures 2002 to 2012[34]



As a rogue elephant

Unchecked, international aviation emissions will *alone* drive warming to over 5˚C by 2100[35]



The green dotted curve **HANSEN** plots an emissions reduction pathway to zero carbon by 2040 (*with a 50% probability of 1.5°C warming*)

The purple dotted curve **IPCC 2** plots an emissions reduction pathway to zero carbon by 2050 (*with a 66% probability of 2°C warming*) from the IPCC's *Fifth Assessment Report*

The red dotted curve **IPCC 3** plots an emissions reduction pathway to zero carbon by 2060 (*with a 50% probability of 2°C warming*) from the IPCC's *Fifth Assessment Report*

The yellow dotted curve **INDCs** plots an emissions reduction pathway to zero carbon by 2100 (*with a 100% probability of 3 to 4°C warming*) based on the INDCs announced at the UN Framework Convention on Climate Change, COP 21

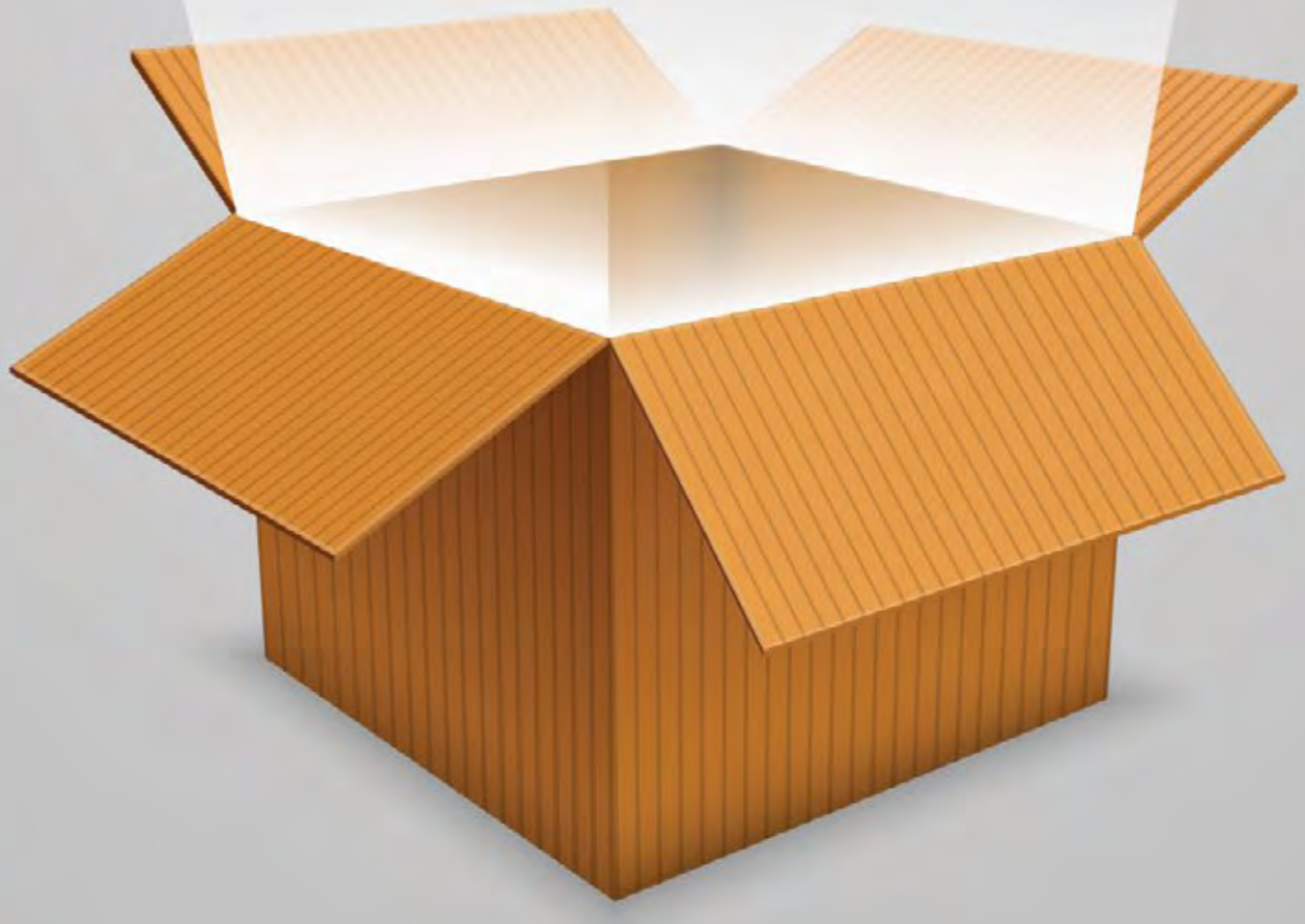
It is not possible to consider as viable any emissions reduction path that allows unconstrained international aviation emissions.

Sir David King, the United Kingdom's permanent Special Representative for Climate Change, presented the dotted line pathways to zero emissions, on the graph above, to the International Energy Agency at their Paris headquarters on 29 January 2016 as part of a presentation *Towards decarbonising the global economy: the direction of travel after COP-21.*[36]

He used it to illustrate the likely warming outcomes of four emissions reduction pathways, including that of the INDCs announced as part of the Paris Agreement after the UN Framework Convention on Climate Change, Conference of Parties 21 (COP-21), in Paris in 2015. When aviation emissions, growing at the industry-projected rate of 5% annually, are added onto each of these pathways, the Global Commons Institute plotted the dashed lines leading to warming of over 5°C by 2100.

THEY'RE UNREGULATED

Aviation emissions face no legally binding constraints



Potential aviation emissions reductions in the near term from existing legal mechanisms will be marginal at best.

THE FOSSIL FUEL SUBSIDY

Unlike domestic airlines, international carriers don't pay significant tax on jet fuel. The Australian fuel excise rate on aircraft gasoline is 3.556 cents per litre, less than 10% of the 40.9 cents per litre rate for road transport petrol and gasoline.[37] The foregone jet fuel tax, in effect a fossil fuel subsidy to aviation, amounts to €60 billion a year globally, according to Green Air Online.[38]

And the international commercial aviation industry hasn't paid these fuel taxes since it was established back in 1944, when the Convention on International Civil Aviation (or Chicago Convention) was negotiated.[39]

The text of the Convention and more recent resolutions of the ICAO – itself established by the Convention – specifically exempt an aircraft's fuel from "national duties or charges".[40]

But the 2006 IMF Working paper *Indirect taxes on international aviation,* concluded "On pure tax policy grounds, the case for a generalized increase in taxes on international aviation is strong."[41] And Jim Yong Kim, president of the World Bank argued, in 2015, for the repeal of all fossil fuel subsidies.[42]

The International Air Transport Association (IATA) is the trade association for the world's airlines and represents some 280 airlines, or 83% of total air traffic. With international aviation operating across multiple jurisdictions with different tax regimes, the IATA has attempted to lock-in ongoing avoidance of a jet fuel tax through multiple bilateral Air Service Agreements with nations across the world. Rather than setting a single tax rate, these ASAs lock-in tax exemptions for the fuel airlines of international operators consume abroad.

In defence of these agreements, the IATA claims that "taxing air transport has no positive impact on the environment but brings a detrimental effect on jobs, competitiveness and the economy."[43]

THE EUROPEAN UNION EMISSIONS TRADING SCHEME

The European Union Emissions Trading Scheme (EU ETS), set up in 2005, became the first scheme to 'regulate' multi-nation aviation emissions when it incorporated aviation in 2012. The scheme was originally intended to cover all flights within, into and out of Europe. But, as reported by Transport & Environment, a European NGO: "Following an international outcry orchestrated by US carriers against the inclusion of foreign carriers in the scheme, the European Commission limited the scheme's application to airlines operating flights in and between EU airports only. This was billed as a temporary measure to give ICAO time to agree [on] a global measure … After reviewing the 2016 ICAO outcome, when a global market-based measure was agreed, the Commission proposed to extend the exemption indefinitely pending a review of the effectiveness of the CORSIA".[44]

The EU ETS uses a market cap-and-trade mechanism, where a cap (or reducing upper limit) on allowable emissions induces participants to: absolutely reduce their emissions; avoid them with non-emissions alternatives; or buy permits within the scheme to 'cover' their emissions. But because there are no practical large-scale alternative aviation technologies available that avoid fossil fuel emissions (see *They're tech-neutral*, page 14), buying permits[45] is the only choice available at present for airlines, short of reducing their business.

However, the overall scheme has already been compromised by an overallocation of permits. Transport and Environment reported in 2017 that, "At present airlines have effectively unlimited access to cheap ETS credits, the cost of which hardly impacts on growth in any way. So aviation traffic and emissions keep growing uninhibited and will continue to do so until the permit surplus problem is resolved".[46]

THE INTERNATIONAL CIVIL AVIATION ORGANISATION'S CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION

In 1997, the group of 191 nation states, party to the United Nations Framework Convention on Climate Change's Kyoto Protocol and not including Afghanistan, Sudan or the USA, agreed that greenhouse gas emissions from international aviation should be 'limited' or 'reduced' by developed countries working through the ICAO. But it was only in October 2016, after 20 years of growing emissions, that the ICAO announced a Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

CORSIA is a 'basket of measures' aimed at "stabilizing the sectors' global CO2 emissions at 2020 levels"[47] and achieving "A reduction in net aviation CO2 emissions of 50% by 2050, relative to 2005 levels."[48] ATAG Executive Director Michael Gill says these measures, "ensure that the aviation industry can continue to grow sustainably."[49]

CORSIA's measures include technological measures (such as a new emissions standard — see *Fuel efficiency*, page 15), the use of alternative 'sustainable' fuels (see *Biofuels*, page 14), operational improvements on the ground, and a carbon trading scheme for offsetting emissions called the Market Based Mechanism (MBM).

Redd Monitor reported: "In November 2017, the ICAO's Council approved a draft document setting out the rules for its [MBM] carbon trading scheme. The 192 member states of ICAO have until 5 March 2018 to respond. ICAO's Council will then approve the document either as it is, or with amendments."[50]

These rules include the Carbon Offset Credit Integrity Assessment Criteria that define acceptable offsets. The criteria exclude all of the following: double counting of offsets, those carbon credits generated from projects with no beneficial impacts on the climate, all carbon credits generated from projects where any beneficial impacts are likely to be reversed, and carbon projects that fail to recognise the rights of indigenous peoples.

It is worth noting that, while the ICAO appears to have learnt something from the failings of previous offsetting schemes in establishing the offset integrity criteria, at least six of eight criteria appear highly likely to rule out forest carbon (drawdown) offsets, according to the report *Unearned Credit: why aviation industry forest offsets are doomed to fail*, by FERN, the European forests NGO.[51]

Nonetheless Carbon Market Watch warned, in February 2018, that there are serious concerns as to whether the rules as currently drafted, coupled with ICAO decision-making processes, will ensure the purchase of credible offsets and the avoidance of crediting bad alternative fuels.[52]

But, are MBM carbon offsets, even of the highest integrity, effective in reducing emissions?

Not according to the New Climate Institute[53], Transport & Environment[54], and Carbon Market Watch. Carbon Market Watch reported that "CORSIA alone, even with the highest possible levels of environmental integrity, will do little to mitigate international aviation's climate impact. … [It] will do nothing to incentivise greater efficiency by airlines and aircraft manufacturers."[55]

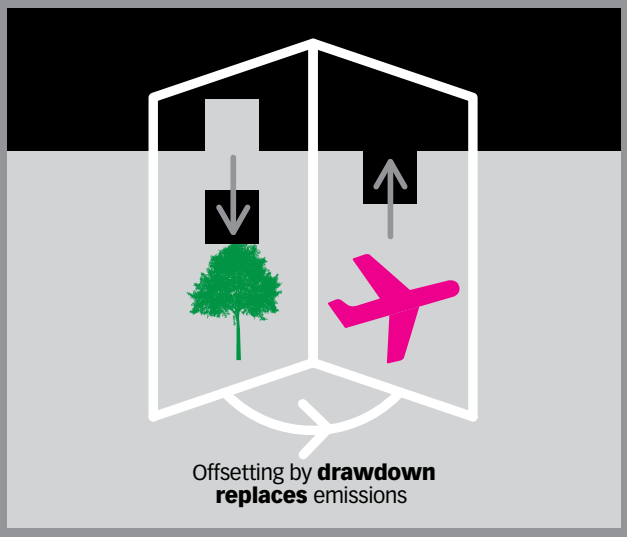
Perhaps not surprisingly therefore, the International Energy Agency has called for clarification of the magnitude of the emission savings expected from CORSIA.[56]

Further undermining CORSIA's effectiveness are the following concerns.

- The scheme runs only to 2035 and doesn't start until 2021.
- Participation by airlines is voluntary until 2027.
- Annual emissions equivalent to the level they reach by the end of 2020 are allowed to continue, meaning the scheme will, according to the Center for Biological Diversity, cover only about 25% of aviation's international emissions.[57]
- CORSIA applies only to CO2 emissions, while non-CO2 emissions, which research has shown could result in warming several times greater than for CO2 alone, remain unaddressed.
- The scheme's central measure, the MBM, does not seek to make absolute reductions in aviation emissions. Under the MBM, airlines will be allowed to offset any emissions above those at 2021.[58]
- To highlight the absence of absolute emissions reductions, during the last three years of the scheme, 2033-2035, airlines will be able to offset up to 70% of their above-2021 levels emissions.

Offsetting: worse than doing nothing

Offsetting by **avoidance adds** emissions



Offsetting by **drawdown replaces** emissions

USERS OF CARBON OFFSETTING SCHEMES create carbon emissions themselves, but offset – that is, pay others for – equivalent emissions those others either *avoid* making or *draw down* from the atmosphere.

Carbon emissions can be *avoided* by either using less of the thing that creates the emissions (say, cutting back on trips by plane or avoiding land clearing) or doing the same thing but with non-emissions technology (say, powering an electric car with renewable electricity).

Carbon emissions can be *drawn down* through re-afforestation, regenerative agriculture and other practices.

In the aviation sector, users of carbon offsetting can be passengers paying extra on their ticket, airlines in the EU ETS, or, after 2027, those in the ICAO MBM.

DO OFFSETTING SCHEMES IN GENERAL HAVE INTEGRITY?

Unanswered questions about offset schemes[59] include the following.

Are claimed-for avoided emissions actually avoided? Would the claimed-for avoided emissions have been avoided anyway through existing land-use practices? Were farmers thrown off their land to make way for claimable carbon sequestration-enabling emissions drawdown?[60]

Were claimed-for drawn down emissions actually drawn down? Were the trees planted? Did they grow for as long as the period claimed? Did a subsequent drought kill them?

Does the price of carbon in the trading scheme, the cost of the carbon offset credit, or the carbon tax on the passenger seat, reflect the real cost of militating the damage caused by those extra tonnes of emissions?

DO AVIATION OFFSETS REDUCE EMISSIONS?

In a world already too hot, every sector of the economy has a responsibility to rapidly reduce its emissions. For the aviation industry to take the credit for another sector's *avoided* emissions allows aviation to shirk its responsibility to rapidly reduce its own emissions.

To avoid catastrophe we need to actually get warming back under 1°C – to the safe climate zone (see page 16). To do this, we need to get to zero emissions as well as draw down the carbon already in the atmosphere that's taken warming to its current, unsafe level. So the aviation industry, in taking credit for emissions that we must *draw down* anyway, avoids its responsibility to rapidly reduce its own emissions. 'Carbon neutral' offsetting doesn't actually reduce the total tonnes of carbon in the atmosphere.[61]

"Offsetting is without scientific legitimacy, is dangerously misleading and almost certainly contributes to a net increase in the absolute rate of global emissions growth."

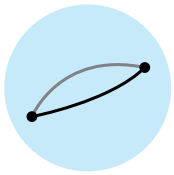
– Professor Kevin Anderson of the UK Tyndall Centre for Climate Change Research[62]

THEY'RE TECH NEUTRAL

No technology, in place or on the horizon, can reduce aviation emissions at the scale and speed required

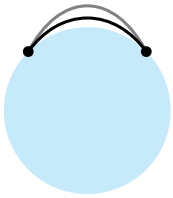
With unconstrained passenger demand projected to 2050, potential aviation emissions reductions in the near term from existing and proposed technical and operational emissions reduction measures, minimal as they are, will be quickly negated by additional emissions from the overall increase in air traffic.

FLIGHT PATHS



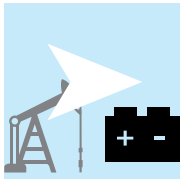
Altering flight paths to reduce the effects of non-CO2 emissions can be problematic. Rescheduling longer flight times would be difficult as there remain significant barriers to providing the required accuracy in predictions of wind, temperature and weather. A 2016 paper, *Potential to reduce the climate impact of aviation by climate restricted airspaces*, reported potential emissions reductions of 12%, but Cait Hewitt, deputy director of the Aviation Environment Federation, noted that coordinating management of restricted airspaces could be difficult to achieve.[63]

LOWER ALTITUDES



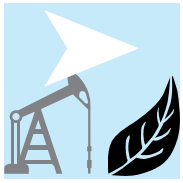
Flying at lower altitudes to reduce contrails increases CO2 emissions as more fuel is burnt to counter the increased resistance of denser air at lower altitudes.[64]

BATTERIES



Long haul electric aviation powered by batteries at low enough costs and with high enough power to weight ratios is at the very least 10 to 30 years away.[65] Norway's state owned air transport operator, Avinor, plans to have all short haul flights, of up to 1.5 hours, entirely electric by 2040.[66]

BIOFUELS



Adding biofuels to regular emissions-generating jet fuel does not eliminate emissions or contrails, and – despite being tagged 'sustainable' – biofuel production can increase overall emissions.

The ICAO's biofuel initiative in their CORSIA 'sustainable aviation' package only targets a 10% greenhouse gas reduction for biofuels compared to regular jet fuel.[67] Expanding demand for biofuel will devastate indigenous cultures and biodiversity, and exacerbate warming as rainforests are destroyed to make way for palm oil plantations.[68]

Aviation emissions reductions claimed for biofuels can be misleading when 'full life cycle' reductions are quoted, as these include the CO2 drawn down by the growing feedstock.[69]

So-called second generation biofuels (also known as advanced biofuels) use non-food based biomass feedstock. In NASA tests in 2013 and 2014, using a 50:50 mix of aviation fuel and camelina plant oil, fewer soot emissions and reduced contrail formation were recorded.[70] In January 2018, a Qantas 787 Dreamliner flew from Los Angeles to Melbourne fueled by a 10% biofuel 90% regular jet fuel mix. The biofuel was sourced from a type of non-edible industrial mustard known as carinata seed. It's manufacturer claims emission reductions of 65 to 85% per litre are possible, or, with maximum regular jet fuel substitution at 40%, a reduction of just 26 to 34%.[71] These non-food crop feedstocks compete for arable land with food agriculture.

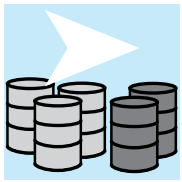
The production of enough biofuel to provide for Australia's aviation needs, calculates Graeme Pearman, Adjunct Senior Research Fellow at Monash University's School of Earth, Atmosphere and Environment, and Professorial Fellow at the University of Melbourne's Australian-German Climate and Energy College, "would likely require an area in the order of that needed to grow Australia's total wheat crop – around 11 million hectares."[72]

British Airways has entered a partnership to design a series of waste recycling plants that will convert household waste into renewable jet fuel to power its fleet. The jet fuel produced at the plant is *hoped* to deliver more than a 60% reduction in greenhouse gas emissions, compared with regular jet fuel. When feedstock is household or food waste, competition with agriculture for land is avoided but the supply of waste dirty oil, grease and fats is finite.[73]

Despite the ambition of some, such as the Norwegian aviation industry, which aims to replace 30% of all aviation fuel used across its airports with biofuel by 2030,[74] second generation biofuel production is too expensive at present[75] and its supply at scale to replace regular jet fuel – 278 billion litres in 2016 – if possible at all, is years away.

Even to meet the CORSIA objective of 'carbon neutrality' by 2020, the transition to biofuels would, as the ICAO admits, "require the realization of the highest assumed increases in agricultural productivity, highest availability of land for feedstock cultivation, highest residue removal rates, highest conversion efficiency improvements, largest reductions in the GHG emissions of utilities, as well as a strong market or policy emphasis on bioenergy in general, and alternative aviation fuel in particular." It concludes: "This implies that a large share of the globally available bioenergy resource would be devoted to producing aviation fuel, as opposed to other uses."[76]

FUEL EFFICIENCY



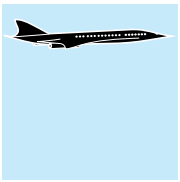
Using more fuel-efficient aircraft could, according to some reports, cut fuel use by 15-20%. Airlines have continued to improve fuel efficiency. By 2016, fuel efficiency for total system-wide services had improved 10.2% compared to 2009, according to the IATA.[77] The new CO2 emissions standard adopted by the ICAO in February 2017 is the world's first global design certification standard governing CO2 emissions for any industry sector. The standard will apply from 2020 to subsonic jet aircraft over 5,700kg and propeller-driven aircraft over 8,618kg, and aircraft type designs, already in production, from 2023. Those in-production aircraft that do not meet the standard by 2028 will no longer be able to be manufactured unless their designs are sufficiently modified.[78] As reported by Green Air Online, the standard "is said to be most stringent for … single-aisle 737/A320 families and larger, which account for more than 90% of international aviation emissions".[79]

But according to analysis by the International Council on Clean Transportation, "The standards will on average require a 4% reduction in the cruise fuel consumption of new aircraft starting in 2028 compared to 2015 deliveries, with the actual reductions ranging from zero to 11%, depending on the maximum take-off mass of the aircraft".[80]

With a typical working life of 20 years, it will be many years however before the worldwide aircraft fleet (24,000 in 2016[81]) is completely refurbished to deliver in full these marginal reductions.

The International Energy Agency (IEA) reports that recent annual average fuel efficiency improvements of 3.7% have exceeded industry aviation targets. Yet, according to the IEA, "the pace of improvement required for the recently proposed CO2 standard by the ICAO for new aircraft falls short of [dangerous] 2°C emissions thresholds".[82]

SUPERSONIC AIRCRAFT



Supersonic aircraft currently in production are likely to emit 70 percent more carbon dioxide than comparable new subsonic airplanes will be allowed to emit, and are also likely to exceed international subsonic limits for nitrogen oxides by 40 percent, according to a 2018 analysis by the International Council on Clean Transportation.[83]

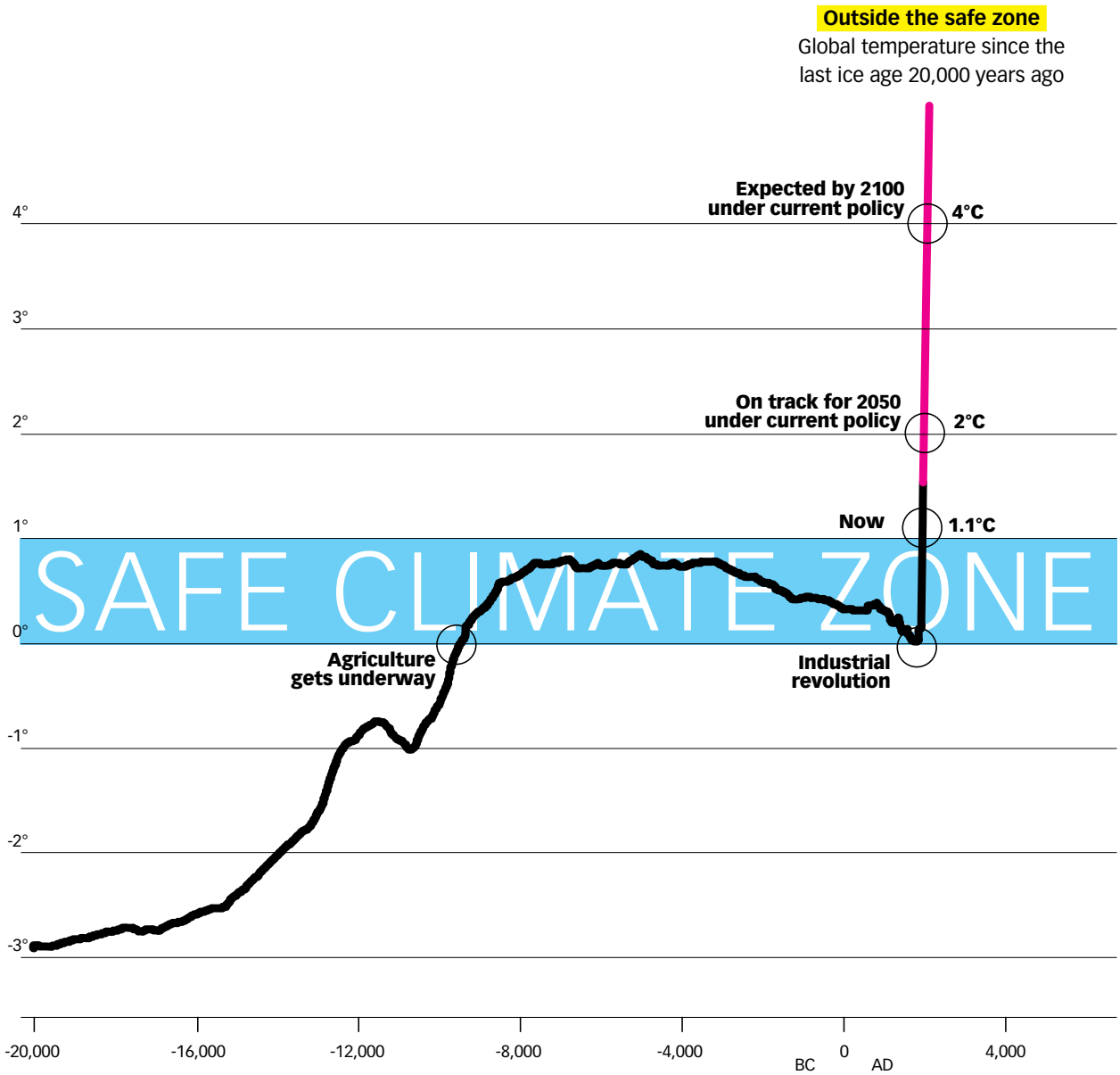
An academic research unit at Paris-Dauphine University focused on the economics of climate change, modelling nine different air traffic growth and aviation energy efficiency scenarios in a 2012 report, *Will technological progress be sufficient to effectively lead the air transport to a sustainable development in the mid-term (2025)?*. "According to our results", they concluded, "CO2 emissions from aviation are unlikely to diminish unless there is a radical shift in technology and/or travel demand is restricted. Despite aircraft manufacturers and airlines initiatives, the control of CO2 emissions from aviation should require more binding measures from policy makers."[84]

The European Parliament's Directorate General for Internal Policies concluded their 2015 report, *Emissions reduction targets for international aviation and shipping*, saying "There is general consensus in the literature that technical and operational measures will not be able to offset emission growth in the coming decades."[85]

Dr Scott Cohen, of the University of Surrey, one of the authors of a 2016 study, *Are technology myths stalling aviation climate policy*, says "The way in which new technologies are presented constitutes a 'myth', a form of propaganda which denies the truth that progress in climate policy for aviation has stalled. The use of these technology myths by industry and government relieves anxiety that nothing is being done, by pointing to future 'miracle' solutions, which in reality are unfeasible."[86]

BUT NEED TO BE ZERO

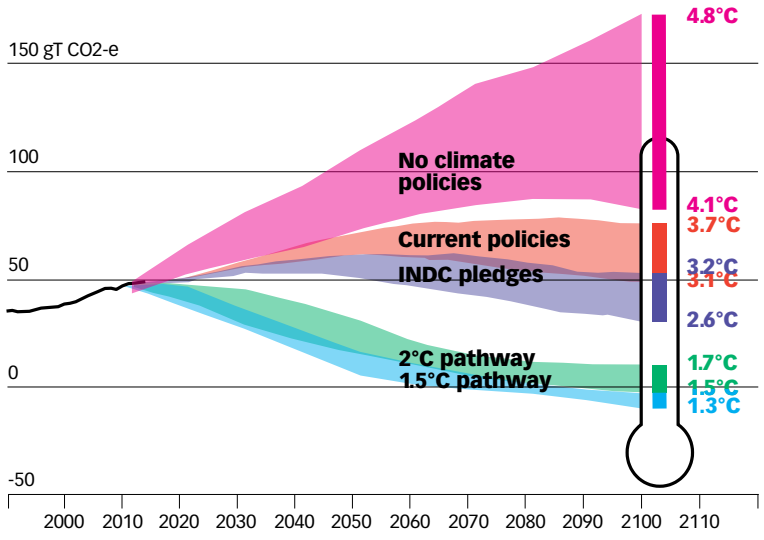
To restore a safe climate, all future emissions need to drop 6-8% a year to reach zero by 2030, and at least 150 gigatonnes of previous emissions needs to be drawn down



BASED ON GRAPH BY JOS HAGELAARS AT HTTPS://OURCHANGINGCLIMATE.WORDPRESS.COM/2013/03/19/THE-TWO-EPOCHS-OF-MARCOTT/
FROM *A RECONSTRUCTION OF REGIONAL AND GLOBAL TEMPERATURE FOR THE PAST 11,300 YEARS* BY SHAUN A. MARCOTT, JEREMY D. SHAKUN, PETER U. CLARK, ALAN C. MIX AT HTTP://SCIENCE.SCIENCEMAG.ORG/CONTENT/339/6124/1198

No more carbon can be safely burnt to get warming under 1.5°C even by as late as 2100

Global greenhouse gas emissions pathways to 2100[96]



2017 was the second hottest year and the hottest non-El Nino year on record, and average global warming is now 1.1°C above that of the late 1800s. The Earth is now hotter than when first human settlements formed and agriculture developed – around 10,000 years ago. We are outside the safe climate zone and, as such, face many hazards.

1.1°C of warming is delivering devastating extreme weather events, dying ecosystems, increased species extinction rates, the unstoppable melting of the Amundsen Sea sector of the West Antarctic Ice Sheet, and drought induced food and water shortages, amongst other outcomes[87]. But the full warming effect of our emissions to date won't be felt for several decades, or centuries in the case of rising sea levels.

1.5°C of warming is only 10 years away, analysis of the latest climate science concludes[88]. Further warming is inevitable, even as we reduce emissions because aerosols – a by-product of burning fossil fuels – have a short-term cooling impact, of around a week, estimated to be in the range of ~0.5-0.8°C. For now, these aerosols are lessening the warming impact of increasing levels of greenhouse gases. But reducing the use of fossil fuels – which we must do – will also reduce the production of aerosols, and push up global temperatures as their cooling mask is removed.[89]

2°C is the upper limit of warming in the Paris Agreement pledge. But emissions reductions via the Intentional Nationally Determined Contributions (INDCs), proposed after the Paris Agreement, will not stop warming at 2°C. The present INDCs would not prevent warming of around 3°C, and up to 5°C when likely carbon cycle feedbacks are included.[90] With greenhouse gas emissions now rising to record levels[91], delivery of even the promised INDCs is not guaranteed.

4°C of warming, among other impacts, would trigger the loss of both polar ice caps, eventually resulting in a 70 metre sea level rise.[92] A 4°C future is, according to Professor Kevin Anderson of the UK Tyndall Centre for Climate Change Research, "incompatible with an organized global community, is likely to be beyond 'adaptation', is devastating to the majority of ecosystems, and has a high probability of not being stable". He goes on, "If you have got a population of nine billion by 2050 and you hit 4°C, 5°C or 6°C, you might have half a billion people surviving".[93]

+4°C We now face an unacceptably high risk of global warming beyond 4°C. Ongoing emissions increase the likelihood that thawing permafrost will trigger the release of Arctic carbon stores.[94] As the Arctic warms so does the permafrost, which covers 20% of the northern hemisphere landmass and has mostly been frozen for half a million years. Thawing organic matter triggers bacterial decomposition that releases large quantities of methane – the most potent greenhouse gas. The methane creates further warming which melts more permafrost, producing more methane. This is the permafrost carbon feedback cycle.

But recent research on thawing permafrost indicates that reducing emissions quickly can possibly delay triggering the permafrost carbon feedback cycle.[95]

The quicker emissions are reduced to zero, the lower the total in the atmosphere, the less likely warming will trigger unstoppable permafrost, the less we have to draw down, and the lower the temperature rise after aerosol cooling is removed.

"Taking a plane is the fastest and cheapest way to fry the planet"

– Bill Hemmings, aviation director Transport & Environment NGO campaigning for cleaner transport in Europe[97]

WHAT GOES UP MUST COME DOWN

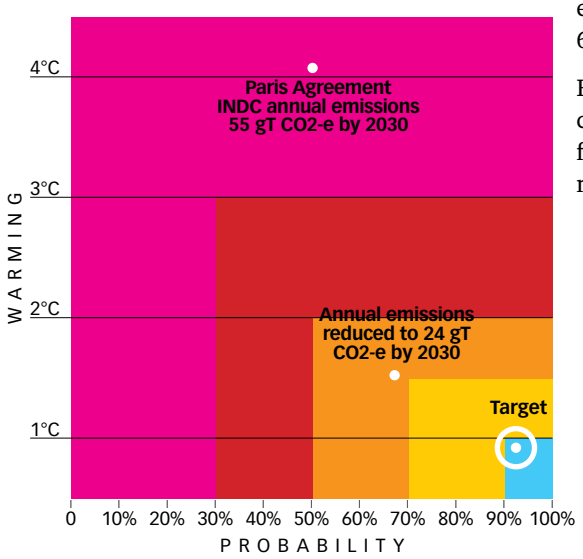
Even reducing emissions much faster than INDC pledges only gives us a two-in-three chance of getting back to the 1.5°C level of warming, according to the United Nations Environment Program in their report *The emissions gap 2017*.[98] But 1.5°C is far from safe.

The reality is that there is no 'carbon budget' – no more carbon we can burn – if we want warming constrained to below the 1.5°C level.[99] Every tonne of emissions we emit from here on in has to be drawn back down out of the atmosphere.

So, emissions must get to zero tonnes as fast as possible, that is, at a speed unconstrained by the 'business-as-usual' politics that today characterises climate policy making. And, because our past emissions have already taken warming to 1.1°C, drawdown of those previous emissions is necessary to get warming back to the safe zone – well below 1°C.

Probability theory

We wouldn't fly on a plane that had a 50:50 chance of crashing



But such cooling of the planet is only possible after warming emissions are reduced to zero, so emissions drawdown is not a substitute for emissions reduction.

In 2017 James Hansen, previously NASA's chief climate scientist, with others, wrote *Young people's burden: requirement of negative CO2 emissions*, a paper researching drawdown, or negative emissions. They found that to achieve 350 parts per million of CO2 in the atmosphere by 2100 – the upper limit to the safe zone – at least 150 gigatonnes of previous emissions already in the atmosphere need to be drawn down, at the same time as emissions are reduced to zero by 6% each year.[100]

Humanity faces an existential crisis not at some time in the future, but right now. We must respond immediately.

YOUR DISBELIEF IS BELIEVABLE

THE FLIGHT OR FIGHT RESPONSE

Nothing short of an immediate and drastic reduction in the 30+ million annual flights[101] will prevent disastrous warming… this is our reality

"Shite", I hear you say, "that can't be right." It's not surprising that you aren't immediately persuaded to give up flying. After all, our world is about growth not limits, and technical solutions rather than difficult behaviour change.

But we do know that telling the truth about dangerous threats (successfully communicating the seriousness of our predicament), then providing effective solutions for overcoming those threats, does work to motivate action (responding effectively by finding the motivation to pursue the path to safety).

Our initial disbelief is nevertheless understandable if we have been mistaken, misinformed, mesmerised, misled, and misunderstood.

WE'VE BEEN MISTAKEN…

What we decide to do is generally shaped by our worldview. Our decisions are mostly consistent with our values. We've learned to value flying. We talk with our friends about it often. Everyone's doing it. Even climate activists and the staff of environment NGOs fly. A UK study, *'Green' on the ground but not in the air*[102], found "there was no association between individuals' environmental attitudes, concern over climate change, or their routine pro-environmental household behaviours, and either their propensity to take non-work related flights, or the distances flown by those who do so".

We see aviation, especially flying overseas, as normal, just like internet access, and a coffee in the morning – as something we can't live without. Isn't flying part of the trajectory of human progress?

How can overseas travel be a problem when it can be so enriching? Haven't we earned that European holiday? Don't we need to visit family and friends overseas, to advance our business and education in foreign countries? What about the assistance we can deliver in developing countries? Are these motivations now being criticised? To acknowledge that flying is harmful challenges our sense of who we are.

Increased mobility is a key performance indicator for modern life, and travel has been valued throughout our history. As an inquiring, social species we are drawn to adventure, to discovery. The classic stories of humanity are journeys, quests, meeting and overcoming adversity, moving from 'poverty' to 'enrichment', being transformed, losing then finding ourselves, and returning home.

In this sense we have been using flight as a means of self discovery. But what happens when the jet plane is no longer an enabler? What if it will not get us home safely? The way we travel, as individuals and as a society, has to change.

MISINFORMED…

News on required climate change action comes to most of us from the established media's interpretations of complex and often out-of-date climate science that's been moulded by consensus into politically acceptable conclusions. This is a process that, not surprisingly, persistently underestimates the risks we face, especially those of smaller probability but massive consequence, that we should most seek to avoid.

IPCC emissions reduction scenarios that are accepted for mainstream broadcast can misinform by failing to mention their low probability of success. For example, the IPCC in their 2014 *Fifth Assessment Report* listed a remaining carbon budget of 1000 gT of CO2 – what we can still burn – as 'compatible' with a 2°C goal.[103] Yet there are actually no emissions pathways, compatible with a very likely chance (>90%) of not exceeding the 2°C target, that have any carbon budget at all.[104]

Other accepted IPCC scenarios fail to factor in real and influential climate dynamics, such as the permafrost carbon feedback cycle.

"The effect of the permafrost carbon feedback on climate has not been included in the IPCC assessment emission scenarios, including the 2014 report," say David Spratt and Ian Dunlop in *What lies beneath: the scientific understatement of climate risks.*[105] "This is despite clear evidence that 'the permafrost carbon feedback will change the Arctic from a [carbon store] to a [carbon emissions] source after the mid-2020s and is strong enough to cancel 42-88% of the total [carbon sequestered on land globally]'".

How can we accurately assess climate risk when we completely ignore known but inexactly measured threats?

MESMERISED…

At the exact time that we need a commitment to a long-term project we can find ourselves dazzled by the attractions of distraction. More 'now' and less 'later' can deafen our alarm at the existential threat we face. Both too much 'virtual' with its lack of physical limits and too little 'natural' can cause us to ignore the value of our life support systems. Too much 'superficial' and not enough 'depth' can distract us from the complex task at hand.

We can also be distracted by living: getting by, keeping the family together, managing illness, and work and financial stresses. It's easy to prioritise other news: rising house prices, the exaggerated threat of terrorism, the daily violence, and the many injustices to those of us with few means.

But since when has turning our backs been the best way to solve a problem? What do we call it when we fly in the face of danger?

MISLED…

Our leaders have misled us. We are told every day that business-as-usual mode – slow change – is as essential to life as oxygen. Its upside, said to be 'jobs 'n growth', is trumpeted, but its failings – including destroying the conditions that sustain life – are ignored. Our leaders act as if we can't afford to save humanity, as if aviation's direct contribution to the global economy of $664.4 billion and 9.9 million jobs in 2014[106] is more important than a liveable planet.

Three in four Australians already consider climate change a 'global catastrophic risk' and four in five support strong action even if it requires considerable changes impacting on our current living standards.[107] We're actually ready for serious action. It's our leaders – our parliamentarians, policy makers and business and media corporates with too much skin in the end game – who are lagging, green-washing, avoiding explanations of our predicament and the effective solutions available. The ICAO's 2016 report *Onboard for a sustainable future*[108] pretends we can keep flying and tackle climate change.

These leaders delayed reducing greenhouse gas emissions by arguing over whether they were harmful or not. Then they said the amount by which to reduce them was difficult to nail down. Then they disagreed on how to make reductions without inhibiting economic growth. The next thing you know permafrost is starting to melt, the West Antarctic Ice Sheet is in unstoppable meltdown, and for an acceptable probability of survival we have too few years and face massive barriers in cutting emissions to zero. And they still stall. If emissions reductions had started in earnest back in the 1980s, the rapid reductions now required may have not been necessary.

Time has run out for market-driven solutions. The priorities driving their deployment will delay us further in getting to where we need to be. We can't change the laws of physics, but we can change the laws of the land.

Leadership is meant to get us safely to the other side of calamity, not enhance calamity.

AND MISUNDERSTOOD

We value harm reduction and we value air travel (well at least those of us in the 5% of the world population who have flown). When harm is distant or indistinct, we can keep flying without turbulance. This is especially so when distraction, deceit, disconnection and an absence of leadership do their work.

But when we realise air travel is harmful to a safe climate, our values are in conflict. We suffer cognitive dissonance. This is our reality, a world that is normal no more.

The world into which we were born is coming to an end.[109] From where we now stand, come what may, our future is one of radical change. Either as chaos and calamity, as the climate makes life unsafe, or as a never-seen-before emergency response. It's now not about changing plane routes, altitudes or fuels. It's about changing our minds.

Existential risk management, explains David Spratt, research director at the Breakthrough National Centre for Climate Restoration, is "not amenable to the reactive (learn from failure) approach of conventional risk management, and we cannot necessarily rely on the institutions, moral norms, or social attitudes developed from our experience with managing other sorts of risks. Because the consequences are so severe, even for an honest, truth-seeking, and well-intentioned investigator it is difficult to think and act rationally in regard to existential risks."[110]

WE CAN BE ZERO HEROES

We stand at the precipice. Do we choose to jump because we think we can fly, or do we stay grounded, for good?

Aviation emissions are booming. They are hidden, catastrophic, unregulated and tech-neutral, but they need to be zero. What can we do? We can't escape it. Air travel demand must be reduced, cutting its emissions to zero rapidly. Yet nowhere in the UN, EU or government environment and energy agency reports, nor those of the aviation industry and its regulatory bodies, is the reduction of air travel demand considered seriously, let alone promoted. It's said to be "challenging" and "politically unpopular"[111], yet on closer inspection might actually be ok.[112]

Public policy options that constrain demand for flying are possible and include those below. Then there's individual choice.

REDUCING DEMAND

Personal carbon quotas. Radical change in levels of per capita flying is possible through a personal carbon quota scheme that includes international flights, says Alice Larkin of the Tyndall Centre for Climate Change Research in her paper *All adrift: aviation, shipping, and climate change policy.*[113] "Personal carbon trading (PCT)", advocates Larkin, "is a radical policy proposal which would entail all adults receiving an equal, tradable carbon allowance to cover emissions from household energy and/or personal travel. The allowance would reduce over time – for aviation, say from one flight per person every 2 years to zero in 10 years – in line with national emissions reduction goals. Most research shows PCT to be at least as socially acceptable as an alternative taxation policy, both fair and effective. Set-up and running costs for PCT will undoubtedly be higher than for alternative taxation policies. However, PCT could deliver benefits from individual and social change motivated by non-economic aspects of the policy".

A carbon tax or frequent flyer levy would ensure those who fly are faced with a price tag that reflects the impact of what they're doing.[114] The German website DW has quoted David Hodgkinson, an associate professor of law at the University of Western Australia, arguing that a carbon tax is needed, especially given the complexity of other cross-border strategies for reducing emissions. "People understand it," he said. "They might not like it, but they understand the properties of a tax. ... Most people, and even the airline industry, would accept that there needs to be some form of price on aviation emissions."[115]

REDUCING GROWTH

Aviation infrastructure bans – on new airports and terminals, new runways, and fleet expansion such as those proposed in the Melbourne Airport Masterplan[116] – are necessary[117]. In August 2018, Friends of the Earth UK mounted a legal challenge in the UK High Court against the proposed third runway at Heathrow. Lawyers for FOE said, "The government has a legal duty to take into account climate change policy and the Paris agreement it has committed to with the global community. The Airports National Policy Statement [proposing the new runway] does not adequately consider those factors and we therefore will argue that it is unlawful."[118]

INCREASING ALTERNATIVES

Alternative modes of travel. High-speed rail and other modes of travel can be prioritised. According to flight data website OAG.com, the Sydney–Melbourne air route is the world's second busiest, with 54,519 flights a year, and Brisbane–Sydney, with 33,765 flights a year, is the eighth busiest.[119] These numbers could be dramatically reduced by a high-speed rail network between Melbourne, Sydney and Brisbane that could provide zero emission journeys. Such a network could, according to BZE in their *High Speed Rail* report, reduce travel emissions up Australia's east-coast corridor by 28%, equating to a 13.5% reduction in regional travel emissions Australia-wide.[120]

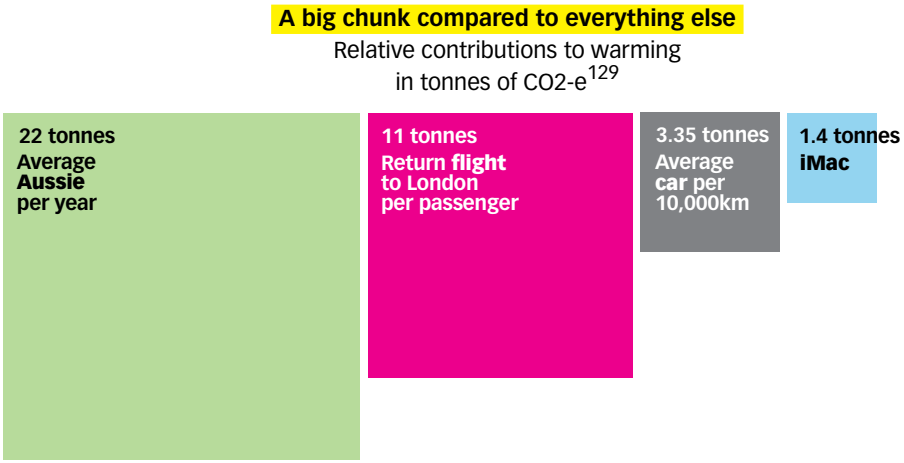
Virtual travel. The world's first public global no-fly climate conference, #WeDontHaveTime Climate Conference, was held on 22 April 2018 to launch the 'We don't have time' climate initiative.[121]

The Australian Research Council Centre of Excellence for Environmental Decisions (CEED) held an online-only environmental science conference hosted on Twitter on 22 May 2018.[122] "Not only does a virtual conference potentially save days of travel, but it also greatly improves accessibility," said Professor Kerrie Wilson, CEED Director and Deputy Associate Dean Research at University of Queensland's Faculty of Science.

Researchers, reporting in the journal *Telematics and Informatics*, found a multiple-site international conferencing format, using advanced videoconferencing technology to reduce intercontinental conference travel, when compared with a traditional one-site format requiring international travel, attracted more attendees and reduced emissions by between 37% and 50% in travel-related greenhouse gas emissions.[123]

Developments in virtual reality technology could provide an overseas tourist experience 'in your own home'.[124]

Policies and travel alternatives such as these could be adopted and rolled out with great urgency. The reductions they deliver can be regulated and monitored when international aviation emissions – allocated either wholly to the country of departure or arrival, or shared – are included in seriously more ambitious INDCs scaled to reduce emissions to zero quickly.



CHOOSING TO NOT FLY

While these policy changes are put in place, immediate flight reductions can be achieved through personal choice – you, me, our friends and colleagues choosing to not fly.

But this is by no means an easy step to take. Choosing to not fly has its challenges. In contradicting accepted norms, doing so can be isolating and uncomfortable for the one who is grounded, and confronting for those who do fly.

As more people take up the challenge it becomes easier. Choosing to not fly doesn't hurt anyone, it saves you money, and you can do it without leaving home.

Canadian climate change researcher Barry Saxifrage quit flying because of "the oversized climate damage caused by jet travel coupled with the industry's refusal to do anything meaningful about it". To prevent emissions equal to the 27 tCO2 created by flying once to Australia and back, he found his family of three would have to stop driving for 17 years or live without household power and heat for 40 years.[125]

Academics, including climate scientists, are already choosing to not fly.[126] A change.org petition[127] calls on "universities and institutions of higher education: (a) to include all university-related flying (whether directly paid by the university or by others) in their environmental impact measurement and goal-setting; (b) to support and work to realize marked reductions in flying by faculty, staff, and students commensurate with the cuts suggested by climate science; (c) to establish and publish short- and medium-term benchmarks for reductions; and (d) to use their influence with professional associations to reduce reliance on flying for academic and research conferencing". It also petitions "academic professional associations: (a) to measure and report the environmental impact of their conferences; (b) to radically reduce the amount of flying needed for conferencing; (c) to establish and publish short- and medium-term benchmarks for reductions; and (d) to work with university-based members to meet key professional objectives in ways that do not require flying and that are sustainable".

Petition signatory, New Zealand attorney Tom Bennion, who manages a law practice without flying, says "I believe that, because of the 'fault line' that flying represents in the climate issue, it would take only a few high-profile institutions (such as climate institutes at universities) and individuals (such as academics, politicians, or film or pop stars) to declare that their frequent-flying days are over, and we would have a whole new debate about urgency and what our governments need to do about reducing emissions".

As Parke Wilde, academic flying petition drafter, says "I have since August, 2014, lived without flying while on the faculty at Tufts University. For me, the decision not to fly was valuable not only because of personal GHG impact (which is small for just one person), but more importantly because it offered insight into what an active academic career might look like in a more sustainable world."[128]

Following their example, fossil fuel divestment campaigners on university campuses could create 'No Fly Zone' faculties by persuading academics to forego air travel to overseas conferences and study. Faculties could purchase state of the art video conferencing infrastructure instead of plane tickets. Climate action, work, union, religious and sports groups can choose to stand in the 'No Fly Zone'.

Choosing to not fly – in being a challenging choice that's outside-the-norm – is of-a-kind with the choices we as a society must immediately make to prevent catastrophic warming. As such, it can kick off a conversation about the challenging, outside-the-norm emergency response needed to restore the planet to safe operating conditions.

DON'T FLY. DRIVE CLIMATE EMERGENCY ACTION

"Winning slowly is basically the same thing as losing outright." – Alex Steffen, futurist and writer on sustainability

EMERGENCY ACTION

The Washington Post reported in February 2018 on a leaked UN draft report's conclusion that there is too little time to avert 1.5°C degrees of warming, barring some massive technological intervention. The draft report noted: "There is ... no documented precedent for the geographical and economic scale of the energy, land, urban and industrial transitions implicit in pathways consistent with a 1.5°C warmer world".[130]

To reduce the risk of warming-generated social collapse and have an acceptable chance of returning warming to the safe zone – under 1°C – future emissions, including those from aviation, need, as previously revealed, to drop at 6-8% a year to zero by 2030, and at least 150 gigatonnes of previous emissions now in the atmosphere need to be drawn down. It's a massive task. And, not surprisingly, despair can set in when we assess the task against what business as usual can do.

But despair turns to hope when we effectively implement all available solutions. An 'all hands on deck', drop everything else, response allows us to do extraordinary things.

Like any other near-death experience, acknowledging our impending climate calamity can lead to a new outlook on life. One that sees an emergency response not as alarmism but as a rational, precautionary "due care and diligence" response to an existential risk.

Emergency action is essential when, as now, events threaten to overwhelm our capacity to respond, when delay increases risk, when failure is not an option, and when the costs of inaction massively outweigh the costs of acting. And when the challenges we face are not amenable to a 'politically realistic' response, when incremental changes within a business-as-usual mindset dominated by vested interests, simply pushing and prodding the market, aren't the fastest way to zero emissions.[131]

Emergency action has appeal when we recognise it as a collaboration across society. It can bring out the best in us. The sky's the limit.

Recognition of the existential threat posed by climate change and the necessity for an emergency response is growing.

- In Australia, a petition, run by a network of advocates, calling on the national Parliament to declare a climate emergency and initiate a massive society-wide climate action mobilisation has over 20,000 signatures.[132]
- In 2016 the Climate Mobilisation in the US organised successfully to have included in the Democratic Party Platform the following wording acknowledging we are in a climate emergency: "[O]ur generation [must] now lead a World War II-type national mobilization to save civilization from catastrophic consequences".[133]
- In 2017 the Council of the City of Darebin in Victoria adopted a five year Climate Emergency Plan, recognising we are in a state of climate emergency.
- In early 2018 the Irish Dáil, or parliament, voted in the Climate Emergency Measures Bill to end fossil fuel exploration and extraction.[134]
- Following an Inquiry into the Implications of Climate Change for Australia's National Security, a report in May 2018 by the Australian Senate's Foreign Affairs, Defence and Trade References Committee recognised climate change as "a current and existential national security risk ... that threatens the premature extinction of Earth-originating intelligent life or the permanent and drastic destruction of its potential for desirable future development".[135]

STEP 1

Today, the challenge for us all is to generate broad community support for political and social leadership that enables a national cross-party 'climate rescue' government to respond to the climate emergency. Such a government would have the single priority of implementing a safe-climate plan, putting on hold the way we're doing things now, and removing all economic obstacles to fast emissions reductions and drawdown.

Traditional antagonists could unite in generating support: our national defence leaders with climate activists to protect strategic assets such as our water, soil and settlements; farmers and environmentalists around a shared goal of landscape regeneration and associated carbon drawdown; and conservatives and progressives around harm minimisation. With a shared interest in such positive outcomes, the inevitable disruptions and hardships could possibly be more easily endured.

Extraordinary to-dos[136]

SPEED & SCALE

☐ 1 TRANSITION AT EMERGENCY SPEED

- Accelerate policy implementation at emergency speed to avoid and reverse Earth system tipping points and damage to people and diversity.
- Mobilise business, labour and the entire community at wartime-like scale and allocate necessary resources.

POLICIES & INITIATIVES

☐ 2 REDUCE EMISSIONS TO ZERO

- Drive rapid reductions in fossil fuel emissions to zero through economic and public policy ending coal mining, gas extraction including fracking, and oil drilling.
- Find substitutes for the fossil fuels used to make steel, other metals, cement, glass, plastics, and chemicals.

BONUS FEATURES ***Cleaner air. Healthier communities.***

100% RENEWABLES

- Maximise the substitution of fossil fuel generated energy with renewable electricity.

BONUS FEATURE ***Jobs.***

ENERGY CONSERVATION

- Do more with less, not least because a massive build-out of solar and wind renewable energy capacity can't match that supplied by fossil fuels, let alone meet projected demand.[137]
- Encourage re-use, repair, and thrift.
- Enable sustainable modes of work and leisure.

BONUS FEATURES ***Financial savings. Connection to community.***

☐ 3 DRAW DOWN CARBON

- Rapidly deploy regenerative agriculture[138] and reafforestation at massive scales to draw down excess atmospheric CO2 and store it safely to achieve 280 to 300ppm.
- Ban land clearing.

BONUS FEATURES ***Increased soil carbon. More nutritious food. Increased biodiversity. Increased drought resilient landscapes. Elimination of hazardous pesticides and artificial fertilisers.***

TARGETS

☐ 4 COOL THE PLANET

- Reduce the Earth's temperature by more than 1°C.
- Reduce greenhouse gases in the atmosphere to pre-industrial levels.

☐ 5 MAKE NO MAJOR TRADEOFFS

- Protect and maintain ecological systems during and after policy implementation.
- Commit to democratic processes and protection of human rights during and after policy implementation.

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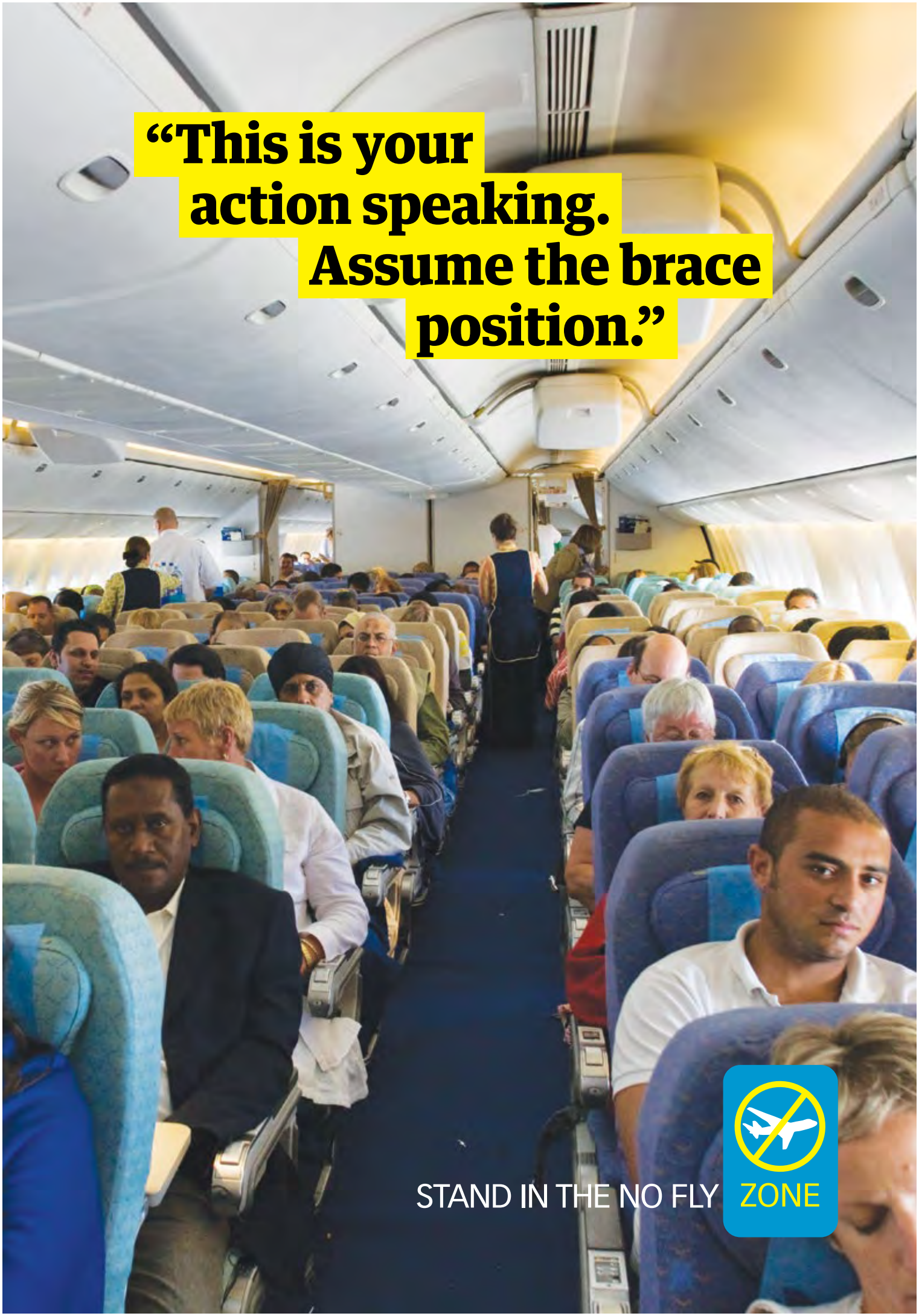
“This is your action speaking. Assume the brace position.”
STAND IN THE NO FLY ZONE