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Are technology myths stalling aviation climate policy?

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ABSTRACT

Emissions from aviation will continue to increase in the future, in contradiction of global climate policy objectives. Yet, airlines and airline organisations suggest that aviation will become climatically sustainable. This paper investigates this paradox by reviewing fuel-efficiency gains since the 1960s in comparison to aviation growth, and by linking these results to technology discourses, based on a two-tiered approach tracing technology-focused discourses over 20 years (1994–2013). Findings indicate that a wide range of solutions to growing emissions from aviation have been presented by industry, hyped in global media, and subsequently vanished to be replaced by new technology discourses. Redundant discourses often linger in the public domain, where they continue to be associated with industry aspirations of 'sustainable aviation' and 'zero-emission flight'. The paper highlights and discusses a number of technology discourses that constitute 'technology myths', and the role these 'myths' may be playing in the enduring but flawed promise of sustainable aviation. We conclude that technology myths require policy-makers to interpret and take into account technical uncertainty, which may result in inaction that continues to delay much needed progress in climate policy for aviation.

Introduction

Aviation has experienced substantial growth over the last 40 years. Aviation industry data show there were about 3700 aircraft in the global commercial fleet in 1970, and 9100 by 1990 (Boeing, 2014; Airbus, 2014). By 2010, this number had again more than doubled to 21,000. Even greater has been growth in revenue passenger kilometres (RPK), which increased nearly ninefold between 1970 and 2010, from 500 billion RPK in 1970 to 4500 billion in 2010 (Airbus, 2014). By 2030, industry expectations are that there will be approximately 40,000 aircraft producing more than 10,000 billion RPK per annum (Boeing, 2014). Continued growth after 2030 is expected: air travel will almost quadruple between 2005 and 2050, with an average worldwide growth rate of 3.5% per year, and energy use triple, accounting for 19% of all transport energy use in 2050, compared to 11% in 2006 (IEA, 2009; see also Owens et al., 2010).

There is thus strong evidence that aviation's global energy use and associated emissions have consistently grown and will continue to grow. This is in sharp contrast to pledges by industry to reduce *absolute* emissions from aviation through technology (e.g. IBAC, 2009; IATA, 2014). Formal responsibility for emission reductions, however, was assigned to the

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International Civil Aviation Organization, under the 1997 Kyoto Protocol, some 20 years after interactions between exhaust fumes and atmosphere chemistry had first been established (Fabian, 1974, 1978), and three years after aviation's impact on climate was first discussed in a comprehensive set of scientific proceedings (Schumann and Wurzel, 1994). Article 2(2) of the Kyoto Protocol excludes international aviation bunker fuel emissions from the reduction commitments of Annex I Parties. Aviation emissions are instead to be pursued through ICAO, in recognition of the difficulty of assigning responsibility for international emissions through individual countries (Clarke and Chagas, 2009). Emissions from domestic flights are included in national GHG inventories and are part of national emission reduction targets (Bows and Anderson, 2007).

The EU had been increasingly critical of ICAO's role in mitigation (Clarke and Chagas, 2009), and in 2005 commissioned a study to assess options to include aviation in the EU emission trading system (ETS) (Wit et al., 2005). Emissions from all flights from, to and within the European Economic Area (EEA) were initially to be included from 2012, with a cap of 97% of average annual emissions from 2004 to 2006, declining to 95% in subsequent years (European Parliament and Council, 2009). However, due to resistance from in particular the US, China, and Russia (Euractiv, 2014), until 2016 only emissions from flights within the EEA will fall under the EU ETS. In the meantime a global market-based mechanism addressing international aviation emissions is to be developed by ICAO to be implemented by 2020 (European Commission, 2014).

As a consequence, while global emissions from aviation continue to increase rapidly, no international policy will in the foreseeable future address this situation. The only approach to emission reductions, the EU ETS, is, as outlined, not functional, as it only includes aviation within the EEA: it is long-distance flights, however, that make up the majority of emissions (e.g. Peeters et al., 2007; Pels et al., 2014; Wood, 2011). Moreover, the system does not consider non-CO_2 emissions, implying that the contribution of aviation to radiative forcing may actually increase through emission trading (Lee and Sausen, 2000), which will result in cost increases too small to lead to significant behavioural change towards less flying (Jotzo, 2010; Mayor and Tol, 2009; Pentelow and Scott, 2010, 2011). In contrast, communication by airlines and airline organisations proposes that emissions from aviation will continuously decline and 'zero emission flight' will be achieved in the future, as evident in industry 'roadmaps' towards climatically sustainable aviation (Fig. 1; ATAG, 2010).

As Fig. 1 indicates, technology, air transport management (operations), infrastructure, as well as additional technologies and biofuels will ultimately result in absolute emission reductions – by 2050 (ATAG, 2010). Notably, the strategy implies that emissions from aviation continue to grow, and ATAG (2010) anticipates only modest growth rates until about 2020 (lower than the peak in 2007), when 'economic measures' will add to the effect of technology, operations, infrastructure and additional (yet unknown) technologies and (yet non-existing) biofuels. Underlying the graph is a proposition that aviation will become increasingly efficient, and that in the long run, low-carbon fuels will replace fossil fuels.

Yet, the strategy, presented in 2010, already contradicts actual emission pathways (Fig. 1, 'Scientific scenario' curve). By contrast, the sustainable emission pathway (Fig. 1, 'Sustainability goal' curve) clearly illustrates that the ATAG scenario represents a watering down of the challenge for sustainable aviation. With regard to efficiency gains, airlines have indeed become more efficient (Peeters and Middel, 2007), i.e. there has been a decline in fuel consumption per passenger kilometre (pkm) (Fig. 2). Since the 1960s, fuel consumption per pkm has declined rapidly, by some 70% (notably, however, jet pistons have been far more efficient). In particular A380 and B787 have made contributions to efficiency improvements, with the A380 being somewhat less efficient than the B787. While further improvements in efficiency can be expected, it also appears clear from Fig. 2 that year-on-year savings are likely to decline and it is questionable whether efficiency gains of 1.5% per year can be maintained up to 2020, or even to 2050, as envisaged by industry. Indeed, Peeters and Middel (2007) expect fuel efficiency gains to decline to <1% per year in the 2020s, a suggestion that would also be mirrored in comparisons of year-on-year fuel efficiency gains and observed absolute emission growth rates (Fig. 3). As shown in Fig. 3, growth in emissions has since the 1960s outpaced efficiency gains, a result of pkm volumes growing faster than efficiency gains.

In light of this situation, this paper focuses on the discourses surrounding aviation technology and specifically 'zero emission flight', a concept proposed by Snyder (1998) nearly two decades ago. New technologies, such as hydrogen fuel, have been sought in an "effort to achieve carbon neutral growth on the path to a zero emission future in aviation" (Nolte et al., 2012, p. 514), referring to aviation without impact on climate. As technological expectations have become increasingly hyperbolic in late industrial modernity, it is important to note that visions surrounding future technologies are not just important for mobilising engineers and scientists; they also play a central role in shaping market-based measures and infrastructure policy (Borup et al., 2006).

In this paper, such aviation technological discourses are framed as 'technology myths', with a 'myth' defined as an idea, story or narrative believed by many people, including decision makers, even though unfounded or false (Oxford English Dictionary, 2014). Myths may be uncritically held for various reasons (Heehs, 1994; Wessels, 2013), including in order to remain in denial of a given truth (*cf.* Stoll-Kleemann et al., 2001). Myths thus serve specific purposes and have real consequences, though in contrast to Sorel (1941), who originally discussed myths as mechanisms instigating action, this paper focuses on the role of technology myths in stalling progress in climate policy for aviation. As outlined by Gotesky (1952: 530), the function of a myth is to keep "...going against defeat, frustration, disappointment; and ... [to] preserve institutions and institutional process." Notably, according to Gotesky (1952), myths are accepted even though (or because) they are beyond empirical testing given their social utility.

Conceptions of myths in transport studies were first introduced by Essebo and Baeten (2012), who discuss notions of sustainable mobility as myths that incorporate two contradictory beliefs, i.e. that quantitative growth in mobility can be integrated with environmental conservation. Essebo and Baeten (2012: 555) consequently note a contradiction between rising emissions from transport in spite of technological innovation, concluding that "...myths create internal logics that help