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An evaluation of possible EU air transport emissions trading scheme allocation methods

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Abstract

The European Commission has been requested by member states to study the incorporation of air transport into their existing emissions trading scheme (ETS). Only CO_2 is to be included, at least initially.

This paper focuses on the method of allocation of emissions permits in the EU context. It has been assumed here that the EU ETS will be applied only to intra-EU flights and that airlines will be the entities selected for implementation. Three UK airlines were selected to evaluate three main types of allocation: grandfathering, auctioning and benchmarking. The airlines were representative of the three major airline business models: network, low-cost carrier and charter/leisure. Based on 2003/2004 aircraft/engine type and operating data, the per passenger impact of each allocation option was analysed for each airline. A new benchmarking approach is proposed that takes into account both the landing and take-off (LTO) cycle and per kilometre emissions: this avoids penalising shorter sector operators and focuses on the damage caused by aircraft and their engines and not on passengers.

Keywords: Aviation emissions trading; Aircraft emissions allocation; Airline environmental economics

1. Introduction

There has been a growing interest in the environmental impact of aviation, in terms of both noise and aircraft engine emissions. Discussions have included both mitigation measures and methods of internalisation of these environmental costs (or the principle of polluter pays).

This paper focuses on engine emissions, which have both local and climate change implications, and where the emphasis of most recent discussions has centred. This has taken place at an international, regional and local level: the standing Committee on Aviation Environmental Protection (CAEP) of the International Civil Aviation Organisation (ICAO) has been asked to investigate proposals for emissions trading, in addition to ICAO's role in setting international standards for engine emissions.

At the regional level, the European Commission is studying the possibility of incorporating emissions trading into their existing emissions trading scheme (ETS) from 2012 (European Commission, 1999, and subsequent press releases). They are also likely to introduce a directive that sets limits on local air quality that would also affect local emission levels around airports. Thus in Europe, aviation is likely before too l ong to be required to control or pay for both its local and climate change impacts of aircraft engine emissions. Up to now this has only been subject to longer-term changes through increasingly stringent ICAO standards applied to new aircraft engines and airport emissions charges at a few EU airports.

The pollutants considered as the main ones emitted from aircraft movements (Woodmansey and Patterson, 1994) are CO_2, particulate matter, SO_2, NO_x and HC. The first, CO_2, has lower unit social cost than the others, but the total amount emitted is far larger (especially for the cruise part of the flight). Social costs are defined as the damage to human health, vegetation, buildings and climate change. Their valuation is discussed in Mayeres et al. (1996) and Perl et al. (1997). The other pollutants account for a lower weight of emissions but have higher unit social costs. CO_2 is estimated to have the longest life (50–100 years) followed by methane (8–10 years), with NO_x lasting only a number

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of days or weeks. However, the global warming impact from aviation is compounded by the emissions of NO_x and water vapour in the upper atmosphere, the latter sometimes leading contrails and cirrus cloud formation (these effects are summarised in Annex 2 of European Commission, 2005). This is difficult to deal with through an ETS and it is intended to address it through other measures, one of which (standards) is discussed below.

Europe is the region of the world with the greatest pressure to reduce emissions, and it is also the region where almost all of the countries have ratified the Kyoto Convention. The EU has also pushed for the inclusion of environmental impacts in the EU/US aviation bilateral agreement. Growing concern is also evident in other world regions, reflected in the work programme of ICAO referred to above.

The first section of this paper will discuss Kyoto and the context for emissions trading, and the efforts at an international and regional level to reduce aircraft engine emissions. This will be followed by a look at the various voluntary measures (targets) initiated by the industry. The fact that such progress is too slow (see ECAC, 2005) leads to the need for imposing incentives, which can be addressed through emissions trading.

2. Means of engine emissions reduction

2.1. Regulatory standards

Regulatory initiatives have been taken in order to limit both local health impacts of emissions and climate change gases. The first covers a number of gases and is more relevant to airports, with air transport treated in the same way as other industries. The second is focused on CO_2 and NO_x, and the cruise mode of operations, with air transport generally thought to have a greater impact on climate change than suggested by its output of these gases.

It is more appropriate to introduce local measures to reduce landing and take-off (LTO) emissions; however, the greenhouse gas elements of these are also relevant to the climate change gas stabilisation that is incorporated in the United Nations Framework Convention on Climate Change (UNFCCC) and subsequent Kyoto Protocol. Article 2.2 requires the parties to work towards the limitation in emissions through ICAO, without laying down any timescale (International Air Transport Association (IATA), 2001).

Up to this point, ICAO's involvement in this field had been the encouragement of improved emissions of new aircraft engines. Aircraft are required to meet the engine certification standards adopted by the Council of ICAO. These are contained in *Annex 16—Environmental Protection, Volume II—Aircraft Engine Emissions* to the Convention on International Civil Aviation. These were originally designed to respond to concerns regarding air quality in the vicinity of airports. As a consequence, they establish limits for emissions of oxides of nitrogen (NO_x), carbon monoxide, unburned hydrocarbons, for a reference LTO cycle below 915 m of altitude (3000 ft). There are also provisions regarding smoke and vented fuel.

2.2. Trends and targets

Airlines and their associations have set themselves targets for increased fuel efficiency, which provide proxies for CO_2 efficiency gains. The International Air Transport Association (IATA) adopted a goal of achieving a 26% improvement overall between 1990 and 2012 in litres per 100 revenue tonne-kms or RTKs (IATA, 2005). This was not especially onerous, since airlines such as British Airways had already achieved a 20% improvement by 2000.

British Airways has a target of a 30% improvement in fuel efficiency between 1990 and 2010 (British Airways, 2004). The metric they use is RTKs per gallon and they are close to achieving this goal with their 2005 level 27% below the 1990 level (British Airways, 2006).

The first aviation and environment summit convened by the major international air transport airline and airport trade associations highlighted the 70% improvement in fuel efficiency over the past 40 years (ATAG et al., 2005). This study compared today's modern aircraft with a fuel consumption of 3.5 l per 100 passenger-km with similar consumption for a modern compact car. They concluded with a shorter term target of 4.0 l per 100 passenger-km in 2008, versus an average of 4.5 in 2002. This is an average annual reduction of 1.9%, significantly higher than recent trends, and achievable through the implementation of improved operational practices.

In the longer term, fuel efficiency (and thus CO_2 efficiency) improvements have been possible of little more than 1% a year, and this is expected to slow in the future (see Table 9-2 in IPCC, 1999). With traffic forecast to grow by 4–5% a year, emissions are clearly set to increase significantly unless further measures can be introduced. Emissions trading provides the means to do this most economically, without resorting to physical controls.

There is a range of existing technologies now available to reduce fuel burn considerably faster than the more recent trend. Green (2005) describes the technologies available for reducing fuel burn and NO_x, as well as contrails. For fuel burn, they range from the operational improvements identified in ICAO of 8% to the laminar flying wing with open rotor propulsion that would produce an almost 70% reduction in fuel burn per tonne-km.

Over the past 20–30 years there has been some economic incentive to apply new technologies from intermittent spikes in jet kerosene prices. Airlines may be entering a period of high fuel prices of longer duration, which would by itself give an incentive to technical innovation. This would have a beneficial impact on fuel burn and CO_2, but possibly an adverse affect on NO_x.

ACARE introduced a target of a 50% reduction in CO_2 emission per tonne-km for an aircraft entering production