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Local emission charges – A new economic instrument at German airports

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A B S T R A C T

In January 2008, charges were introduced at selected German airports aimed at reducing local emissions of nitrogen oxide and hydrocarbon. The charge is aimed at setting economic incentives to accelerate the introduction and foster the use of environmentally friendly engine technology and is designed to be revenue-neutral in the sense that it does not increase the airports' overall revenues from air traffic. To achieve this, the general landing fees need to be decreased by the amount of the emission charge. The introduction of this charge will have economic impacts on airlines and may have an impact on airline competition in the German air transport market. Case studies based on empirical data are presented for selected German airports. The results indicate that airline's finances will be affected differently by the emission charge, depending on the engines employed and on the aircraft population of the airport considered.

1. Background and objectives

A new emission charge was introduced to improve local air quality in the vicinity of German airports. Emissions of nitrous oxide (NO_x) and hydrocarbon (HC) being emitted during the landing- and take-off-cycle (LTO cycle) are charged. NO_x and HC are the main contributors to combustion-related local air pollution and precursors of ground level ozone. A positive more wide spread side-effect of the charge on local NO_x emissions is that it will also reduce greenhouse gas effects – NO_x is not limited by the Kyoto protocol. Because more NO_x friendly engines are used, the amount of the gas emitted will be reduced at cruise level as well as below 3000ft during the LTO cycle. On the other hand, a trade-off exists between the reduction of NO_x and CO_2 because aircraft engines can technologically be optimized either to minimise the use of fuel, and thus CO_2 emissions, or to minimise NO_x emissions.

The new emission charge in Germany aims at offering an economic incentive to reduce NO_x and HC emissions by allowing carriers employing relatively environmentally friendly engine technologies to cut their landing fees. In contrast, airlines using engines emitting a relatively high amount of these pollutants, will have to pay higher landing fees. At the same time the charge is designed to be revenue-neutral in the sense that it does not increase an airport's overall revenue from air traffic. Therefore the charge aims at achieving environmental and not fiscal goals.

2. Current European approaches

An aircraft emission charge on local NO_x and HC emissions was first introduced in Switzerland in 1997 and in Sweden in 1998. All turbofan engines with more than 26.7 kN thrust were ranked according to their specific emissions establishing different emission classes – five classes in Switzerland and seven classes in Sweden. In 2000, airline and other industry representatives expressed their wish for a harmonization of the different European emission charges. For this reason, a Europe-wide harmonized approach was developed by a European Civil Aviation Conference (ECAC) (2003) working group between 2000 and 2003. This group created the ERLIG formula that provides a methodology for classifying and calculating NO_x and HC emissions deriving from aircraft engines. Local emission charges following these guidelines were introduced in Sweden and at London Heathrow Airport in 2004, London Gatwick Airport followed in 2005.

In January 2008, an emission charge based on ERLIG recommendations was introduced in Germany at Frankfurt and Munich Airports (Fraport, 2007), Cologne Bonn Airport followed in April 2008 and Hamburg Airport will act accordingly in 2010. In Germany, the introduction of the local emission charge is understood as a three-year pilot phase. After this pilot phase, the environmental and economical impacts of the charge will be investigated and the design of the charge may be subject to modifications. Switzerland is planning to modify its system of local emission charges and moving towards the Europe-wide harmonized approach. While the goal of establishing economic incentives and the principle of revenue neutrality have been practically

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identical in Sweden, UK and Germany, the methods of calculating the amount of the charge, on determining thresholds and the method of achieving revenue neutrality differ.

At the European Union (EU) level, the Commission has since 2008, been analyzing whether additional charges on NO_x emissions at European airports can be a viable approach to reduce international aviation's climate impact. Measures under consideration of the EU Commission include (CE Delft, 2008b); a NO_x charge modified by a distance factor, an en-route charge on NO_x emissions, an increased NO_x stringency for LTO emissions standard and a multiplier on CO_2 emissions.

This approach is part of the general EU strategy to examine the full range of external costs for all modes of transport, to analyse the impact of the internalisation of external costs and to prepare a stepwise internalisation program for the EU (Council of the European Union, 1999). Research conducted since the late 1960s suggests that economic instruments based on social marginal cost pricing could lead to considerable benefits compared to rather traditional 'command-and-control' politics (CE Delft, 2008a). Cost efficient transport pricing has also been advocated in a number of policy documents published by the EU Commission, notably the 2006 mid-term review of the White paper on the EU transport policy (Commission of the European Communities, 2001, 2007) and the Greening Transport Package from July 2008 (Commission of the European Communities, 2008a, b, c).

Another important regulatory measure is the inclusion of international aviation into the EU Emissions Trading Scheme (EU ETS) for the limitation of CO_2 emissions. According to the EU Directive (Council of the European Union, 2009), which came into force in February 2009, international aviation will be included in the EU ETS from 2012 (Scheelhaase et al., in press). As an additionally incentive for reductions of NO_x emissions, the EU Commission will put forward a proposal for a directive that is expected in 2010.

3. Local emission charges for airports in Germany

The emission charge for German airports is designed around the ERLIG recommendations to guarantee a high level of international compatibility. Another important goal has been to find the most practicable rules and regulations for both airports and airlines. The German Aerospace Centre (DLR) conducted two studies on this issue on behalf of the German Federal Ministry of Transport (Zukunft, 2002; Scheelhaase et al., 2005) and is supporting the implementation of the new instrument at the participating German airports by providing a common data basis for the calculation of the emission charge; as of September 2009 there was emission-specific data covering about 17,000 aircraft.

The emission charge can be implemented by German airports on a voluntary basis. If an airport wishes to participate, it has to apply. The charge only relates to local NO_x and HC emissions around airports. Because "summer smog" is a local environmental problem, the standardized International Civil Aviation Organisation (ICAO) LTO cycle (landing and take-off movements below 3000 ft) is the basis for calculating and charging emissions (Fig. 1). All aircraft are charged for their NO_x and HC emissions during the LTO cycle with all types of engines being included so that the charge is non-discriminatory.

Three sets of data are used for the calculation of NO_x and HC emissions:

1. Data for turbofan engines of more than 26.7 kN thrust is taken from the ICAO "Aircraft Engine Exhaust Emissions Data Bank" (International Civil Aviation Organisation, 2004).
2. Emissions deriving from turbofan engines of less than 26.7 kN thrust and from so-called unregulated engines (e. g. helicopters or other very small aircraft) will be calculated by using the "Emission Value Matrix for Aircraft with Unregulated Engines" developed by the Swiss Federal Office for Civil Aviation and the Swedish Civil Aviation Authority (Unique AG, 2003).
3. Emission data of turboprop engines is reported by engine manufacturers to the Swedish Aeronautical Institute (FOI) and has been made available to DLR and to the participating German airports.

Because of local conditions, actual emissions may differ from the emissions stated in the data banks but the use of a single recommended data basis is needed for the standardization and harmonization of local emission charges aimed for at European airports.

The German emission charge will be calculated in three consecutive steps. In a first step, the total NO_x emissions of the engine are calculated. This is done by using the ERLIG formula

$$NO_x\,\text{Aircraft} = E \times \sum_{\text{LTO-modes}} (60 \times T \times F \times I_{NOX}/1000) \quad (1)$$

where: E is the number of engines fitted to the aircraft; T is the time in mode according to Table 1 (in min); F is the fuel flow per mode (in kg/s); and I_{NOx} is the NO_x emission index per mode (in g/kg fuel). The standardized times of the LTO modes as well as the thrust-settings are taken from the ICAO LTO cycle.

By inserting the engine-specific data from the data banks, the number of engines of the aircraft under consideration as well as the time in mode and the fuel flow per LTO mode shown in Table 1 into the ERLIG formula, NO_x emissions for virtually any given airframe/engine combination during the LTO cycle can be calculated.

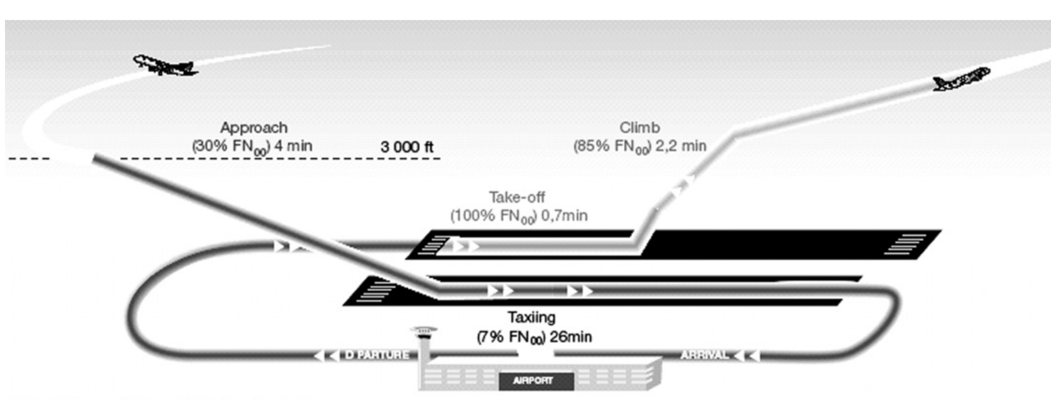

Fig. 1. ICAO LTO Cycle. Source: International Civil Aviation Organisation, 1993.