AIRCLIP – Airports and Climate Preservation

David STEIN, Gregor WILTSCHKO, Daniel NITSCH, Andor FARKAS, Manfred SCHRENK

(David STEIN, M.Sc., CEIT Alanova, CEIT Alanova, Am Concordepark 2, 2320 Schwechat, Austria, d.stein@ceit.at)
(Gregor WILTSCHKO, CEIT Alanova, g.wiltschko@ceit.at)
(Mag. Andor FARKAS, CEIT Alanova, a.farkas@ceit.at)
(Mag. Daniel NITSCH, CEIT Alanova, d.nitsch@ceit.at)
(DI Manfred SCHRENK, m.schrenk@ceit.at)

1   ABSTRACT

The growth in air travel has drawn much attention to the level of emissions caused by aircraft engines, however ground operations at airports have often been overlooked when considering wholistic strategies for lowering emission levels in air transport. Airports meanwhile have increased their strategic importance and function as major transport nodes and sources of employment within their respective metropolitan regions. Therefore urban planners and policy makers should place more importance on limiting the environmental impacts caused by the various operations and services found at airports. This is especially true concerning the implementation of environmentally friendly technologies at airports in the areas of waste management, logistics, resource management, transport planning, and mobility management. The research project AIRCLIP includes information gathering, classification and evaluation of activities dealing with environmental impacts at airports. AIRCLIP concludes with concrete recommendations and strategies for the implementation of relevant technologies and infrastructure investments at Austrian airports. Vienna International Airport (VIE), as the largest Austrian airport, will serve as the case study of this investigation. The results of this research project will recommend the implementation of those environmentally friendly activities and courses of action most suitable for Vienna's International Airport (VIE) and other Austrian airports.

AIRCLIP will investigate the range of international best practices implemented at various airports around the world by means of a survey and literature research. After the analysis, the project will continue to investigate those measures which are most feasible for Vienna International Airport through a quantitative and qualitative evaluation. As a result, the project will recommend concrete courses of action for implementing environmentally friendly measures that are at the same time economical and ecologicaly pragmatic. Therefore, the results of AIRCLIP should be transparent and transferable to other airports around the world.

The Project AIRCLIP is part of the research programme TAKE OFF, conducted and financed by the Austrian Ministry for Traffic, Innovation and Technology (BMVIT) and the Austrian Research Promotional Agency (FFG). Additionally to a workshop at the Corp-2008, the results will be presented in a final international conference in December 2008. The results will also be presented as a public report.

2   THE PROJECT AIRCLIP

2.1   Introduction

Recent developments in civil aviation can be attributed to a growing globalized society in which mobility over long distances has increasingly played a large role. As this rate of development has resulted in an increasing level of energy consumption and emissions, environmental protection and efforts to hinder climate change have become the modern scientific challenge of all times. Research of eco-friendly measures in air transportation focus mostly on developing technical improvements of aircraft. Even though aircraft are responsible for contributing to a large share of emissions in air transport, groundside operations and infrastructure also produce a significant amount of pollution. Nevertheless, much research in air transport still focus mostly on technology related initiatives for aircraft engines.

Airports serve as the focus of scientific research in AIRCLIP as they are not only exclusively hubs for passenger and freight transportation but also function as centres for tourism, shopping, business, work and leisure. Additionally, airports function as intermodal facilities for different modes of transport. Therefore, a wider range of differentiated and complex activities can be found at airports.

Environmental effects are not limited to noise pollution, but also include airborne emissions, which stem from both airside and landside based activities. Climate protection measures and technologies should focus on airside as well as landside activities. Airside operations include ground movements of aircraft (taxiing) as

well as maintenance vehicles. Also, machinery and infrastructure at airports, whether on the runway apron or for waste management require special climate-friendly measures. Relevant landside operations include energy consumption and emissions of airport buildings, waste disposal, but also the aspects of commuting of passengers and employees to and from the airport.

Several international examples show that environmental protection plays a major role in the strategy and development plans of many airports around the world. Such solutions include logistic and technological measures to improve energy efficiency of airport facilities as well as the use of renewable energy sources, the construction of sustainable airport buildings, and the use of low-emission fuels for airside maintenance vehicles. An increased awareness in "green" environmental measures does contribute to a higher demand for technology and possibilities of climate-friendly measures at the airport.

2.2   The Research

The research project AIRCLIP will perform basic research for climate-protection and necessary measures for the development and planning of airports as complex infrastructure with its various land- and airside actions.

The basic research steps taken will collect information about international best practices in all possible fields of airport research. The aim is to describe the possibilities for evaluating and implementing best practice measures for Vienna International Airport (VIE). Discussions about this topic should focus on the abilities of airports around the world to benefit economically through the adaptation of environmentally friendly measures. Therefore, the Project AIRCLIP should provide the needed assistance to VIE in order that it contributes to the international commitments of climate protection such as the Kyoto Protocal to which Austria is a signatory.

The project consists out of the following stages:

- Definition of the research framework
- Data collection about energy saving measures taken at international airports (Best-Practice-Study).
- Quantitative and qualitative evaluation of the collected data.
- Transfer of filtered results to VIE
- Strategy implementation phase

Concurrent to the evaluation of survey and other collected results on best practices, the Airclip research team will make an analysis of Vienna International Airport's operating environment in order to prepare for the transfer of all appropriate measures. During the transfer stage, the research team will evaluate the measures according to economic and ecologic criterion as well as to their feasibility.

Finally, during the strategy phase, the research team will develop and document concrete recommendations. In the final stage, CEIT-Alanova will organize a workshop to discuss the results with international experts in this field.

The results should provide an overview of potential environmentally-friendly measures and give an index of recommended implementations. They will include recommendations for the possible implementation of measures or infrastructural modifications to be made at Austrian airports. The examined practices focus on the areas of supply and disposal, resource management, traffic organization, and logistics.

The most important case to be made for conducting this research is to bring environmental improvements to Vienna International Airport, which, as the largest airport in Austria and as one of the largest airports in Central Europe, would signify the potential for ecological, economic and technical aspects to guide VIE's decisionmaking concerning environmental improvements and provide a best-practice case study for other major airports of similar size and stature.

2.3   Results

CEIT-Alanova will present the results of this research to the Austrian air transport industry for their own intended use. After making the necessary technical and monetary efforts, airports are expected to benefit through these measures. The integrated approach of the entire airport system which integrates airside and landside processes gives the project an innovative character and goes beyond interdisciplinary descriptions and evaluations.

The collection of international examples will provide a high level of comparison and a solid evaluation of measures, as well as a realistic estimation of their potential. Additionally, this study will offer to support their implementations through follow-up research. The transfer of research results will be a valuable aspect of this study as it will offer climate protection as well as the improvement of economic efficiency and optimized use of resources. Therefore, it can contribute to the optimization of the entire system of the Austrian air transport sector.

2.4 Defining the Airport System

2.4.1 Defining Airports according to Functions

AIRCLIP has to outline the approaches for classifying airport and related activities. Such approaches are useful for making finer definitions such as differentiating between landside and airside activities at airports. Five approaches were developed for characterizing and defining airport activities. Such definitions will be useful in creating a system of measures for reducing impacts of airports and new synergies and potential for cooperation between various interest groups as well as allow for a more integrative form of analysis that avoids simply focussing on just the "operational, technical" issues for improving the ecological impacts of airports.

Defining the Airport System, the following definitions were created for AIRCLIP:

a) Activity approach

b) Spatial approach

c) Marketing approach

d) Accessibility approach

e) Stakeholder approach

The *Activity Approach (a.)* differentiates between the basic categories of services that take place on and around an airport (ie such as classifying aviation and non-aviation activities). Aviation activities are those operations defined by the technical operation of the airport, directly supporting the air traffic function (Güller & Güller 2003). Non-aviation activities, such as shopping, cafes and restaurants can also be found at an airside airport sites but are more than likely to make up the core of activities at the landside end of operations. Airport related activities (logistical, distributional and operational business) are mainly located within the airport area. Airport-oriented activities can be found both, directly at the airport but also away from it, in the broader airport region. Among others these businesses include hotels, restaurants, exhibition centers, large scale international transport, distribution and logistics centers (Güller and Güller 2003).

The *Spatial Approach (b.)* de-limits activities, specifically at airports, according to whether they are airside or landside events. Airside activities are those activities that take place either at an airport's terminal before the boarding gates that cater to flying passenger's needs when using an airport facility. Airside activities also include those activities taking place along an airports apron or runway either to prepare an aircraft for its next departure or to service an aircraft after its arrival. Shopping mall concepts merged into passenger terminals (with retail, restaurants, leisure) and logistics and air cargo facilities are some examples of airside activities. Landside activities are those which consist of the amenities for passengers either before boarding or after exiting the airport system. Such activities, however, have also expanded their use to potential customers who are not flying. Hotels and entertainment, office and retail complexes, convention and exhibition centers, free trade zones and time-sensitive goods processing are examples of landside processes (Kasarda 2006).

The *Marketing Approach (c)* looks at the geographic scope in which marketing plays in promoting airports. The concept for marketing a "greener airport" would raise awareness for making airports more environmentally friendly. Such an approach may even justify the introduction of anti-polluting measures that are more costly in terms of operations but nevertheless reinforce the "green image" that an airport wants to promote. Otherwise, airports have traditionally marketed themselves based on factors that appeal to the idea of comfort during a journey; this would include such incentives as the availability of flights to various destinations, level of services and amenities at the airport, short waiting and processing time, and in certain cases, the ease of accessibility and amount of parking that an airport might have.

The *Accessibility Approach (d)* outlines the transportation connections between the airport and its outer environment in terms of terminal stations and modes of travel. By using such an approach, we could discuss the importance of impact reductions through increasing multi-modal accessibility for airport passengers and employees.

The *Stakeholder Approach (e)* gives the perspective of various stakeholders at airports, such as the airport authority and the airlines but also transportation providers, vendors and concessions, hotel and conference facilitators are considered to be among the many actors within airport cities.

These approaches have their respective perspectives but could also be seen in terms of their related characteristics. The Activity and Spatial Approaches (a & b) match together the various activities that take place at airports, whether aviation or non-aviation, according to airside or non-airside environments. While the airside environment is likely to be dominated by aviation related activities, landside activities, on the other hand, could be a combination of aviation and non-aviation related activities. Airport-related activities are likely to take place both at airside and landside environments, and airport-orientated activities strictly take place in a landside environment. The accessibility approach is for the most part a landside activity. While most traffic to airports is generated by passengers and airport employees, airport cities, due to the variety of activities that they host, are experiencing a growing percentage of activities that are non-aviation related. The marketing and stakeholders approaches (c & e) are related processes since stakeholder interests will determine the extent of achieving "greener measures" at airports. In the meantime, marketing in itself could increase stakeholder interest and even attract new investors to become stakeholders in an airports "greening process".

2.4.2   Definition of Airports according Size

A breakdown of airport classification using studies conducted by the Boston Consulting Group and by the European Commission's Airports Council International (ACI, according to a European Commission´s Working Paper), four basic classifications groups were established by each agency, both according to each agency's own methodology. Whereas BCG (2004) established its order according to the extent an airport is either an 1.) international hub (ie Heathrow, Frankfurt and New York JFK) 2.) major airports that serve as an international origin & destination (O & D) airport (ie. Sydney) 3.) a secondary hub or O & D Airport (ie. Vienna) or 4.) a regional airport (Innsbruck), the ACI Group (2008) based its decision according to passenger volumes: 1.) >25 million/year 2.) 10 to 25 mil./yr 3.) 5-10 mil./yr 4.) <5 mil./year. In any case, our investigations of airports should consider their size and capacity, since, theoretically, the larger the mitigated measure taken at an airport, the larger its effective impact when airport size is taken into account.
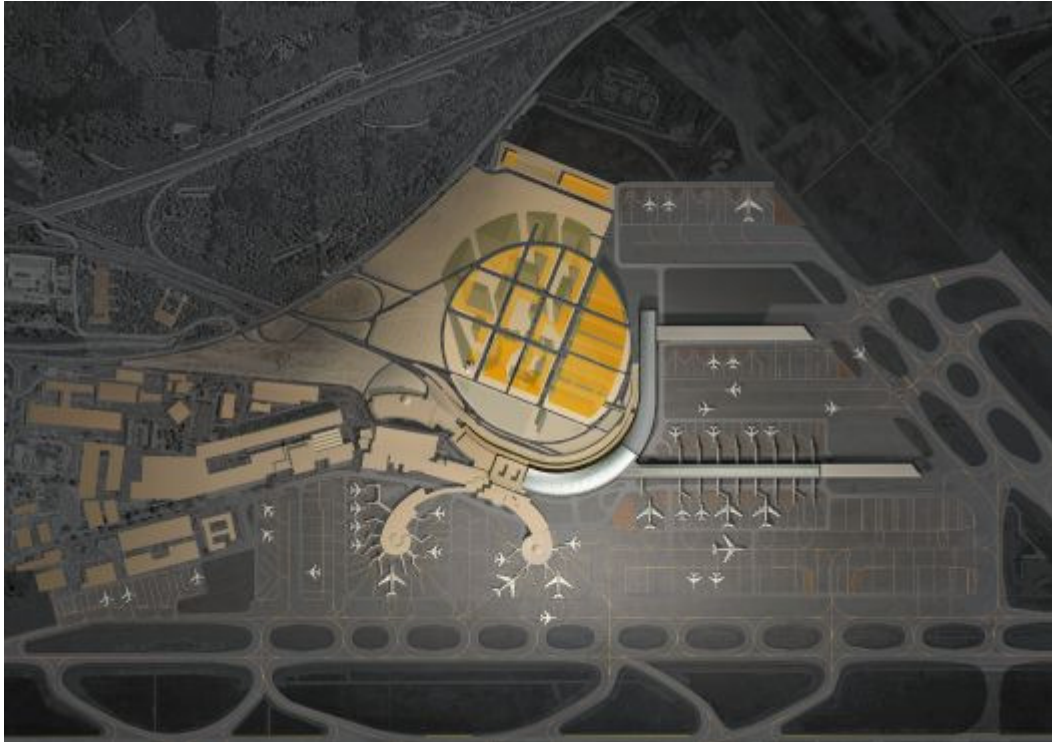
2.4.3   ” Defining an “Airport City

Fig. 1: Layout of Vienna's Airport after its current expansion scheduled in 2009 (Facts&Figures:Vienna International Airport GmbH)

The term *"airport city"* describes a new understanding of airports as dynamic centers of activity for travelling, shopping, business, leisure and even housing, whereas non-aviation activities have a significant importance (Güller & Güller 2003). Apart from its primary functions such as handling passengers, freight and aircraft, airports play a strategic role in regional development and are key facilities for a region's level of competitiveness. On the one hand they are catalysts for economic activity and create direct and indirect employment benefits. Beside their function as intermodal transport nodes, modern airports nowadays are surrounded by hotels and shopping facilities, provide office space and conference rooms. Airports, on the other hand, are a direct source of environmental impacts and therefore require that certain land use forms are excluded in their direct vicinities.

AIRCLIP will take into consideration those impacts that an airport would have as it expands into an "airport city". Based on the airport city concept, the planning task airport city moves away from a purely "technical airport planning" towards a more integrative approach including urban planning issues. As this happens, it would be critical from the standpoint of an airport operator as well as from a regional authority to establish a form of public-private cooperation within an airport-city in order to address the issues of growth and economic development. Such a partnership would also be useful in addressing the impacts that aviation and non-aviation businesses would have on an airport's environment. An airport city encompasses not only the airport at the core of its economic activities but also the related aviation as well as non-aviation activities located within the intermediate and outer airport region (compare Fig. 1).

It can therefore be summarized that two main trends in airport development, namely the increasing importance of non-aviation businesses and the improvement of multimodal infrastructure leads to the concept of an airport city. This spatial dimension has to be taken into consideration when defining and evaluating environmental issues concerning CO_2-emissions as well.

2.5   Guidelines given by international and national climate policies

2.5.1   Energy Policy of the European Union

Air transport will be influenced by the *Biofuels Directive (2001)*, which states that 5.75 % of all transport fossil fuels are to be replaced by bio fuels by the end of 2010. This affects aircraft and ground operations vehicles, as they have to be equipped accordingly.

The *Directive on the energy performance of buildings (2006)* requires new buildings, as well as "large existing buildings undergoing refurbishment" (e.g. airport terminals) to meet certain minimum energy requirements. Boilers and air conditioners must be regularly inspected to maintain high levels of energy efficiency. This directive has of course severe impact on airport planning, since airport terminals already have high start-up costs. It has to be determined early in the planning phase how a terminal facility will meet not only current energy efficiency regulations, but also how it can easily be modified to meet future regulations. Terminals, hangars and warehouses will have to undergo frequent modifications. Also, heating and cooling systems have to be kept state of the art due to strict efficiency limits for such systems.

2.5.2   Climate Strategy of Austria

Austria's biggest contributions to the emissions of greenhouse gases were in the sectors of transport and energy production (Gugele et al, 2006). Worldwide, air transport contributed 3.5 % to the greenhouse effect (Vienna International Airport, 2004, p 48).The reduction of emissions by air transport is a crucial goal, as by 2012, international aviation will be included into the European Union Emissions Trading Scheme (EU ETS).

However, it is not only aircraft that generates emissions but also airports. The AIRCLIP Project aims to discover potential in reducing emissions through measures made in ground operations and also through improving the share of public transport and other environmentally friendly forms of transport for connecting the airport with its surrounding environment (i.e. Airport region, Airport City, etc.).

The potential of reducing emissions could also be covered by exporting best practices already used at Austrian airports. The CDM (Clean Development Mechanism) programme credits industrialized countries when they implement their CO_2 reducing technology in developing countries. The JI (Joint Implementation) targets measures taken in other industrialized countries. To obtain credits from these two programmes, one has to prove that the implementations abroad would not have been fulfilled without this incentive.

The CDM and JI programmes can be seen as not only a cheaper way to reduce emissions – the cost of reducing emissions abroad may be much lower than in Austria, but it can also be seen as a way to transfer environmentally friendly technology into developing countries in order to let them achieve emission reduction measures at the level of developed countries. Therefore, AIRCLIP will also list measures and good practices that VIE as well as other Austrian airports could export to airports in other countries since, through the CDM and JI programmes, such measures could help each individual airport obtain credits for their targets in achieving overall emission reductions.

2.6   The Best Practice Study

2.6.1   Best Practices

The measures can be categorized into four core applications according to different spatial dimensions, after a definition framework of the "system airport" is completed. During the first phase of our research, a couple of good practices were already discovered and will be investigated further during the progress of the study.

Examples of good practices of other airports including airside measures:

- Measures to reduce the use of the Auxiliar Power Unit (APU) of an aircraft.
- Installing electric outlets on hardstands to substitute Ground Power Units (GPU)
- Measures to reduce taxiing times of aircraft
- Refueling of Aircraft: Fuel pipelines to substitute fuel tankers.
- Increasing the efficiency of ground operations, like loading, unloading, maintenance.
- Use of bio-degradeable de-icing agents.

And landside measures:

- Construction of low-energy terminal buildings brings significant reduction of energy consumption for heating and cooling
- Installing sensors to shut down light and conditioning in unused parts of the terminal

- Improving the modal split: Encouraging passengers and employees to use public transport to get to the airport
- Other commuting programmes include car-sharing initiatives or the improvement of non-motorized access to the airport.
- Recycling programmes

Several airports worldwide already committed themselves to a strict environmental certification, like ISO 14001. Stockholm's Arlanda Airport has undertaken a wide range of eco-friendly measures, but also several other airports around the world have implemented several measures that are worth examining.

2.6.2 The Questionnaire

A standardized online questionnaire was sent to several airports around the world in late April to determine the measures that airports have taken in reducing their environmental impacts and energy needs. The questionnaire surveyed the airports on the various impacts of their operations ranging from the mode of travel made by passenger and airport employees to the form of energy supplies used for terminal buildings or the fleet of vehicles used to service aircraft on airport runways. Airports were also surveyed as to whether they organized any programs to promote environmental awareness (ie ridesharing, recycling programs) and the extent that they have conducted environmental reporting. The responses should provide examples of environmentally good practices. However, in certain cases there will be the need for follow-up questions for some airports. Furthermore, surveyed airports were also given the opportunity to evaluate their own perceived image of being an environmentally friendly airport. As an incentive for cooperation, the final results of our study will be shared with participating airports.

Figure 2: AIRCLIP on-line questionnaire for airports

3   CONCLUSION

Ground operations at airports are often overlooked when considering wholistic strategies for lowering emission levels in air transport. The project AIRCLIP will take into account the growing impacts that airports have on emissions and energy needs. Airports have increased their strategic importance and function as major transport nodes and sources of employment within their respective metropolitan regions. Therefore, urban planners and policy makers should place more importance on limiting the environmental impacts caused by the various operations and services found at airports.

AIRCLIP includes a scientific process of information gathering, classification and evaluation of activities dealing with environmental impacts at airports and, as part of its conclusion, will recommend strategies for implementing the relevant technology and infrastructure investments at Vienna International Airport (VIE) as well as at other Austrian airports. AIRCLIP will also list those measures and good practices already widely implemented at Austrian airports as their CO_2 reduction objectives can still be exported to foreign countries through CDM and JI programmes in order for Austria to obtain credits for achieving CO_2-reduction. Therefore, the results of AIRCLIP should be transparent and transferable to other airports around the world.

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