AIRCLIP – Airports and Climate Preservation

1 AIRPORTS, AIRPORT REGIONS AND ENVIRONMENT

1.1 Airports, the aviation industry and the environment

Recent developments in civil aviation can be attributed to an increasingly globalized society in which mobility over long distances becomes more and more important – and more and more common as well. Paradoxically, the improvement of information and communication technology infrastructure (ICT) does not appear to lessen air travel, but actually to foster it as the global reach of companies is extended and information about recreational (touristic) opportunities abroad become more easily accessible via the internet. Because globalization and the concomitant increase in air travel has been accompanied by rising energy consumption and emissions, environmental protection and efforts to prevent climate change have become the modern scientific challenge of our times. To date, research into eco-friendly measures for the air transport industry have focused primarily on developing technical improvements for aircraft. Although aircraft contribute a large share of emissions, groundside operations and infrastructure also produce a significant amount of pollution. Moreover, the emissions associated with such operations continue to grow as airports evolve into city-like hubs of economic activities – airport cities.

In addition to carbon emissions (CO_2), other major *environmental* concerns at most airports include noise, local air quality, ground and surface water and soil quality, recycling and sustainability as well as habitat and wildlife management (Airport Council International [ACI]. *Airports-Actions on Climate Change*. [2008]). Because of the growing importance of landside operations and the evolution of airport cities, environmental and *climate protection* measures and technologies at airports 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 from airport buildings, waste disposal, but also the impact of passengers and employees commuting to and from the airport.

Environmental protection has come to play a major role in the strategy and development plans of many airports around the world and is also recognized by the Airport Council International (ACI) which represents 1,679 airports in 177 countries.

1.2 Airports, airport cities and airport regions

Apart from their primary functions such as handling passengers, freight and aircraft, airports nowadays play a strategic role in regional development and are key facilities for the competitiveness of any territory. Airports are engines for economic activity, create direct and indirect employment and may act as innovative centres for new (environmental) technologies within a region. Moreover, modern airports function as intermodal transport nodes and incorporate hotels, shopping facilities, office space, conference rooms and leisure facilities. As such, they are recognized as clusters from a general spatial perspective and “airport cities” in specific if they show the qualitative features of a city: density, access, quality, environment, services (Güller, Mathias/Güller, Michael [2003]).

Although the evolution of airports into airport cities and airport regions is driven by the general increase in the role of aviation for both business and leisure travel, landside activities are being increasingly important sources of income for the airports themselves. Services, real-estate business, concessions, parking and other activities potentially make up 50% of the airports’ profit (Güller, Mathias/Güller, Michael [2003]; AT Kearney [2006]). Concomitant

to the economic development of the airport and its landside activities, airports are also evolving into multi-modal transportation hubs. High speed trains and international bus lines complement the destination map of the airport and increase the accessibility of the region as well. As a result, the airport's importance from an environmental perspective increases also through its role as a transport and interchange node combining different modes of transport, both public and individual. In consideration of airport city concept, three spatial layers (see figure 1) were applied in our research into the potential fields to reduce CO_2 emissions at airports.

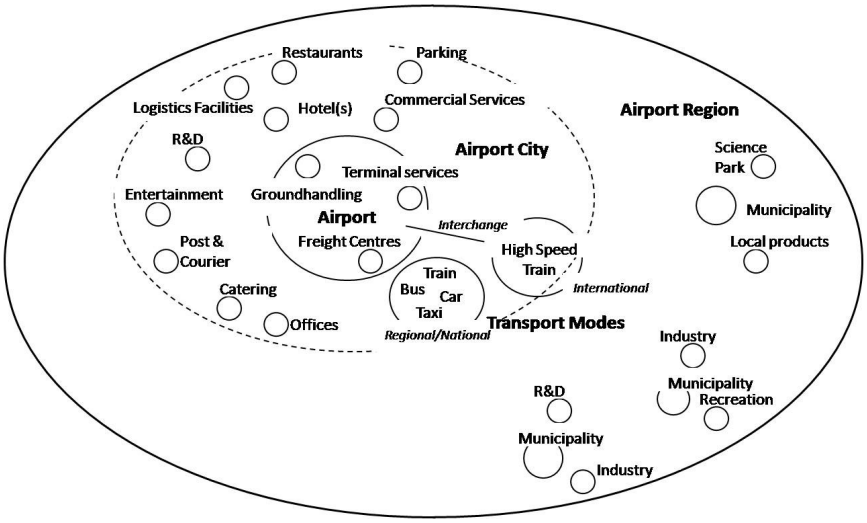


Figure 1: Airport, airport city and airport region (own illustration based on Güller, Mathias/Güller, Michael (2003). *From Airport to Airportcity.* Barcelona. Güller & Güller architecture – urbanism)

2 AIRCLIP RESEARCH STUDY

2.1 Introduction

Research activities in different areas of the air transport industry deal with the development of technologies for climate protection, energy efficiency and sustainability, whereas airports represent one field of action in this area. As a result of both increasing air traffic (at least until 2008) and growing awareness of the rising energy use and emissions throughout the aeronautical industry, environmental issues and climate protection are gaining attention from a research perspective.

The project AIRCLIP is part of the national research programme TAKE OFF, conducted and financed by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT) as the programme owner and the Austrian Research Promotional Agency (FFG) as the programme management.

AIRCLIP collected, analyzed and documented best practices associated with about 200 environmental measures for the reduction of CO_2 emissions at and around 60 international airports in the areas of airfield operations, transport and mobility, energy efficiency, renewable energy and administrative activities. The results of the AIRCLIP project comprise recommendations and strategies for the implementation of relevant technologies and infrastructural investments at Austrian airports. Included in the results of the research project are an overview of potential for the implementation of measures aimed at reducing CO_2 emissions and recommendations on courses of action for Vienna and other Austrian airports.

2.2 Research Methodology

The research methodology followed a four stage research approach:

- Focused literature review, expert interviews and an online survey to gather data on relevant state-of-the-art environmental practices and technologies at airports around the world.
- Analysis of relevant documents provided by the air transport industry at the international level, online research of environmental activities at and around airports and data collection from approximately 200 examples relevant to the study and documentation thereof in an online database.
- Detailed analysis and evaluation of selected national and international best practices based on information provided by contact persons (like environmental managers) from the relevant airports and information available online.
- Recommendations for implementing relevant technologies and infrastructural investments at Vienna International Airport (VIE) and other Austrian airports.

In addition, the project included two relevant dissemination activities:

- A session involving international experts organized at REAL CORP 2008 conference entitled “Mobility Nodes as Innovation Hubs” under the topic “Climate Protection and Airports”, and
- a workshop held at Vienna International Airport (VIE) in fall 2008 involving about 40 experts from different sectors (aviation, transportation, public authorities, …) and the whole airport region.

2.3 Potential fields of CO_2 reduction at airports

AIRCLIP differentiates six potential fields of action to reduce CO_2 emissions. These fields of action were considered when investigating best practices and are defined as follows:

- Transport and Mobility - this potential field incorporates the reduction of CO_2 emissions through improvement of landside transportation concepts. It addresses improving (from an environmental perspective) modes of getting the passengers, employees, suppliers and visitors travelling to and from the airport.
- Airfield operations – activities in this field target the reduction of CO_2 emissions through the improvement of airside activities on the ground. Activities to reduce CO_2 emissions include, for example, the provision of GPUs (Ground Power Units) and pre-conditioned air instead of APUs (Auxiliary Power Units), and environmentally friendly ground vehicles.

- Energy efficiency – significant reduction of CO_2 emissions/costs at airports can be achieved through the improvement of the energy efficiency of facilities at/around the airport. There is a huge potential for making energy use more efficient (reduction of CO_2 emissions through efficient lighting systems, co-generation systems for producing heat and electricity or so-called "Green Building Programmes".

- Renewable energy - international examples demonstrate that there are possibilities for airports in terms of producing solar power (photovoltaic plants), geothermal power, wind power or bio fuel-based district heating. The airport can use its existing facilities (roofs of parking houses or docks) to install solar panels or even resort to its specific natural resources in its adjacent environment to access geothermal power.

- Administrative - activities in this field cannot be measured directly in terms of CO_2 as they lead only to indirect reductions. Such activities may include several management initiatives within the airport but include also potential co-operation with stakeholders within the airport city and the airport region.

- Others - relates to activities not assignable to the other categories mentioned above. Activities in this field are, for example, initiatives to utilize local materials or the creation of green areas in adjacent municipalities by the airport operator or waste management.

2.4 The research

As a backdrop and in addititon to the research effort and literature review, an online questionnaire was developed and distributed to the environmental departments of airports through ACI Europe and ACI North America. The responses of the 21 airports that participated in the online survey provided valuable insight into the activities described above. Based on the theoretical framework offered by the literature review and survey research, a comprehensive best practice database was developed with detailed descriptions of about CO_2 reducing measures undertaken at about 60 airports across the world. The online database contains approximately 200 best practices classified according to various research criteria including airport classification, spatial classification (of the activity), benefits, measurement, stakeholders, investment and associated operation costs, time horizon and transferability. From these criteria, a system was developed to filter the best practices in accordance to their relevance to Vienna International Airport (VIE) and other Austrian airports. These best practices were then further developed into specific recommendations for Vienna International Airport (VIE).

2.5 Examples of best practices from the final reportof AIRCLIP in detail

Transport and mobility

[ARN01] EcoTaxis

Since 2005 Stockholm-Arlanda Airport has implemented separate lines outside its terminals for so called EcoTaxis (i.e. hybrid/renewable fuel-powered taxis). Taxis gather in a designated remote parking area. To get physical access to the remote parking area, and participate in the queue system, a taxi has to be registered at the airport. This provides an opportunity to manage the taxi fleet by limiting the registrations and ultimately determine what taxi vehicles get in line for business at the airport. EcoTaxis enjoy priority in the dispatching system. The taxi management system is run by a contracted entrepreneur, employing three people full time. Total costs for the project are covered in the taxi arrival fee.

The result of this initiative was an increase in the share of EcoTaxis at the airport from about 1 percent to 35 percent of all taxis within two years, with an estimated reduction of 3,770 tonnes CO2 during 2007. The objective of the airport is that by 2011 all taxi vehicles operating at the airport meet the official definition of environmentally "clean" cars.

The initiative had a positive environmental effect on the entire region of Stockholm Arlanda Airport. As the airport is a very important hub for taxi traffic, many taxi operators followed the idea to install cars driven on renewable fuels. There has also been a positive media response in association with the EcoTaxi programme.

[ARN01] EcoTaxis	
Airport	ARN, Arlanda-Stockholm, Sweden
Airport Classification	Group 2
Type of activity	Transport
Spatial Classification	Landside
Level of implementation	Airport Region
Project Start Date	2005, implemented by 2011
Main Goal of the Activity	CO_2-savings through the increase of EcoTaxis among all taxis used at the airport
Secondary Benefits	Encourages taxi providers in airport region to install environmental friendly fleets; positive media response
Measurement	Savings of 9000 metric tonnes/year through an increase from 34 percent to 100 percent EcoTaxis (17 percent travelling by taxi)
Stakeholders involved	Airport Operator, additional entrepreneur running the taxi management system (Europark), taxi providers
Investments	EUR 50,000
Annual Running Costs	Costs are covered by taxi arrival fee
Transferability	Medium (Implementation dependent on willingness of taxi providers)
Time Horizon	Medium term
Evaluation	+ CO_2 Reduction Potential high + Cost/Benefit positive + Regional Impact (increasing number of EcoTaxis in the *whole region*)
Airport Contact	Hampus Eriksson, Environmental Advisor
Homepage	www.arlanda.se

[BOS02] Priority car parking for environmentally friendly vehicles

As part of Earth Day celebrations, Boston Logan International Airport (BOS) has set aside 100 parking spaces for drivers of hybrid and alternative-fuel vehicles. The parking spaces are conveniently located close to the elevators and pedestrian walkways in the parking garage and therefore reward drivers of such vehicles. In addition to encouraging passengers to switch to more environmentally-friendly cars, together with the city of Boston, BOS also initiated a similar program aimed at taxi drivers with hybrid cars. This program allows Taxi drivers to get in the front of the line twice in a 12-hour shift. Taxi drivers normally wait 30 to 60 minutes in the taxi line. Moving to the front of the line will allow an additional two airport trips per shift with an average fare of $ 25 (EUR 17). The city is also trying to encourage operators to buy more hybrid or alternative-fuel cabs through a $ 25.000 (EUR 17,200) grant program.

[BOS02] Priority car parking for environmentally-friendly vehicles	
Airport	BOS, Boston Logan International Airport, USA
Airport Classification	Group 1
Type of activity	Transport
Spatial Classification	landside
Level of implementation	Airport Region
Project Start Date	2007
Main Goal of the Activity	Encourage switch to alternative-fuel vehicles
Secondary Benefits	Marketing, less fuel costs for individual
Measurement	Number of 300 g/person-km of CO_2 reduction per new alternative fuel vehicle
Stakeholders involved	BOS, city of Boston, ICLEI-Local Governments, local taxi operators
Investments	n.a.
Annual Running Costs	Fleet maintenance (by private firms)
Transferability	High
Time Horizon	Immediate
Evaluation	+ CO_2 Reduction Potential low + Cost/Benefit neutral
Airport Contact	Stewart Dalzell
Homepage	www.massport.com

Airfield operations

[VIE011] New Compressed Natural Gas (CNG) fuel station at the airport

In the Spring of 2008, the airport operator of the Vienna International Airport switched 37 of its ground vehicles from diesel to CNG. Fueling these VW Caddys required delivery by truck as a mobile fueling station several times a week. However, with the expansion of the ground fleet of the airport operator and the dominant local airline Austrian Airlines in 2008 and 2009 with more CNG-vehicles, it became necessary for the airport to construct its own CNG fueling station. Erdgas Mobil GmbH, a subsidiary company of the Energie Allianz Austria (holding company of the regional energy providers Wien Energie, EVN and Bewag/Begas),

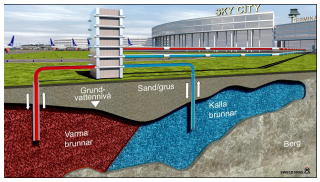
built this new internal CNG fueling station in the Summer and Fall of 2008. The fueling station began operating in November 2008 and comprised a total investment of about EUR 650,000 for two compressors, two fueling stations and the connecting CNG pipeline. This new CNG station provides a secure, convenient, cost and CO2 reducing means for fueling and operating the airport's expanded CNG ground fleet. About 20 percent of the needed CNG is produced as "biogas" by the cooperative biogas company EVM in Margarethen am Moos inside the airport region. The reduction in operating costs lies between 40 and 50 percent (depending on the vehicles and the current fuel prices). The CO2-reductions approach 30 percent compared to petrol cars and 15 to 20 percent compared to diesel cars. Because of the growing number of CNG vehicles, a further CNG fuelling station is planned at another area of the Vienna International Airport.

[VIE11] New Compressed Natural Gas (CNG) fuel station at the airport	
Airport	VIE, Vienna International Airport, Austria
Airport Classification	Group 2
Type of activity	Airfield Operations
Spatial Classification	Airside
Level of implementation	Airport
Project Start Date	November 2008
Main Goal of the Activity	Better and steady supply of the growing number of more environmental friendly CNG vehicles at the Vienna International Airport (Flughafen Wien AG is expanding from 37 to more than 100 CNG cars; Austrian Airlines is ordering more than 40 new CNG vehicles end of 2008, beginning of 2009)
Secondary Benefits	Less CO_2 emissions (up to 30 percent reduction compared to petrol cars; 15 to 20 percent compared to diesel cars); less maintenance costs (40 to 50 percent less than with diesel and petrol kilometres as 1 kg of CNG equals the energy value of 1.5 litre petrol or of 1.3 litre diesel)
Measurement	Fuel consumption; CO_2 emissions
Stakeholders involved	Erdgas Mobil GmbH (subsidiary company of the Energie Allianz Austria); Vienna International Airport (Flughafen Wien AG)
Investments	EUR 650,000 for gas stations and connecting pipelines (from Erdgas Mobil GmbH alone)
Annual Running Costs	-
Transferability	High
Time Horizon	Immediate
Evaluation	+ CO_2 Reduction Potential medium + Cost/Benefit positive (fixed supply contracts with the airport companies for their CGN cars)
Airport Contact	Erdgas Mobil GmbH, Mr. Michael Granitz, michael.granitz@erdgasmobil.co.at
Homepage	http://www.wienenergie.at/ media/files/2008/erdgastankstellen_november2008_9623.pdf

Energy efficiency

[ARN08] Aquifer heating and cooling

Cooling of LFV's buildings at Stockholm-Arlanda largely employs water from a nearby lake enabling the airport to reduce the number of cooling units containing environmentally hazardous CFCs (Freon). The airport also lies close to a moraine ridge created during the last Ice Age. The composition of materials and water within the ridge creates a submerged aquifer area with temperature-storing properties. The aquifer has a "thermos-like" property where:
1) warm water can be stored during summer to be used for heating during winter and
2) cool water can be stored during winter to be used for cooling during summer.
With the help of water pumped out of the aquifer, the airport can deliver cool temperatures to its district cooling network in summer and heat to its ground heating system in winter. By utilising these geothermic properties of the aquifer, LFV estimates that 5 GWh of electricity and 10 GWh of heat will be saved annually - equivalent to 20 percent of the airport's heating needs and at least 60 percent of all its cooling needs. This will enable Stockholm-Arlanda to make its energy production both cheaper and more environmentally friendly.
Since most of the airport's heating and cooling already employs renewable sources, the reduction in CO2 emissions will not be so large, but these energy savings make renewable energy available elsewhere to replace fossil fuel-based energy. The estimated effect of the system is equivalent of a direct usage of electricity yielding 7,000 tonnes of CO2 in the European grid. The number of cooling units using chemical coolants can also be reduced.



[ARN08] Aquifer heating and cooling	
Airport	ARN, Stockholm Arlanda Airport, Sweden
Airport Classification	Group 2
Type of activity	Energy Efficiency
Spatial Classification	Airside and Landside
Level of implementation	Airport, Airport City
Project Start Date	Implemented by 2009
Main Goal of the Activity	Savings in heat and electricity
Secondary Benefits	Cheaper energy production, Saving of chemical cooling units
Measurement	Savings: 5 GWh of electricity, 10 GWh of heat: Reduction of 7,000 tonnes CO_2 yearly
Stakeholders involved	Airport Operator
Investments	EUR 2,500,000 with a payback of 4 years due to energy savings
Annual Running Costs	n.a.
Transferability	Medium (depending on geological conditions)
Time Horizon	Medium term
Evaluation	+ CO_2 Reduction Potential high + Cost/Benefit positive + Regional Impact (use of regional resources)
Airport Contact	Hampus Eriksson, Environmental Advisor
Homepage	http://www.arlanda.se

Renewable energy

[SZG02] Photovoltaic plant (solar power) on 5 Terminal roofs

Since 2003, photovoltaic plants have been installed on the roofs of five hangars at Salzburg Airport - Wolfgang Amadeus Mozart - producing environmentally friendly electricity. There are about 2,700 m² of solar panels producing 237 KW (or 85 KWh per m²). The installed solar cells consist of monocrystalline silicium modules from Sharp and are estimated to have a lifespan of about 40 years. The annual production of 233 MWh corresponds to the average consumption of about 200 households in Salzburg. The produced electricity is directly fed into the power grid of the regional energy provider Salzburg AG and is being sold as green electricity to households and companies. Initial investments were EUR 1.25 mio. and the expected ROI in just 12 years makes this project very reasonable from an economic and environmental standpoint. The same construction company (NET - New Energy Technologies) as in Salzburg will plan, construct and operate a photovoltaic plant for Austrian Airlines at the Vienna International Airport in Spring 2009 (with 6,000 m² and 600 MWh). This photovoltaic plant should go online in the Summer 2009 and will also produce green electricity for households and companies. The operator of Vienna International Airport has proofed such a solar plant on the roof of two car parks in a feasibility study in Fall 2008. One result of the project is an estimated ROI in 19 to 20 years (compared to about 12 years in Salzburg). Therefore there will be no direct implementation of such a solar energy project beginning of 2009. But the facility management of the Vienna International Airport will keep an eye on the further solar energy development in the upcoming years.

[SZG02] Photovoltaic plant (solar power) on 5 Terminal roofs	
Airport	SZG, Salzburg Airport - Wolfgang Amadeus Mozart, Austria
Airport Classification	Group 4
Type of activity	Renewable
Spatial Classification	Airside
Level of implementation	Airport
Project Start Date	March 2003
Main Goal of the Activity	Environmental friendly electricity production without CO_2-emissions on 2,725 m² of solar panels (monocrystalline silicium moduls) with an output of about 237 KW (= 85 KWh per m²)
Secondary Benefits	Supply to the regional electricity grid and selling it as green electricity for households and companies
Measurement	Annual production of 233 MWh
Stakeholders involved	Salzburg Airport-W.A. Mozart; energy provider Salzburg AG for the distribution; NET - New Energy Technologies for the construction of the & know-how
Investments	EUR 1.25 mio. for the whole grid-connected photovoltaic system; estimated lifespan of about 40 years; the ROI expected in 12 years
Annual Running Costs	No data; the produced electricity is supplied to the grid of Salzburg AG and sold as “eco/green electricity”
Transferability	Medium
Time Horizon	Short term

Evaluation	+ CO_2 Reduction Potential high + Cost/Benefit positive (high investment costs but expected ROI in 12 years)
Airport Contact	Salzburg Airport-W.A. Mozart, Mrs. Typelt
Homepage	http://www.salzburg-ag.at/Erzeugung.1072.0.html http://www.neue-energie-technik.net/de/photovoltaikprojekt-flughafen.html

[ARN10] Bio fuel-based district heating

Stockholm-Arlanda Airport has a designated unit, Arlanda Energi, focusing on the airport's energy issues such as electricity and indoor climate. Today the airport mainly uses bio fuel-based, piped-in district heating (mostly from wood pellets). Since "Arlanda Energi" was formed, it has expanded the district heating system throughout the airport, including airport-based companies and organisations, thereby greatly reducing the use of oil heaters. Arlanda Energi is now developing solutions for the last handful of oil-fueled heaters at the airport. All heaters with fossil fuel will be taken out of service by 2010 at the latest.
The reduction in annual CO2 emissions has been approximately 94% since 1990 (from 16 000 tonnes to 1 000 tonnes). What lies ahead will eliminate the last 1 000 tonnes.
Investments have so far totalled about EUR 2 500 000, with an average ROI of 5-6 years. Future investments include a handful of facilities and will involve initial spending of approximately EUR 1 100 000, with an estimated ROI of less than 8 years.

[ARN10] Bio fuel-based district heating	
Airport	ARN, Stockholm Arlanda Airport, Sweden
Airport Classification	Group 2
Type of activity	Renewable
Spatial Classification	Airside and Landside
Level of implementation	Airport, Airport City
Project Start Date	Implemented by 2010
Main Goal of the Activity	Ensure supply of green electricity based on renewable energies
Secondary Benefits	-
Measurement	Reduction of 17,000 metric tonnes yearly
Stakeholders involved	Airport Operator, Arlanda Energi
Investments	EUR 3,600,000
Annual Running Costs	n.a.
Transferability	Medium
Time Horizon	Medium term
Evaluation	+ CO_2 Reduction Potential high + Cost/Benefit neutral (high investment costs)
Airport Contact	Hampus Eriksson, Environmental Advisor
Homepage	http://www.arlanda.se

3 RECOMMENDATIONS

The following table summarizes the recommendations for Vienna International Airport (VIE) and sets the planning horizon and the level of influence for the airport operator.

	Recommendations to reduce CO_2 emissions at VIE	Planning Horizon	Years	Influence
A	**Transport and Mobility**			
A1	Mobility management	short-term	1-2 years	indirect
A2	Rideshare	short-term	1-2 years	indirect
A3	EcoTaxis	medium-term	3-6 years	indirect
A4	Airport busses with biodiesel	medium-term	3-6 years	indirect
A5	Promotion of bicycle use	short-term	1-2 years	indirect
A6	Provide parking for environmentally friendly cars	immediate	<1 year	direct
A7	Promoting Inter-Modality	long-term	>6 years	indirect
B	**Airfield Operations**			
B1	Development of eco-friendly ground vehicles	immediate	<1 year	direct
B2	Development GPU/Pre-conditioned Air	medium-term	3-6 years	direct
C	**Energy Efficiency**			
C1	LEEDs + efficiency standards	medium-term	3-6 years	direct
C2	LED Lighting	medium-term	3-6 years	direct
D	**Renewable**			
D1	Biogas energy production	medium-term	3-6 years	indirect
D2	Solar-Energy (on hangar of AUA, on roofs of parking decks)	short-term	1-2 years	indirect
E	**Administration**			
E1	Modernization Program	short-term	1-2 years	direct
E2	EcoBusinessPlan	short-term	1-2 years	indirect
E3	Offset Carbon emissions	short-term	1-2 years	indirect
E4	Dialog Forum VIE and Environmental fund	short-term	1-2 years	direct
E5	VisitAir Center and Environmental Information	immediate	<1 year	direct
E6	Promotion of successful best practices of VIE	immediate	<1 year	direct

Table 1: Recommendations for VIE depending on planning horizon, needed years for implementation and possible influence for the airport operator

The recommendations described above cover three key sectors:

- Energy
- Administration
- Transport and Mobility

VIE should be lauded for its efforts to improve efficiency as energy consumption is concerned, despite drastic increases in passenger load over the past decade, total energy requirements have increased at the airport by only a fraction. Nevertheless, despite the airport's positive example as an energy efficient consumer, it remains one of the region's largest energy consumers with consumption levels approaching that of a small city. With this in mind, the best practices cited for consideration above not only provide a means for the airport to improve further still on the efficiency front, but also would allow it to evolve into an energy producer providing energy from renewable resources.

Within the framework of the Dialogue Forum, VIE has demonstrated its ability to take on a role as a leader in a collaborative effort among regional stakeholders to address environmental issues such as noise pollution. Our recommendations advocate expanding this coordination role of the airport and its collaborative efforts at the regional level into other areas of environmental protection including CO_2 reduction and increasing environmental awareness among airport workers and travellers alike.

Further bolstering the need for VIE's adoption of a regional perspective and expansion of collaborative efforts is the fact that the area where the most significant potential for CO_2 reduction lies is one where the airport has the least direct influence: mobility. VIE lies at the center of a transportation hub, nevertheless, the other elements of the hub are to a large extent independent entities albeit dependent on the airport. Through the recommendations described above, VIE can position itself as a chief driver for the development and implementation of environmentally friendly regional mobility solutions.

4 CONCLUSION

The aim of this research was to help Vienna International Airport (VIE) position itself as an example of how airports can approach the issue of climate change. VIE is the gateway to Austria and thereby is in many ways Austria's face to the world. As such, it should follow in the nation's footsteps and strive to position itself as a positive example of sustainability at the forefront of the fight to prevent climate change. In this manner, it can join other European airports in becoming another "best practice airport" in the fight to reduce CO_2 emissions.

The most successful international airports in terms of the realization of environmental measures for the reduction of CO_2 emissions include: Stockholm-Arlanda, Zurich, Geneva, Hamburg, Munich, Copenhagen, London-Heathrow as well as Portland, Seattle, Auckland and Sydney. In addition, the implemented environmental measures at and around Austrian airports such as Vienna International, Salzburg or Innsbruck Airport are noteworthy best practices offering quite good benchmarks on the reduction of CO_2 emissions.

One major asset of the research study AIRCLIP is that it was written in English, that the exchange of expertise and best practices can therefore go much easier in both ways from Austria to the world of aviation as well as into Austria, and that all results of the study – the final report as well as the online database - are fully available to all people interested in the subject (see links at the end of this paper).

5 REFERENCES

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Link to final report:
http://www.bmvit.gv.at/innovation/verkehrstechnologie/downloads/airclip_final_report.pdf

Link to best practices database:
http://spreadsheets.google.com/pub?key=p1FqmxDsZkcJzT74YWg-ZAQ

Link to article in the New York Times: "Airports See Success in Reducing Emissions":
http://www.nytimes.com/cwire/2009/04/24/24climatewire-airports-emission-reduction-efforts-start-to-10667.html?scp=3&sq=Macabrey&st=cse